

Pablo van der Lugt

Booming Bamboo

The (re)discovery of a sustainable material
with endless possibilities

Materia



**MATERIAL
DISTRICT.
TALKS**



WBCMEXICO



**MATERIAL
DISTRICT.**

MAKE IT MATTER

ELS ZIJLSTRA

Modern materials:



PROTECT US...



ENJOY US...



EMBRACE US...



SAVE US...



INSPIRE US...



SEDUCE US...



CHALLENGE US...



KEEP US DRY...

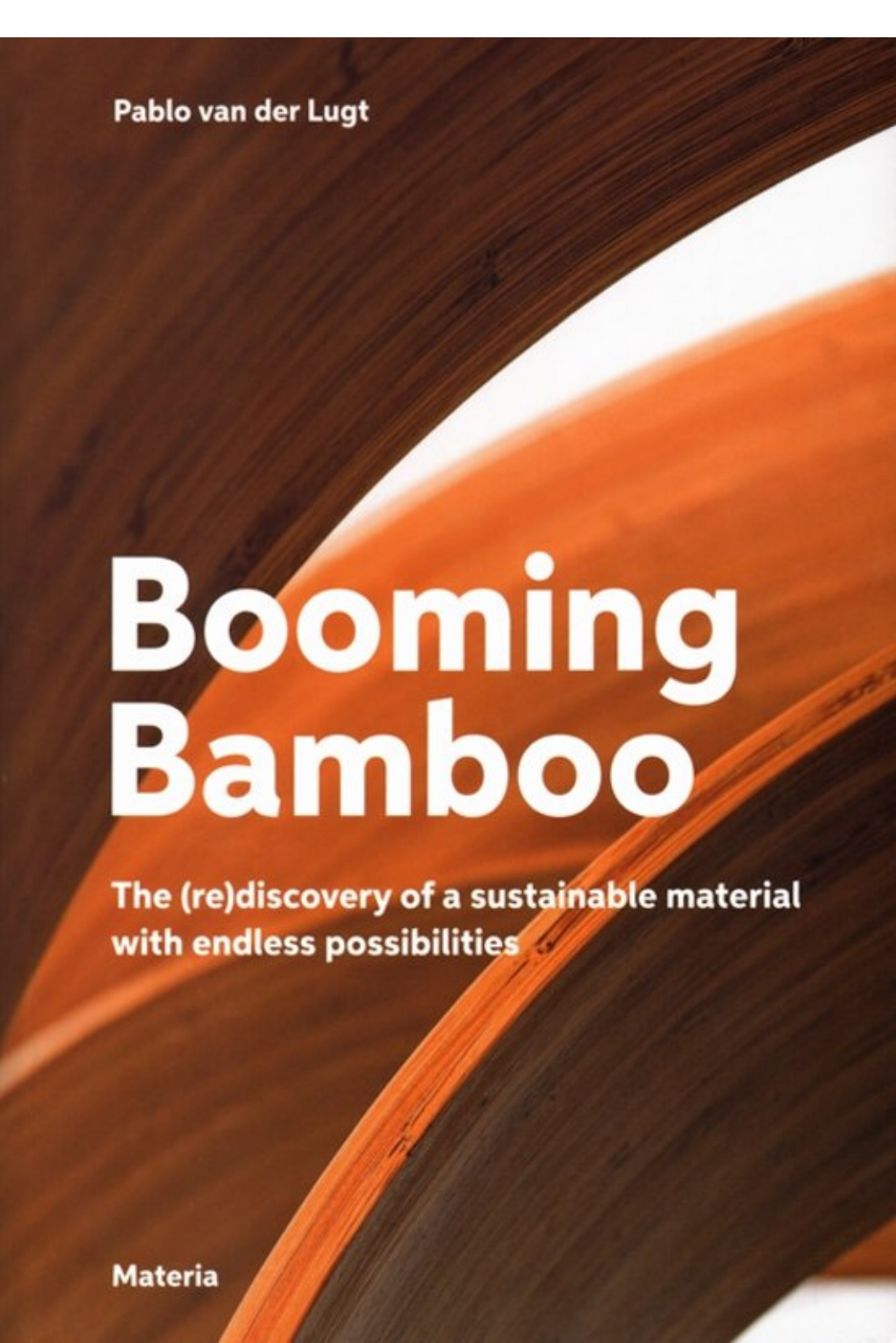


CONNECT US...



HEAL US...





Pablo van der Lugt

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The (re)discovery of a sustainable material
with endless possibilities

