MOSO® Bamboo Products

Mastering green

Harvested after only 5 years

CO_2

Locks enormous amounts of CO_2!

MOSO®
Mastering Bamboo

MOSO® **develops** and **creates** bamboo products for **indoor** and **outdoor** applications that meet the **highest technical requirements** and **quality** standards, enhance the **beauty** of applications and are made from the **sustainable**, renewable resource Moso bamboo.
With more than **25 years of experience** in the bamboo industry, MOSO® has learnt to manage the production process to **perfection**. Bamboo is one of the **fastest growing** plants on earth. Although giant bamboo is formally not a wood but a **grass**, it has **excellent** hardwood like characteristics. Discover the **benefits** that **MOSO® Bamboo Products** can offer in your project. Follow the bamboo footprints!

More information about bamboo is available in the book "Booming Bamboo – the (re-)discovery of a sustainable material with endless possibilities" at:
▶ www.boomingbamboo.com or request MOSO® for a copy.

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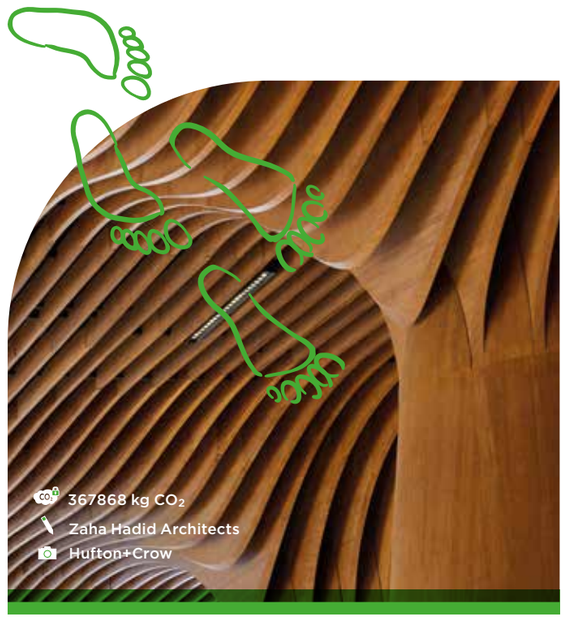
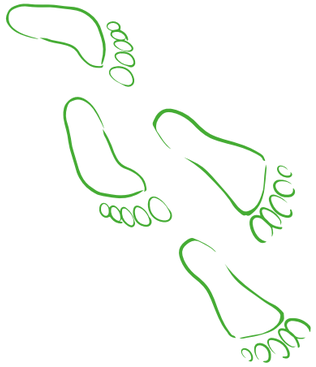


CityLife Shopping District - Podium Zaha Hadid
LEED Gold - (10,000 m² + 70,000 m¹) Milan, Italy

MOSO® Bamboo Footprint

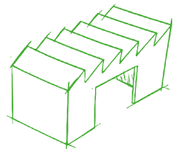


To determine the environmental impact of a product, every phase of the life cycle should be taken into account. MOSO® Bamboo Products offer clear sustainability advantages in each phase. During growth Moso bamboo absorbs enormous amounts of CO_2 in the forest and in the biomass. As long as the MOSO® Bamboo Products are in use, they act as a carbon store. The inclusion of MOSO® Bamboo Products contributes to a higher LEED, BREEAM, Green Star, HQE and DGNB certification score for green building projects. That's one of the reasons why you can find MOSO® Bamboo Products in many sustainable reference projects all over the world.

Growth phase

Fastest growing plant on earth, sustainability managed

- Made from the extremely rapidly renewable giant bamboo species "Moso", renowned for its CO_2 absorbing and O_2 producing capacity.
- Abundantly available in China (approx. 7 mio ha) and always sourced from sustainably managed forests and plantations.
- The Moso bamboo plant consists of multiple stems. As a result, several stems may be harvested each year without killing the mother plant.
- All standard, solid MOSO® Bamboo Products are FSC® certified.



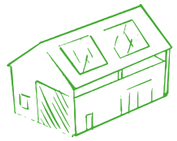
Production phase

Responsible production

- CO_2 emissions during production are lower than carbon uptake during growth*. This makes MOSO® Bamboo Products a carbon store during use.
- MOSO® Bamboo Products are made in production facilities that are ISO 9001 and ISO 14001 (important quality standards) certified.
- Optional: use of low emissions glue with no added formaldehyde, complying with the strictest emissions norm: E0 (EU requisite = E1).
- MOSO® is developing a bio-based glue for indoor and outdoor MOSO® Bamboo Products.