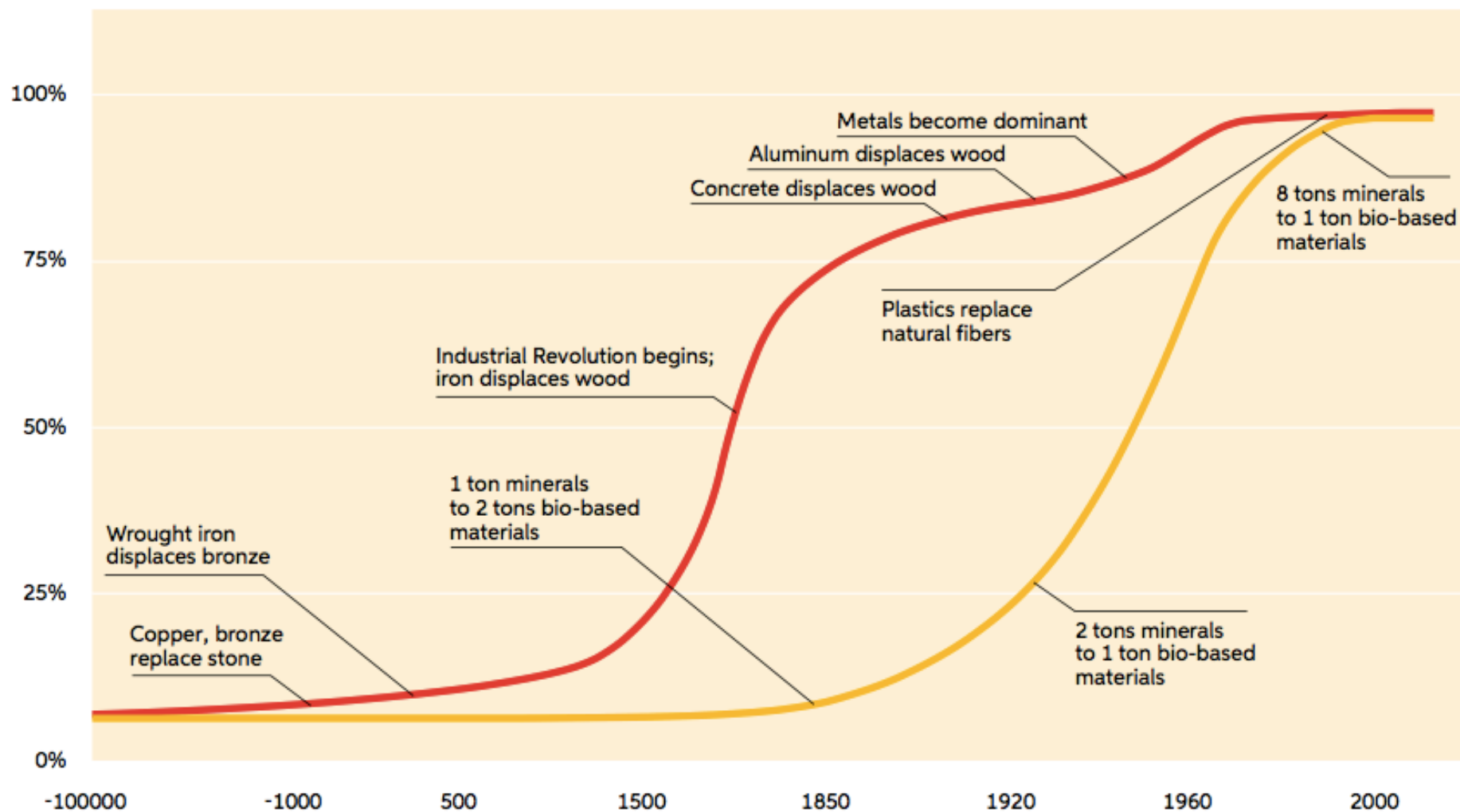
Materia

Why Booming bamboo?

- The urgency of biobased sustainable materials
- The ladder of circularity
- A-Biotic materials
- Biotic materials

Figure 1.1 - Trajectories of dependence - increasing addiction to non-renewable materials

- relative proportion of non-renewable to renewable materials (Ashby)
- relative proportion of minerals to bio-based materials in USA (Morris)



CIRCULAR ECONOMY - an industrial system that is restorative by design

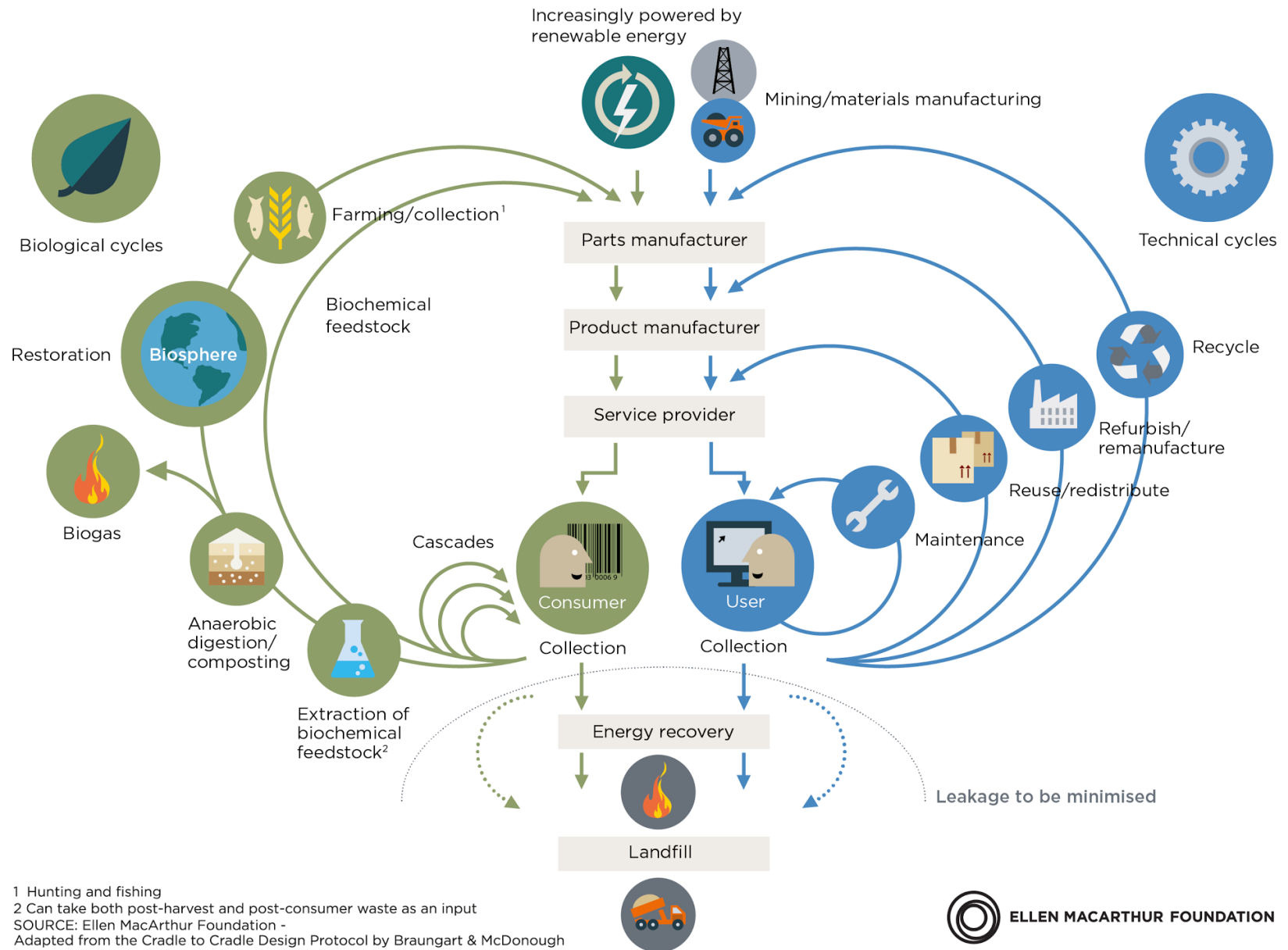


Figure 1.4 - Annual world production of materials vs. global reserves 1A.1 - 1A.12

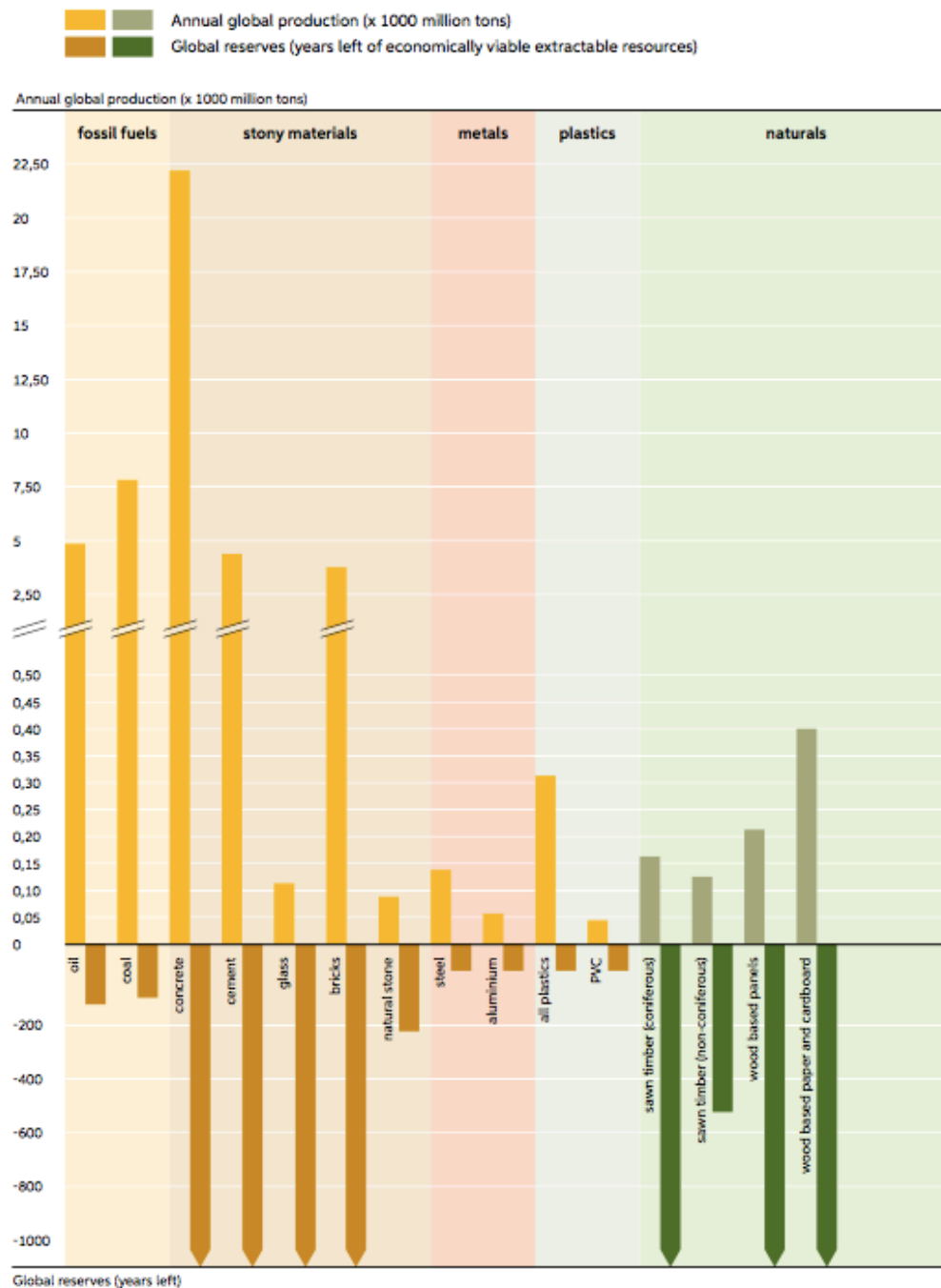


Figure 4.6 - Carbon footprint over life cycle per volume unit (kg CO₂ eq/m³ building material) ^{4.2 - 4.5}