*) Excluding MOSO® Bamboo N-durance®

Kempegowda International Airport
LEED Platinum
(1,000,000 m) Bengaluru, India



Use Phase

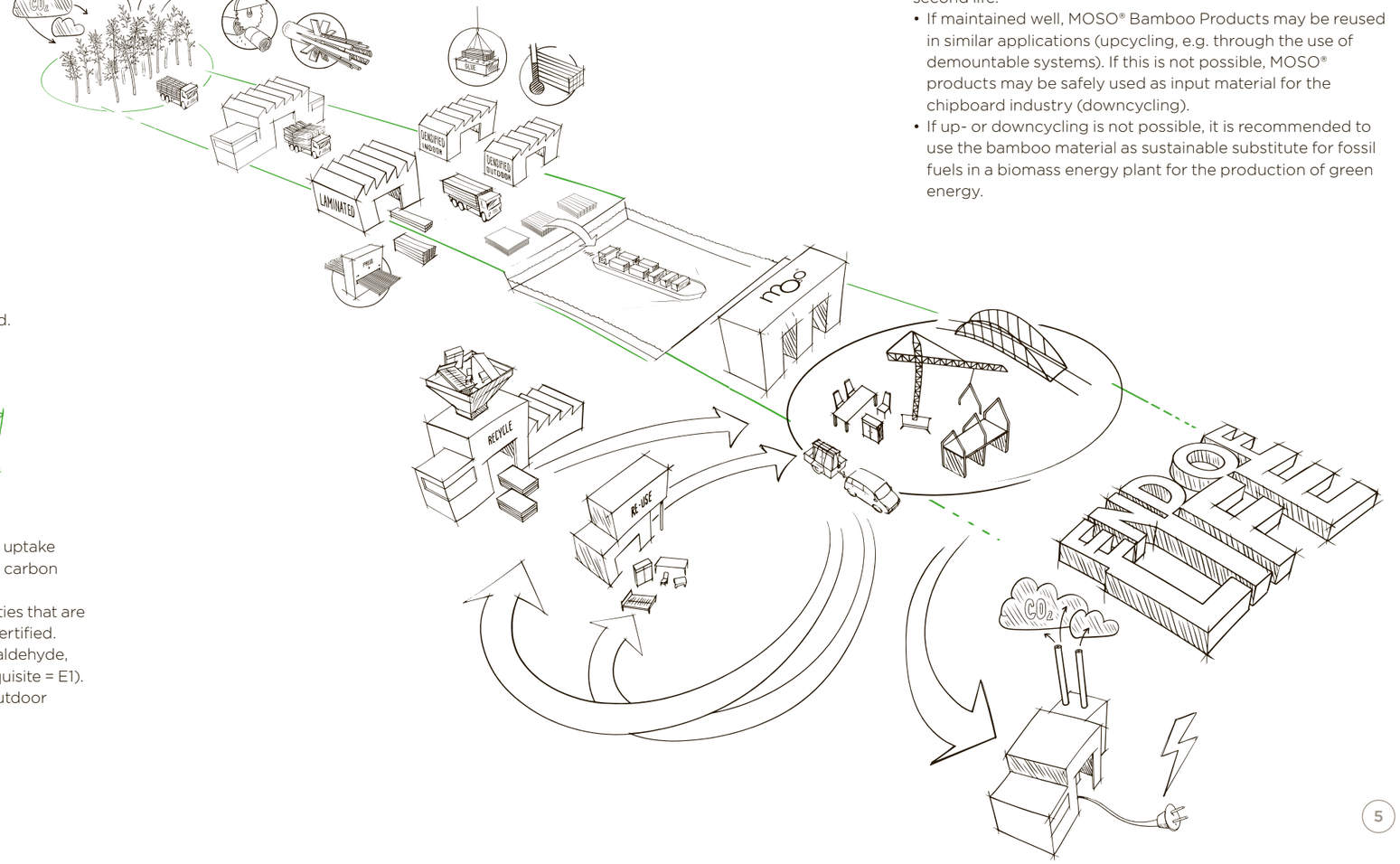
Healthy indoor environment, highly durable

- Durable = Sustainable: because of the hardness, high density and stability, MOSO® Bamboo Products last very long (less replacement) even in tough circumstances.
- Proven Quality: all MOSO® Bamboo Flooring products meet the requirements of EN 17009 and many are guaranteed up to 30 years. MOSO® Bamboo Outdoor products achieve the use/risk Class 4 according to EN 335 and are guaranteed up to 25 years.
- Healthy indoor climate: very low emissions of volatile organic compounds (VOCs); MOSO® floors have been rated A and A+ in France with respect to VOC emissions: the best classification possible!
- Extra credits for sustainable building eco-labels, such as LEED, BREEAM and WELL (see page 13 for details).

End-of-life phase

Easy to recycle and reuse

- MOSO® Bamboo Products fit very well into the Circular Economy concept, within the Biological cycle. We are working on a bio-based glue for 100% compliance.
  ▶ www.inbar.int/bamboo-in-the-circular-economy
- MOSO® Bamboo Products offer several options for the second life:
  - If maintained well, MOSO® Bamboo Products may be reused in similar applications (upcycling, e.g. through the use of demountable systems). If this is not possible, MOSO® products may be safely used as input material for the chipboard industry (downcycling).
  - If up- or downcycling is not possible, it is recommended to use the bamboo material as sustainable substitute for fossil fuels in a biomass energy plant for the production of green energy.



Moso bamboo Growth phase

Bamboo: wood, plant, grass?

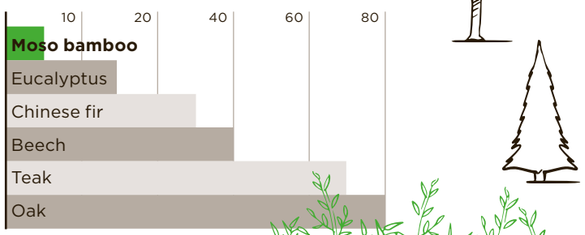
From a botanical point of view, bamboo belongs to the grasses and is therefore not a tree. Bamboo is a collective name for a group of botanical species. Although the complete taxonomy is still evolving, current estimations are that around 1600 different varieties exist. There are considerable differences in size, colour, mechanical properties and climatic preferences between species. The Moso bamboo species is native to China and other Asian countries and grows up to 20 meter long, with a diameter of 10-12 cm.

Unsurpassed growing speed

Bamboo: the fastest growing plant in the world

Because of the fast growth, Moso bamboo is managed as an agricultural crop: the annual harvest of the 4 to 5-year-old stems provides a steady annual income to farmers and stimulates the bamboo plant to reproduce even faster. Therefore, by default, no deforestation occurs with production of MOSO® Bamboo Products, while large amounts of CO_2 are captured in the bamboo forests and products.