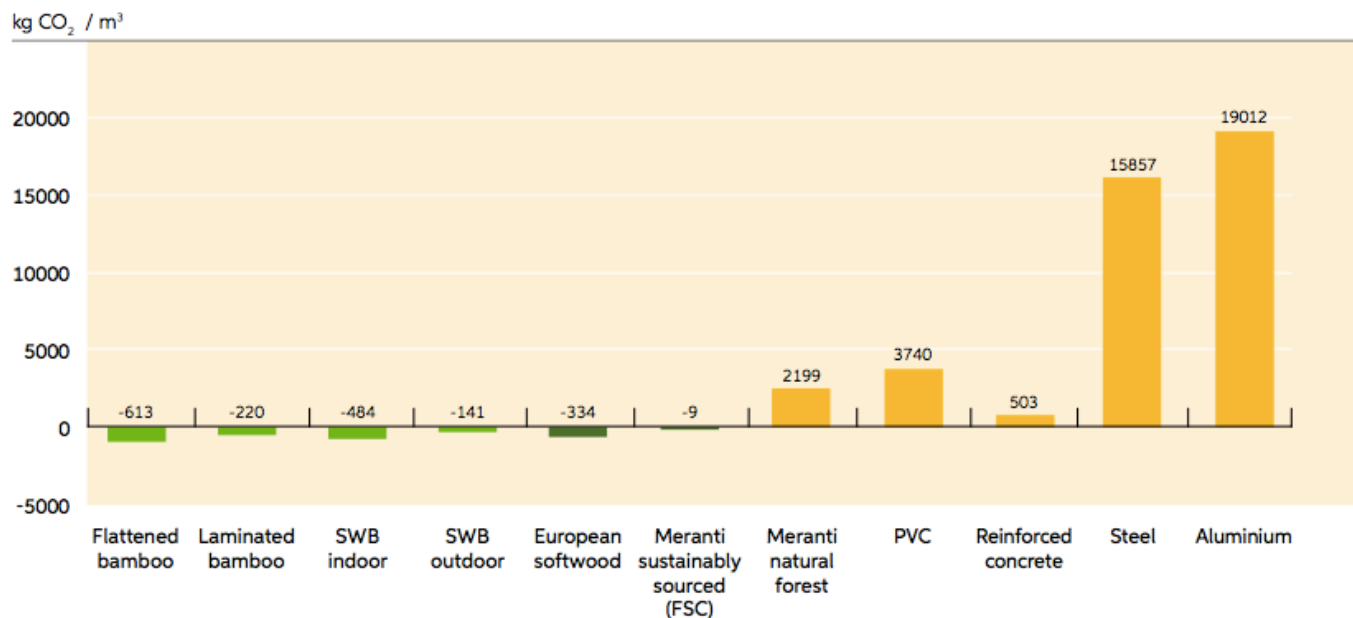
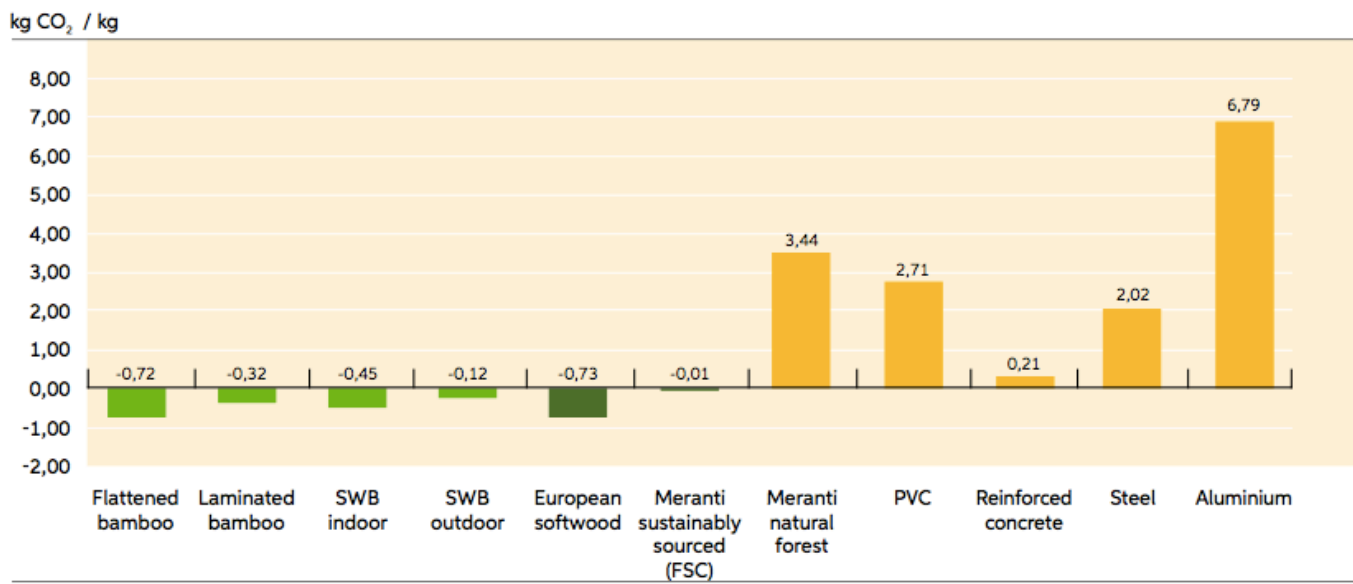


Figure 4.7 - Carbon footprint over life cycle per weight unit (kg CO₂ eq/kg building material) ^{4.2 - 4.5}







How many Chinas does it take to support China?