Harvesting age (years)

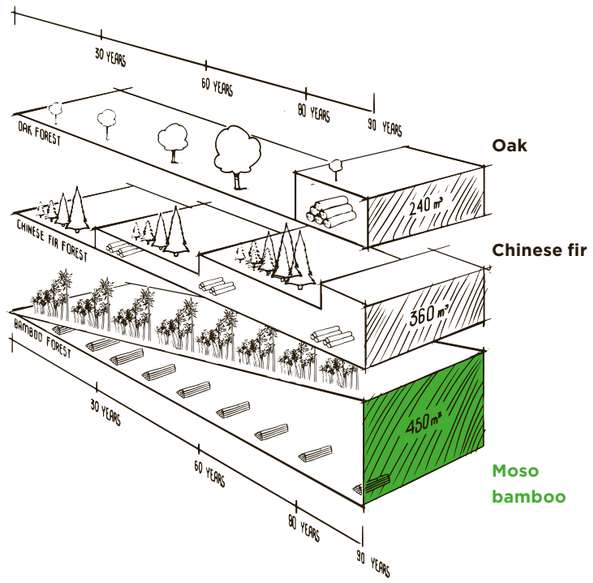


Forest production per ha

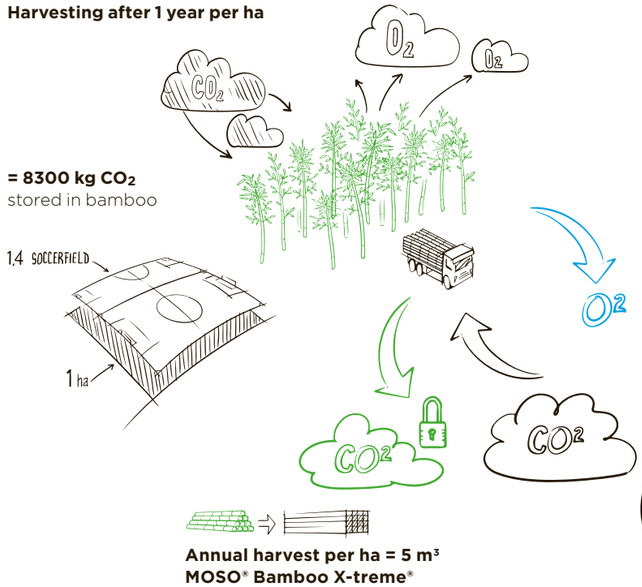
Bamboo forest stays Intact, no deforestation

A large difference with wood production forests is that a bamboo forest stays intact after stems are harvested due to the underground rhizome system and multiple bamboo stems that sprout from the mother plant. That means that each year about 20-25% of the mature bamboo stems can be harvested which, like mowing your lawn, will activate the growing potential of the bamboo and lead to a maximum annual yield. In contrast, wood production forests are often harvested in rotation cycles, where a large amount of wood becomes available at once, but which takes considerably longer (up to 80 years). After harvesting, a large amount of wood is available for processing. In a bamboo forest, there is a constant supply of material on a yearly basis due to this fundamental difference of forest management and characteristics.

Forest production per ha (10,000m²)



Harvesting after 1 year per ha



For example, when Moso bamboo is grown on a hectare of land (about 10,000 square meters) for a year, it yields 5 m³ of bamboo material. 5 m³ of MOSO® Bamboo X-treme® can capture and store 8,300 kilograms of carbon dioxide (CO2). To put this in perspective, this is equivalent to the CO2 emissions produced by a mid-range car driving 69,818 kilometers.

= 6000 kg O_2
= About 21 years of oxygen for one person's breathing needs.

= More than 3 roundtrips from Amsterdam to Hong Kong by airplane.

= 69,818 km driven by a middle class car.
= 1,7 trips around the world!

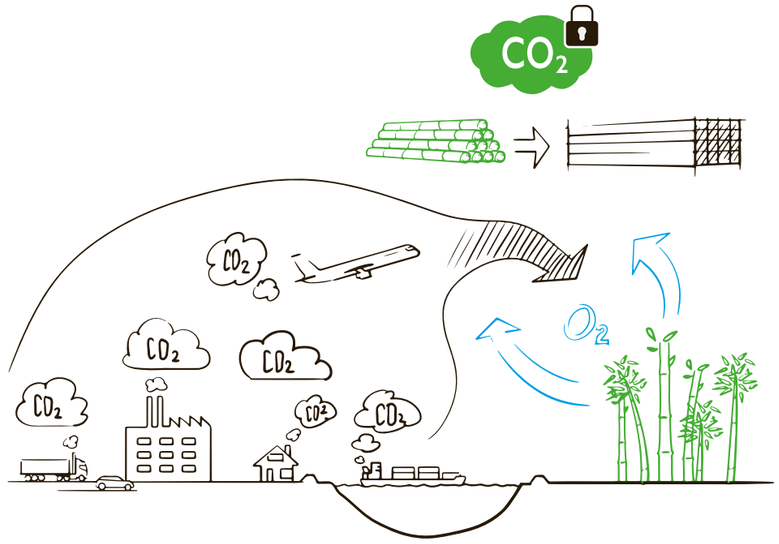
Carbon storage in bamboo

Biobased materials act as CO_2 sinks

Through photosynthesis, plants absorb carbon dioxide (CO_2) and convert it into glucose (building block for biomass) and oxygen. The CO_2 is stored in the material for the lifetime of the product, and even longer if the product is recycled into new, durable products. Due to the fast growth – and related high yields - Moso bamboo locks far more CO_2 in durable products compared to most wood species. The combined carbon reduction potential of a giant bamboo production forest in the ecosystem (soil, roots, plant) and the durable products that come from the harvest, can add up to 1000 tons CO_2 per hectare.

▶ www.inbar.int/understanding-bamboos-climate-change-potential

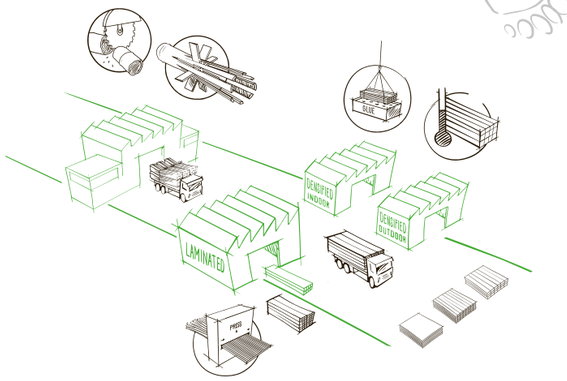
The CO_2 emissions, bamboo absorption & carbon storage



Bamboo growth speed = 1 meter a day!