 CHINA	2.7	  
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What about some other countries?

 FRANCE	1.4	 
--	-----	---

 U.S.A.	1.9	 
--	-----	--

 INDIA	2.0	 
---	-----	--

 GERMANY	2.1	 
---	-----	---

 GREECE	2.6	  
--	-----	---

 U.K.	3.0	  
--	-----	---

 EGYPT	3.2	   
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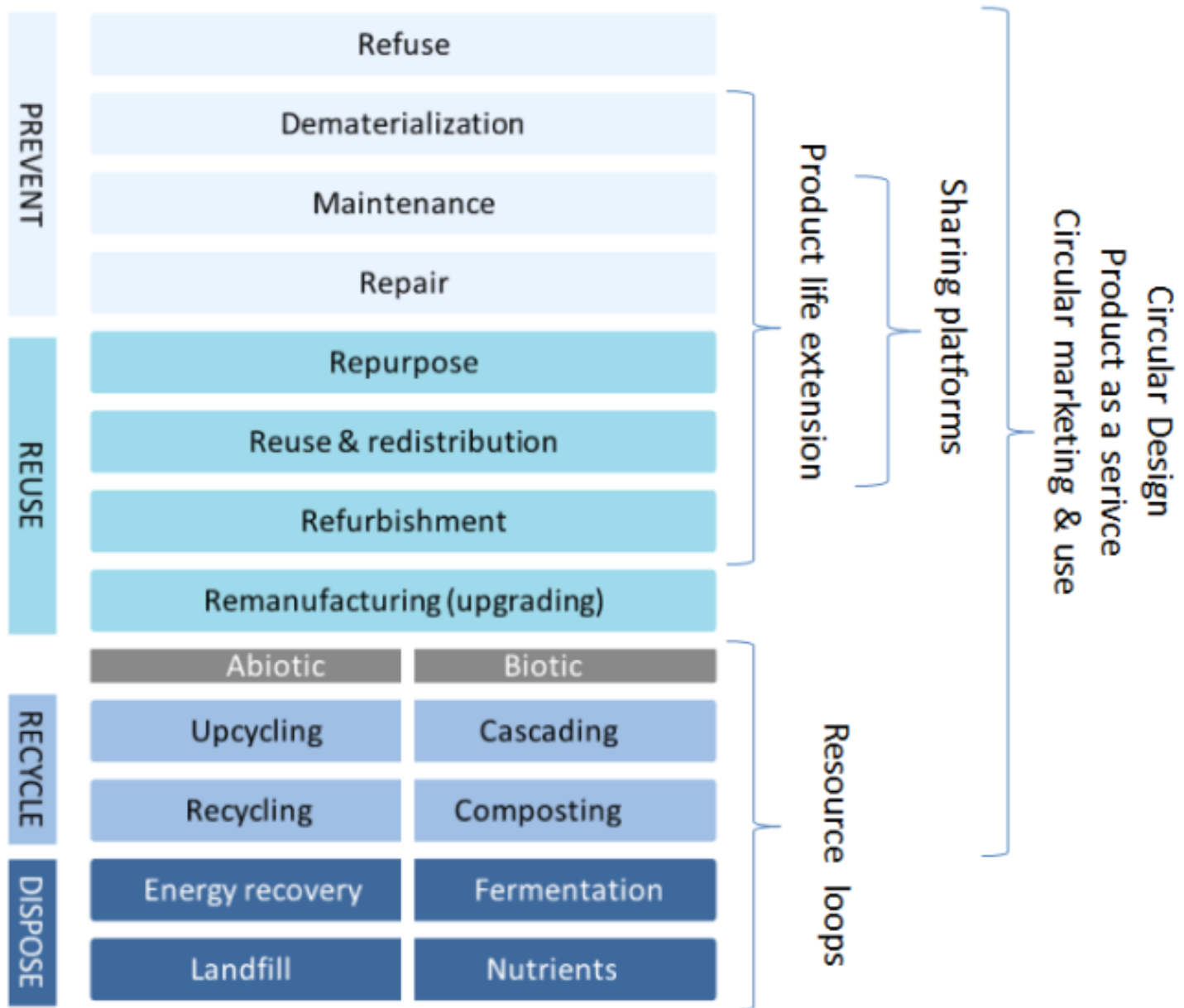
 SWITZER- LAND	3.5	   
--	-----	--

 ITALY	3.8	   
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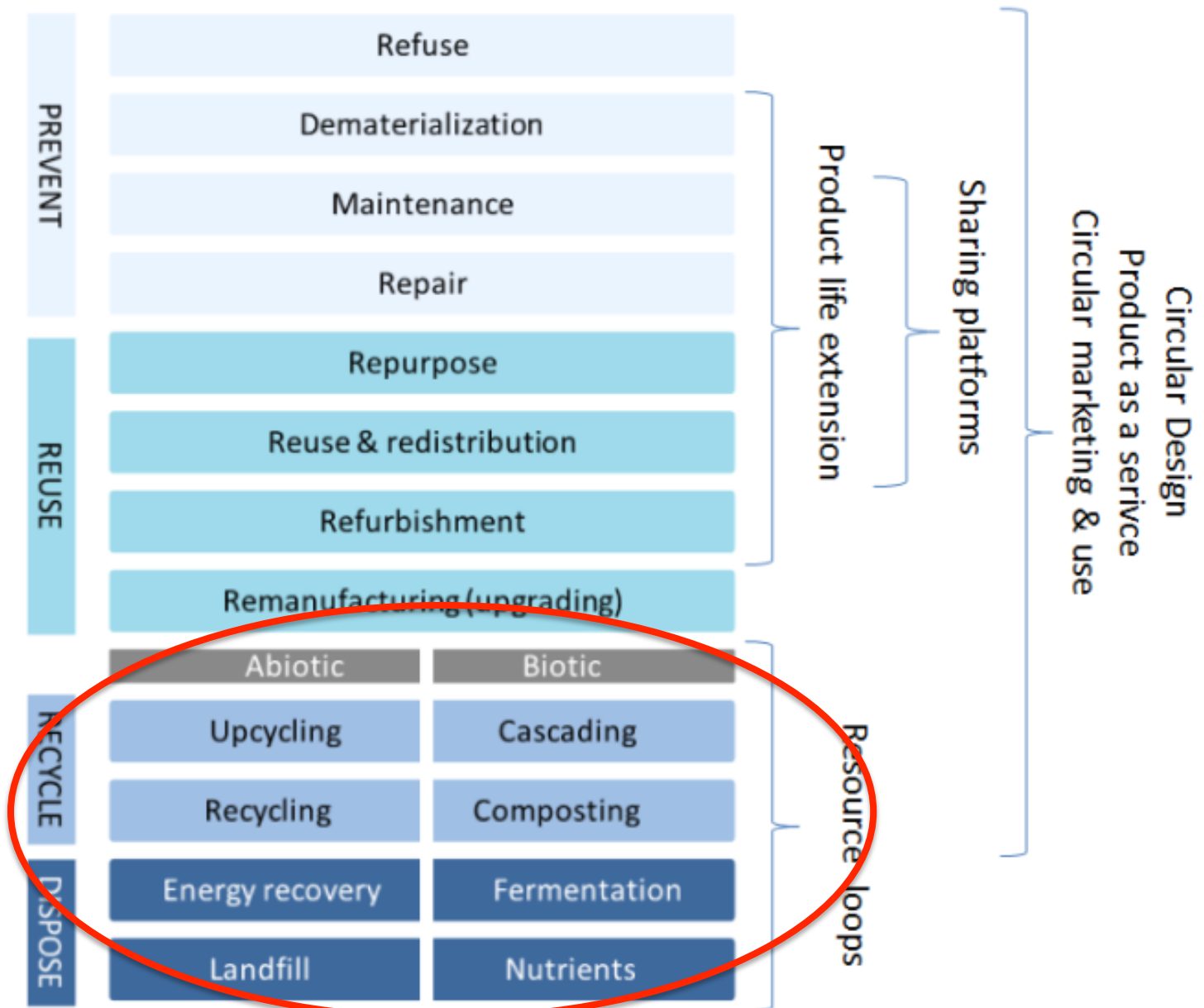
 JAPAN	5.5	    
---	-----	---