MOSO® Bamboo Production phase

Transforming a hollow bamboo stem into a high quality MOSO® product – how is it done? With more than 25 years of experience in the bamboo industry, MOSO® has learnt to manage the production process to perfection.



Carbon footprint

MOSO® Bamboo Products environmental studies

MOSO® has conducted several LCA studies, including carbon footprint studies together with Delft University of Technology (TU Delft) and NIBE (LCA experts). The 2015 LCA report, was the first of its kind and resulted in many new findings about the carbon footprint of bamboo products. The environmental impact of MOSO® Bamboo Products, excluding the carbon sequestration effect, has also been published in 2016 and updated in 2022 in an official Environmental Product Declaration (EPD) following EN 15804 (www.moso-bamboo.com/epd). The results show that the carbon footprint of MOSO® Bamboo Products* during production is lower compared to carbon stored during growth.

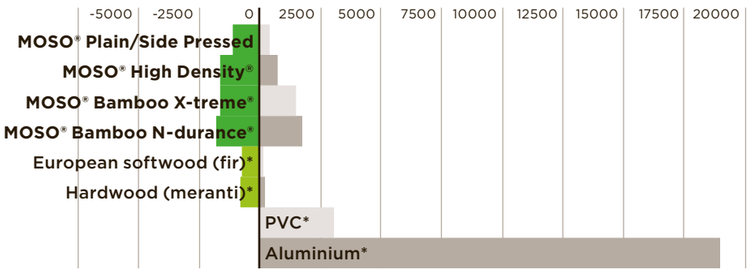
*) Excluding MOSO® Bamboo N-durance®

Construction stored carbon (CSC)

MOSO® Bamboo Products act as a carbon store

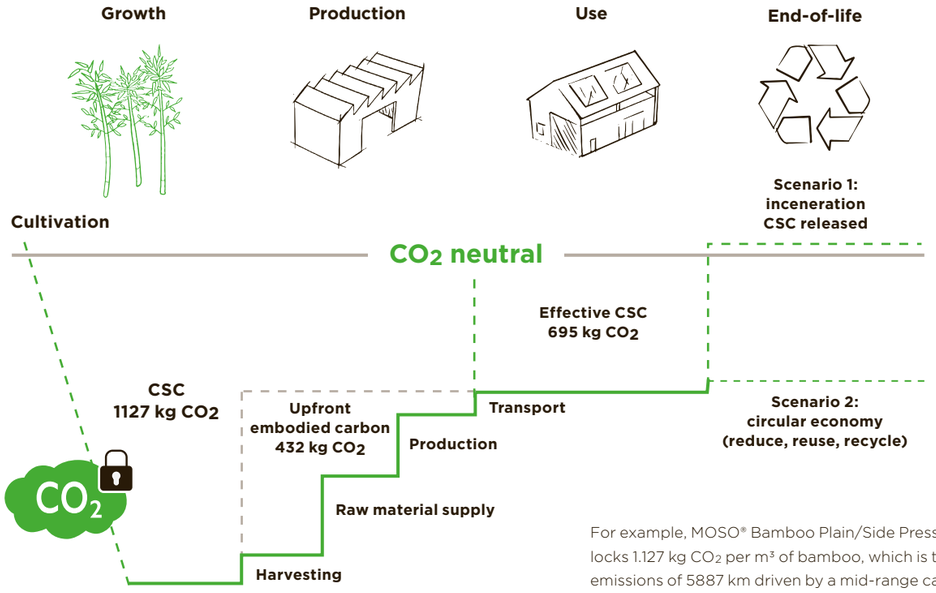
All plants, algae and certain organisms, including Moso Bamboo, undergo a process known as photosynthesis in which carbon is stored in the material throughout its useful life. The locked amount of CO_2 can be calculated rather simply by looking at the density of the material and taking into account the biobased content (biogenic carbon - EN 16449). Since bamboo is so dense, it stores high amounts of carbon throughout the product life cycle. Although this carbon storage is a huge benefit for biobased materials, this carbon storage is not (yet) taken into account in whole life carbon assessments as it is assumed that within 100 years the biobased material will be discarded (decay) or incinerated. However, based on circular economy principles and applied in the built environment in long-lasting applications this carbon storage - also known as Construction Stored Carbon (CSC) - may be perceived as semi-permanent and under certain conditions is even eligible for voluntary carbon credit systems.

CO_2 storage vs. CO_2 emissions during production and transport



in kg CO_2 eq/m³ material
*) Data abiotic materials from Idemat database TU Delft (industry averages).

▶ www.moso-bamboo.com/production



For example, MOSO® Bamboo Plain/Side Pressed (laminated bamboo) locks 1.127 kg CO_2 per m³ of bamboo, which is the equivalent of the CO_2 emissions of 5887 km driven by a mid-range car.

For more information check out the Construction Stored Carbon methdology of NGO Climate Cleanup, which includes MOSO® Bamboo Products in their database:

▶ www.climatecleanup.org/constructionstoredcarbon

For various MOSO® projects the amount of CSC has been calculated, see the examples in this booklet with the icon of a cloud of CO_2 with a lock.

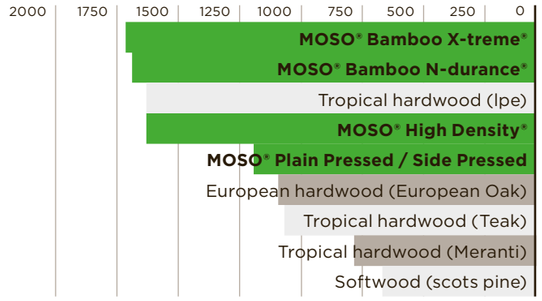
▶ www.moso-bamboo.com/how-much-co2-is-stored-in-bamboo

Sustainable production

From bamboo plant to product

The fast growth and abundant availability make bamboo a rapidly renewable resource, and a perfect material for many applications in and around buildings. With good reason, it's often called 'the building material of the future'. However, bamboo as a raw material cannot be used outdoors without a protective treatment.