 WORLD	1.6	 
---	-----	---

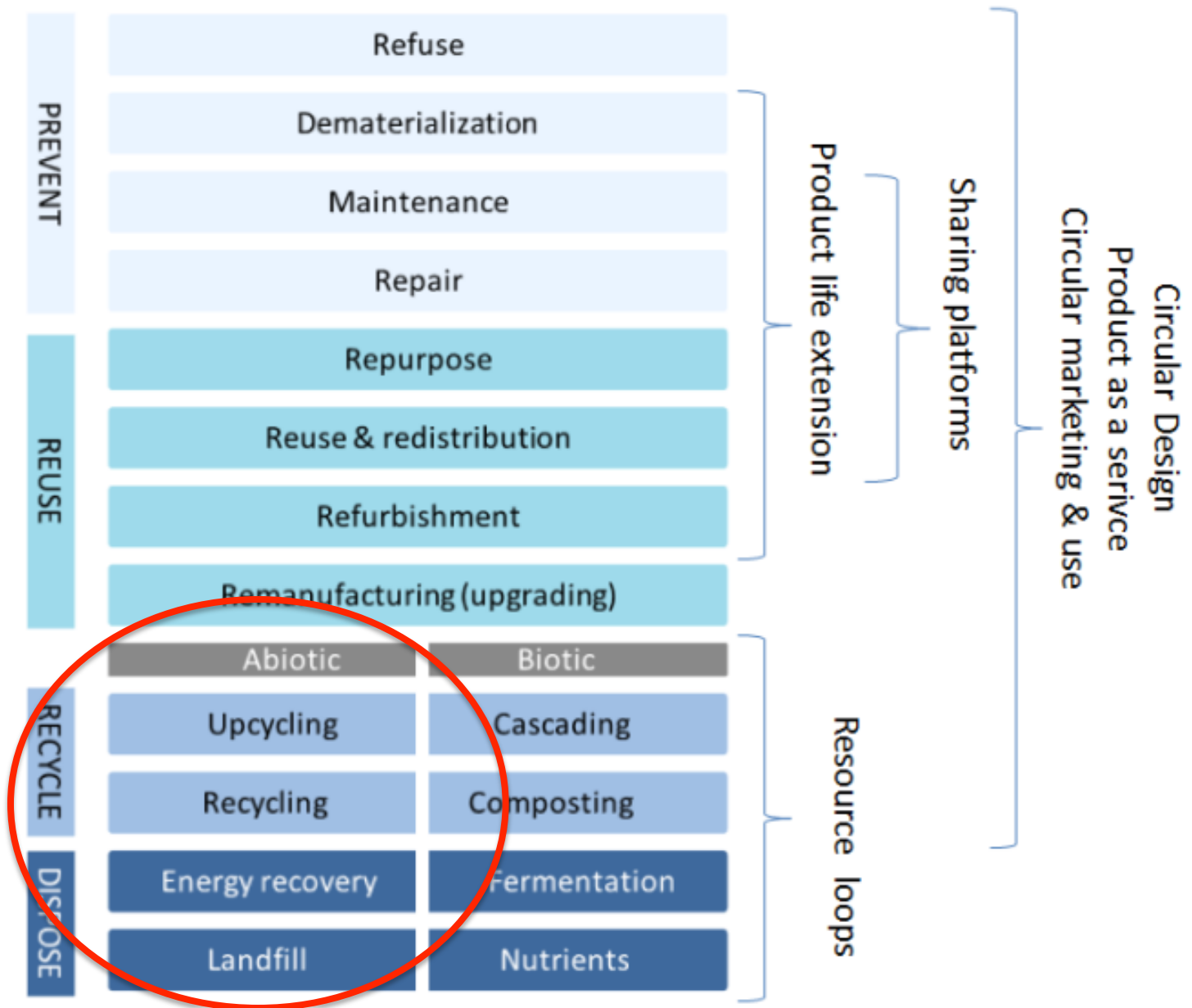
Ladder of circularity



Ladder of circularity



Ladder of circularity



https://www.youtube.com/watch?v=Hka_qjLHy0w

(weliswaar mooi initiatief tot recycling maar hierna feiten uit het boek dat recycling niet futurebestendig is)



Aluminium and steel

Recycling costs 5-10% compared to the production of virgin aluminium
25% compared to the production of virgin steel.

High recycling rates of around 60% for aluminium and 70% for steel.

There is not enough secondary aluminium and steel material (scrap) available worldwide to meet demand now and in the future

This means that of all the newly produced aluminium and steel only about 1/3 is made from recycled materials, the rest is based on virgin material.

Aluminium and iron are expected to be depleted within this century

Concrete

- Concrete recycling is increasing, with recycling rates between 30% and 80% in Europa and the USA,
- Often in lower value-added applications (downcycling) such as road bedding or aggregate (up to 20%) in new concrete.
- Carbon intensive virgin cement needs to be added.