Construction Stored Carbon (CSC)

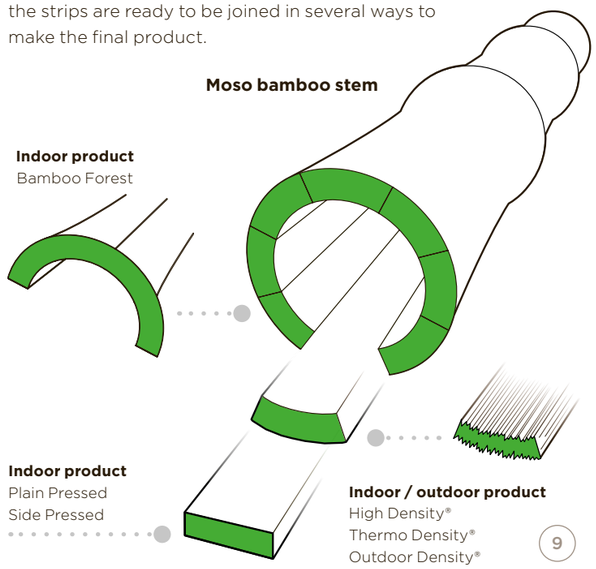


In kg CO_2 eq/m³ product

Due to its high "sugar"-components, bamboo is more susceptible to being attacked by micro-organisms and fungi, which is relevant for outdoor applications. Let us explain how we get from the raw bamboo material to the final product.

Bamboo stem to strip

The first step in the production phase is getting from the hollow bamboo stem to a material that can be further utilised. To do so, the stems are split lengthwise to strips (much like how fries are made) and the outer skin (bark) is removed. The untreated strips have a yellowish colour (Natural) but can be lightly steamed, reducing the yellowish tone (Ecru) or more intensely steamed for a warm brown colour (Caramel). After treating and drying, the strips are ready to be joined in several ways to make the final product.



Strip to indoor product

Indoor products come in different variations. For Plain Pressed, the bamboo strips are positioned horizontally and glued together. For Side Pressed, the strips are positioned vertically and glued. Flexbamboo uses a flexible fabric backing to connect wide bamboo strips. High Density® involves crushing the strips into strands and gluing them under high pressure. Bamboo Forest flattens the bamboo stem through a special process to create the top layer of a solid bamboo board.

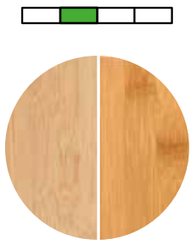
Strip to outdoor product

To create outdoor products several additional steps are essential. The strips are crushed using a number of incision rollers which create cross linked strands. The untreated strands are a light yellow colour. By modifying the bamboo strands with a special Thermo-Density® (X-treme®) or Outdoor-Density® (N-durance®) process, the dimensional stability of bamboo is improved by about 50%. The heat-treatment at 200°C (X-treme®) or steam-pressure treatment at 140°C (N-durance®) provides the highest durability class possible: Class 1 following EN 350.

Colours of MOSO® Bamboo Products

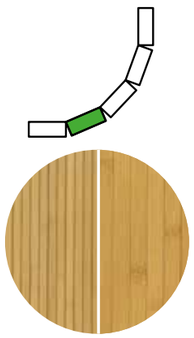
Bamboo's original, natural colour is light brown with a yellowish tint. By treating bamboo with steam, the light brown colour becomes more intense and the yellow shade disappears, we call this Ecru. |By increasing the temperature and pressure during the steam treatment, the durability and stability is enhanced and a warm brown colour appears, this is called Caramel. The colour Tiger was specially developed for panel materials: a mix of light and dark strips. Particularly in the case of outdoor products, the treatment is done at higher temperatures and with more pressure, which makes the bamboo warm or dark brown.

MOSO® Plain Pressed Ecru & Caramel
(Laminated Bamboo)

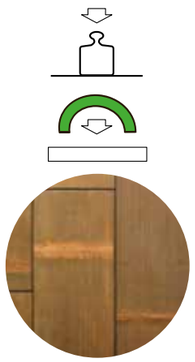


MOSO® Side Pressed Ecru & Caramel
(Laminated Bamboo)

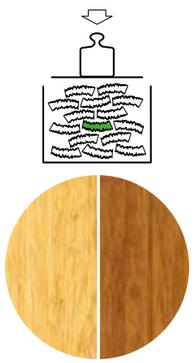
MOSO® Flexbamboo Caramel



MOSO® Bamboo Forest

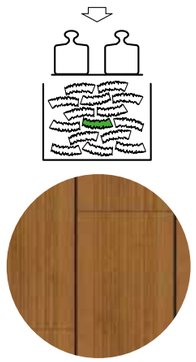


MOSO® High Density® Natural & Caramel



MOSO® High Density® Natural + Caramel (Tiger)

MOSO® Bamboo N-durance®



MOSO® Bamboo X-treme®

MOSO® Bamboo+ Benefits

Bamboo products are hard, stable and extremely versatile in their application. In addition to this natural beauty, they convince with durability and sustainability benefits. These advantages are backed up by a warranty of up to 30 years. The properties of bamboo are equivalent or even superior to those of most hardwood species and other building materials.

Endless resource & Stored Carbon

Bamboo is an 'endless' resource. It grows faster than any other plant; up to 1 meter per day! Each year the 4-5 year stems are harvested, providing room for the younger bamboo to grow to maturity. During growth, Moso bamboo absorbs more CO_2 than is released during production. As long as the MOSO® Bamboo Products are in use, they can act as a temporary carbon store (Construction Stored Carbon).

Natural beauty

The most striking feature of MOSO® Bamboo Products is certainly its natural beauty. The beautiful natural grain gives bamboo a distinct design appearance. Combined with the vast choice of different styles, configurations and colors, there is always a MOSO® Bamboo Product available which will match your preferences.

Hard & durable

Bamboo, after processing, is very hard and durable. This means MOSO® Bamboo Flooring and decking can be used in heavy duty applications, where conditions such as high-traffic are expected. As well as this, several products are more than suitable for being used outdoors.

High stability

Due to the composition of individual strips, bamboo will shrink and swell less than most solid wood species, providing a very stable solution. For outdoor use this is even enhanced through the Thermo-Density® or Outdoor-Density® process. This means that unique and intriguing solutions and creations can be developed.

Healthy

MOSO® Bamboo Products are also a healthy choice as they are antistatic and anti-allergic. Further they have very low emissions of harmful VOCs (Volatile Organic Compounds).

Fire resistant

MOSO® Bamboo Products fulfill stringent fire safety requirements and MOSO® has tested almost the full range of bamboo products. High Density® products even reach fire resistance Class B without use of fire retardants.

Vast choice

Combined with the vast choice of different styles, configurations and colors, there is always a MOSO® Bamboo Product available to match the desired needs. From commercial to domestic use and industrial applications to unlimited solutions, MOSO® has both the knowledge and expertise to help you progress.

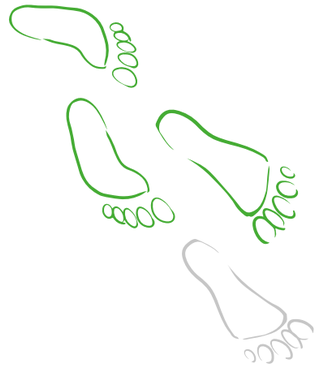
▶ www.moso-bamboo.com/project-support

Up to 30 years guarantee

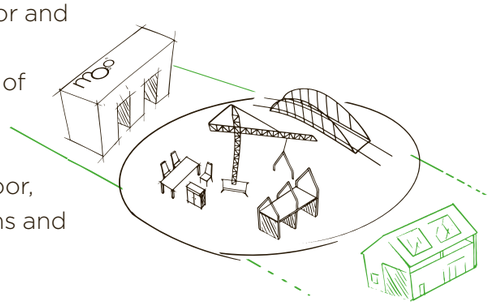
Developing the best bamboo product is only possible through continuous attention for each detail during production. MOSO® Bamboo Products are of the highest quality and come with a product guarantee of up to 30 years.

▶ www.moso-bamboo.com/products

MOSO® Bamboo Use phase



MOSO® develops and creates bamboo products for indoor and outdoor applications that meet the highest technical requirements and quality standards, enhance the beauty of projects and are made for a long-lasting life in several demanding applications. The MOSO® products can be divided into four product groups: MOSO® Bamboo Outdoor, MOSO® Bamboo Flooring, MOSO® Bamboo Panels, Beams and Veneer and MOSO® Bamboo Unlimited.



Durable = sustainable

Durability is an important yet often overlooked aspect of sustainability. The longer the lifetime of product, the lower the environmental impact will be, simply because it will take longer before you need to replace it. Durability depends highly on the quality and characteristics (such as hardness, density, stability, etc) of the product. MOSO® Products score very high on all these factors making the product very durable.

Healthy indoor environment

A healthy indoor climate is important. In Europe and the USA there are very strict rules and norms regarding indoor emissions of Volatile Organic Compounds (VOCs). In Europe the emission of formaldehyde is regulated in the EN717-1 norm. The maximum tolerated level is called E1 and all MOSO® products comply with this. Several MOSO® products even comply with the strictest level: E0 – no formaldehyde emission detectable. Furthermore, all MOSO® Bamboo floors have been rated A and A+ in France with respect to emissions of VOCs: the best classification possible.

Certifications

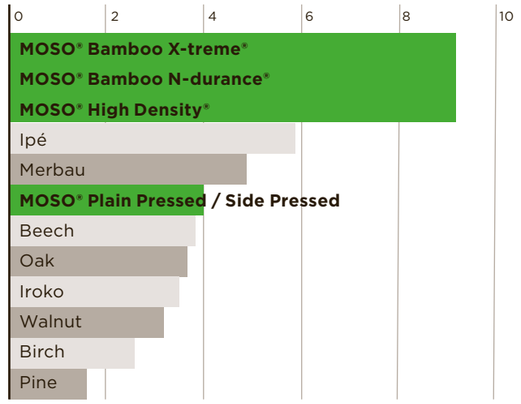
The sustainability, safety and quality of MOSO® Bamboo Products is independently proven by the most respected ecolabels and certifications in the market.

▶ www.moso-bamboo.com/certifications

Moso International Headquarters

(1100 m²) Netherlands

Average brinell hardness



▶ www.moso-bamboo.com/certifications

MOSO® Bamboo+ Green contribution

MOSO® Bamboo Products offer clear sustainable advantages. The inclusion of MOSO® Bamboo Products contributes to a higher LEED, BREEAM, Green Star, HQE and DGNB certification score for green building projects. That's one of the reasons MOSO® Bamboo Products can be found in many sustainable reference projects all over the world. Furthermore, all standard, solid MOSO® Bamboo Products are FSC® certified.

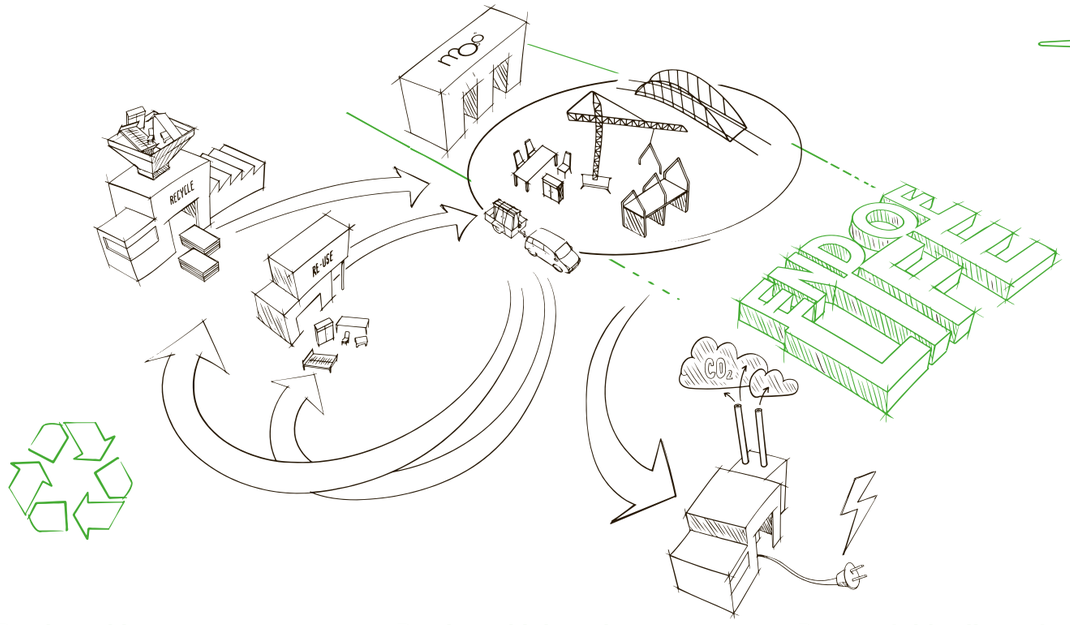
LEED, BREEAM & WELL

WELL, LEED and BREEAM are three prominent certification systems that focus on sustainability and environmental performance in the built environment. Each of these systems has its own unique approach and criteria, but they share a common goal: to promote more sustainable and healthier buildings. BREEAM and LEED focus mainly on the environmental impact of a building, WELL focuses on the health of the people inside.

LEED BD+C - v4	Contribution	Flooring	Panels, Beams & Veneer	Outdoor
MR Credit - Building life-cycle impact reduction	direct	yes (if solid)	yes	yes
MR Credit - Building product disclosure and optimization - environmental product declarations	direct	yes (if solid)	yes	yes
MR Credit - Building product disclosure and optimization – sourcing of raw materials	direct	yes (if requested with FSC®)	yes (FSC®)	yes (if requested with FSC®)
MR Credit - Building product disclosure and optimization – material ingredients (Reach optimization)	direct	yes	yes	yes
EQ Credit - Low Emitting Materials	direct	yes	yes	
SS Credit - Heat Island Redustion	direct			yes
IN Credit - Innovation	direct	yes (if used in innovative applications or if helps to meet twice the criteria limit)	yes (if used in innovative applications or if helps to meet twice the criteria limit)	yes (if used in innovative applications or if helps to meet twice the criteria limit)
EQ Credit - Interior Lighting	indirect	yes (if natural colour)	yes (if natural colour)	
EQ Credit - Acoustic performance	indirect		yes (optional)	
BREEAM International (2016) credit	**Contribution**	**Flooring**	**Panels, Beams & Veneer**	**Outdoor**
HEA 2 - Indoor Air Quality	direct	yes	yes	yes (if used indoors)
MAT 1 - Life Cycle Impacts	direct	yes (if solid)	yes	yes
MAT 3 - Responsible Sourcing of construction products	direct	yes (if requested with FSC®)	yes (FSC®)	yes (if requested with FSC®)
MAT 5 - Designing for durability and resilience	direct	yes (if High Density®)	yes (if High Density®)	yes
Innovation	direct	yes (if used in an innovative application)	yes (if used in an innovative application)	yes (if used in an innovative application)
MAN 2 - Life cycle cost and service life planning	indirect	yes (if High Density®)	yes (if High Density®)	yes
HEA 1 - Visual comfort	indirect	yes (if natural colour)	yes (if natural colour)	
HEA 5 - Acoustic performance	indirect		yes (optional)	
WELLv1 Building Standard™	**Contribution**	**Flooring**	**Panels, Beams & Veneer**	**Outdoor**
FEATURE 4: VOC REDUCTION (all solid MOSO® products)	direct	yes	yes	no (WELL is focused on indoor products)
FEATURE 25: TOXIC MATERIAL REDUCTION (all solid MOSO® products)	direct	yes	yes	no (WELL is focused on indoor products)
FEATURE 88: BIOPHILIA I – QUALITATIVE (all MOSO® products applied for flooring, walls, ceiling or as substitute for wood composite materials)	direct	yes	yes	no (WELL is focused on indoor products)

MOSO® Bamboo End-of-life phase

Of course we hope MOSO® Bamboo Products will be enjoyed for many years, but there will come a moment when they have reached the end of their life cycle. At that moment, another characteristic of bamboo will become important: it is easily recycled, for example, as resource to make chipboard, as bamboo is assessed as category B waste wood. However, we prefer the reuse of MOSO® materials in similar applications (upcycling), for example, facilitated by the use of demountable facade systems such as GRAD® for MOSO® Bamboo X-treme® Cladding. Only as a last resort, bamboo may be burnt in a biomass energy plant to create green electricity and substituting fossil fuels.



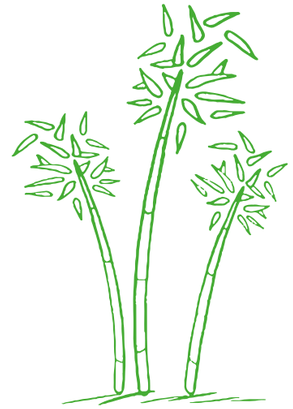
Bamboo chips

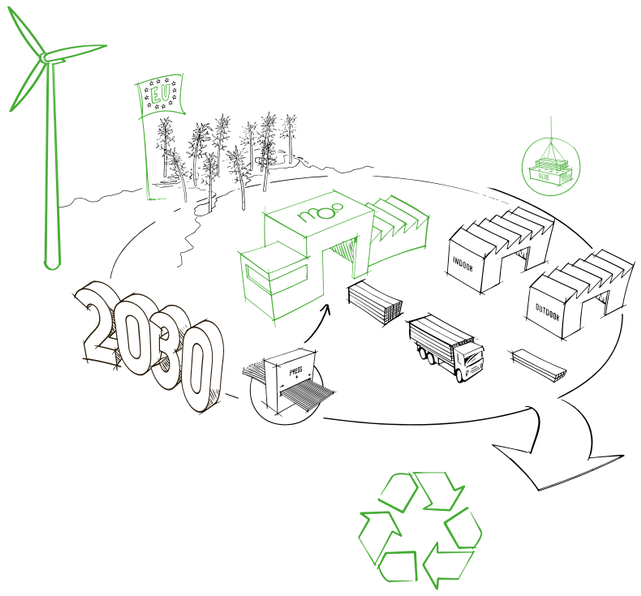
Bamboo chipboard

Demountable clip-system
MOSO® Bamboo X-treme® Decking with GRAD® system

MOSO® Bamboo Looking ahead

To stay within our carbon budget, we need a radical change to biobased construction moving away from our current lineair, largely fossil-based, building economy. During this transition, we believe that MOSO® Bamboo Products and the latest mass timber products should work together to replace abiotic materials like concrete, metals and plastics.





Reducing our carbon footprint

In addition to seeking out new alliances with the timber industry, MOSO® continues to search for ways to reduce the carbon emissions. We have pinpointed four key elements for reducing the carbon footprint and increase the circularity of our engineered bamboo products even further the coming years:

1. Developing biobased, non-toxic glue alternatives.
2. Lowering the transportation distance, e.g. in developing products made from European bamboo in collaboration with BambooLogic.
3. Recycling and reusing engineered bamboo products from donor buildings that were designed for disassembly.
4. Utilizing higher energy efficiency and increasing renewable energy content in production facilities.

Follow our progress on this topic through our blog and social media channels, and find out how bamboo can truly make a significant difference toward a climate neutral, circular economy.

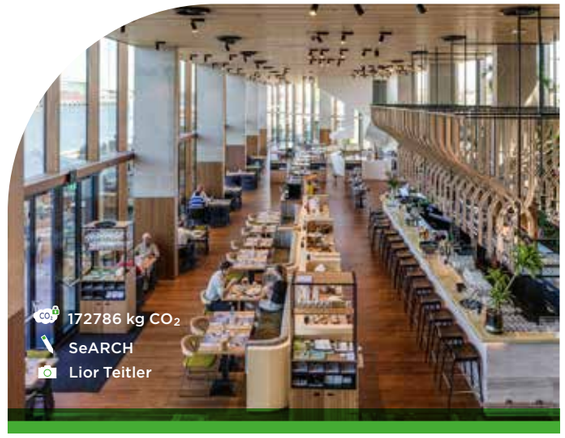
▶ **blog.moso-bamboo.com**

Bamboo and wood, partners in biobased construction

In the most sustainable hotel complex in the Netherlands, the Hotel Jakarta by WestCord in Amsterdam (BREEAM Excellent), the structure is made of cross-laminated timber (CLT) and glulam, and all the finishings (floors, walls, ceilings) are done with MOSO® Bamboo Products, representing an integrated approach to biobased construction that can help reduce carbon emissions.

Together with the mass timber supplier for Hotel Jakarta, DERIX, MOSO® is researching the option of developing a CLT panel with bamboo top-layer for future projects.

▶ **www.moso-bamboo.com/jakarta**

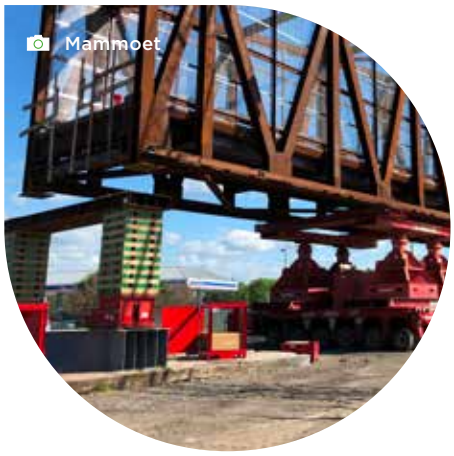


Hotel Jakarta Amsterdam BREEAM Excellent
(11,033 m² + 5800 m) Netherlands

ASICS EMEA Headquarters indoor LEED Gold + WELL Gold
Netherlands

Tour Saint Gobain outdoor
HQE + BREEAM Outstanding + LEED Platinum (1000 m²) Paris, France

Mammoet Jacking Beams unlimited Hardwood timbers replaced by sustainable bamboo - Netherlands



Green, greener, greenest

Check out the **MOSO® Mastering Bamboo** movie at:
www.moso-bamboo.com/moso

Check out how **bamboo** can save the world at:
www.moso-bamboo.com/sustainability

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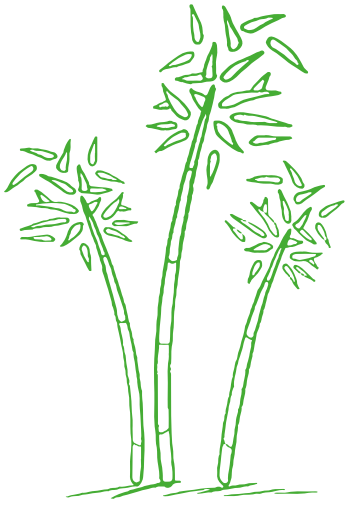

www.moso-bamboo.com

Mastering **bamboo**

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