Plastic

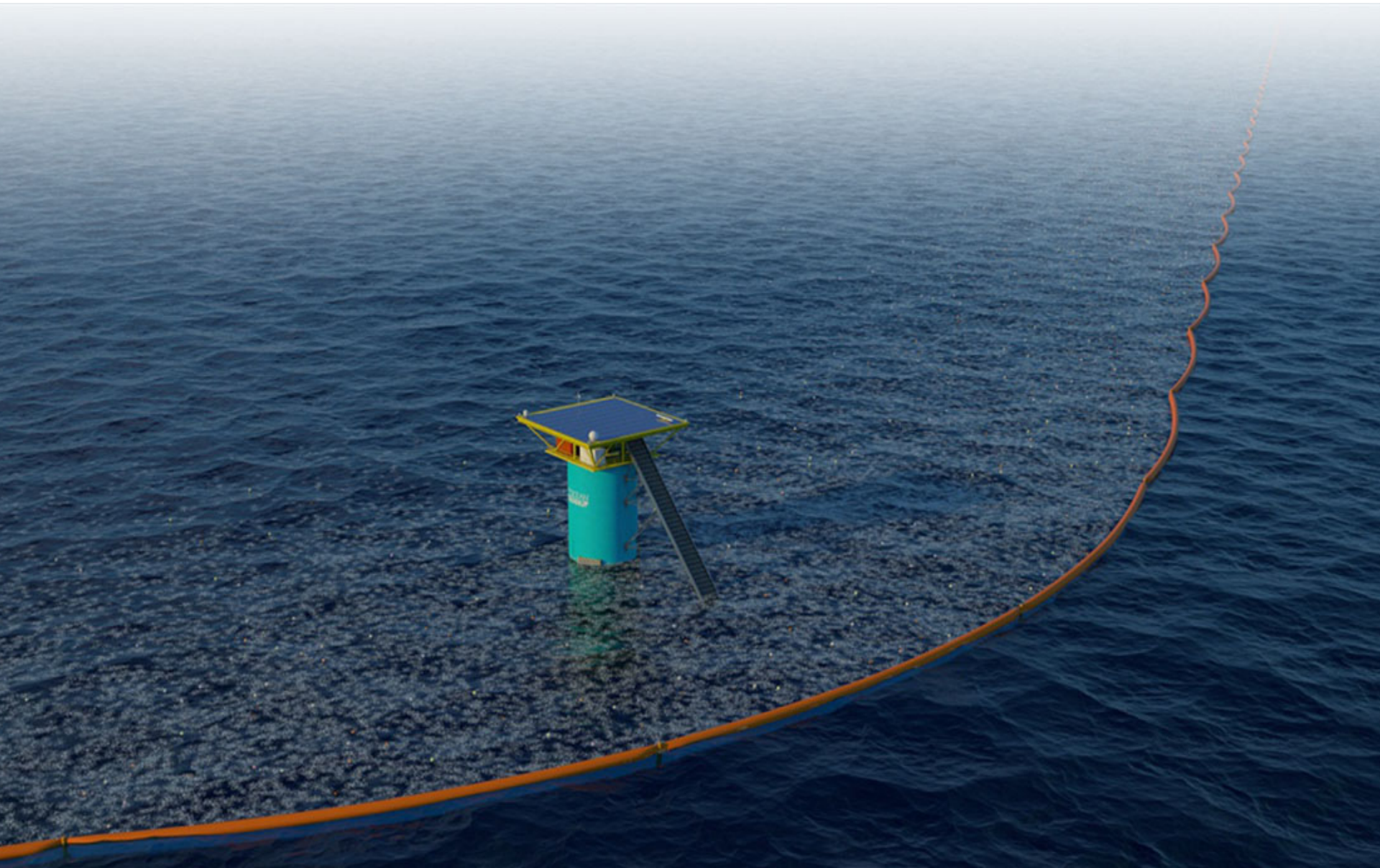


Europe (26% recycled, 36% burned, 38% land filled)
USA (9% recycled, 91% discarded).

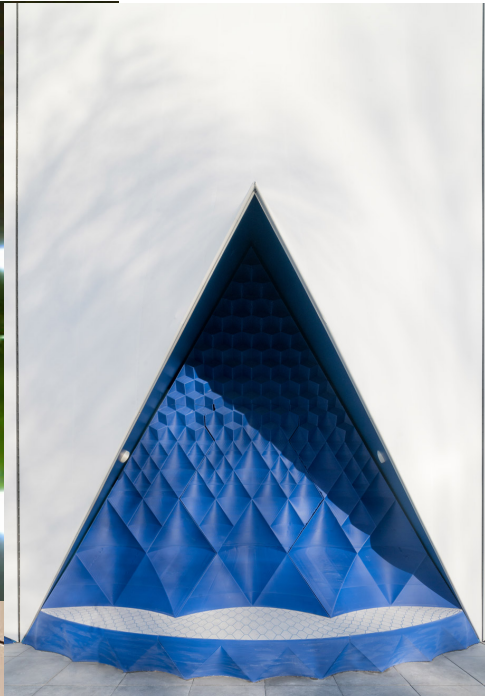
1.19 Each year about 10-20 million tons of post-consumer plastics end up in the oceans

The main European 'recycling' route – burning plastics for energy production – leads to toxic emissions of hydrochloric acid, sulphur and nitrogen dioxide, furans and heavy metals.

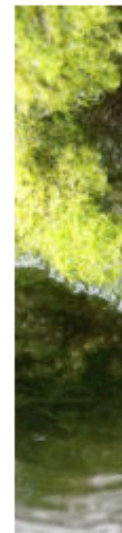
The ocean clean-up



NEW PLASTIC



BIO-FOAM MADE FROM ALGAL BLOOM



 Share  Tweet  Share  Email

17 October 2016

Algae are one of the few species that actually thrive because of global warming, forming a problem of their own. Algae grow fast, but only live for a short time before starting to decay, a process that consumes oxygen from the water. In large quantities, called algal bloom, algae can suffocate the aquatic life. A US based company called Bloom has found a way to harvest the algal bloom and turn it into bio foam.

ArchiCo
Tijdschrift & website voo

BIOPLASTIC CALLED WHEYPACK MADE FROM CHEESE WASTE



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 [t](#) Tweet
 [in](#) Share
 [✉](#) Email

3 March 2017

If there is one thing the Dutch, and thus Materia employees, love, it's cheese. However, in the cheese making process, a **byproduct called whey** is produced. In Europe alone, the annual production of whey from cheese makers is 75 million tonnes. Most of this is used for animal feed, but the food waste

ArchiCo

BIOPLASTIC MADE FROM CO₂ AND AGRICULTURAL WASTE



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14 October 2016

Plastic consumption is a major problem, mostly because only a small part is recycled and a large part ends up in our oceans. However, we keep using it because it is so convenient and you can do so many things with it. One solution is to make bioplastic from renewable plant sources, because it has all the qualities of plastic and is in addition biodegradable. Scientists from [Stanford University](#) have

building
holland



The event for
construction

BIOPLASTIC MADE FROM PINENE FROM PINE TREES



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 [t](#) Tweet
 [in](#) Share
 [✉](#) Email

7 February 2017

Plastic waste is a major problem in our world, because current plastics are made from oil, which is unsustainable. To replace oil based plastics, bioplastics made from renewable sources are up and coming. Scientists from the Centre for Sustainable Chemical Technologies at the [University of Bath](#) have developed a renewable plastic from a chemical called pinene found in pine needles.

GLYCIX

Category

Plastics

Code

PLA888

Country

Netherlands

Brand

Plantics BV



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REQUEST INFORMATION

ArchiCo

23 December 2015 - story by materia

Glycix is a biobased and biodegradable thermoset plastic for use in inflexible items used in homes and buildings such as telephone casings, insulation foam, trays, tables and lamps. Researchers Gadi Rothenberg and Albert Alberts discovered

MESTIC: BIOPLASTIC MADE FROM COW DUNG



[f](#) Share [t](#) Tweet [in](#) Share [✉](#) Email

16 November 2016

An average cow eats about 50 kilograms of grass per day, which means that it also produces a lot of poo. Cow dung contains phosphate and nitrogen, which, in small dosages, is beneficial for the soil. Unfortunately, because of the large amount of cows, the agricultural sector produces a surplus of manure, which is harmful for the soil, water and air. Earlier we reported on a company that made [ceramics with](#)

ArchiCo
Tijdschrift & website voo

PROTEIN: TURNING MILK INTO BIOPLASTIC



Share



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Share



Email

1 December 2016

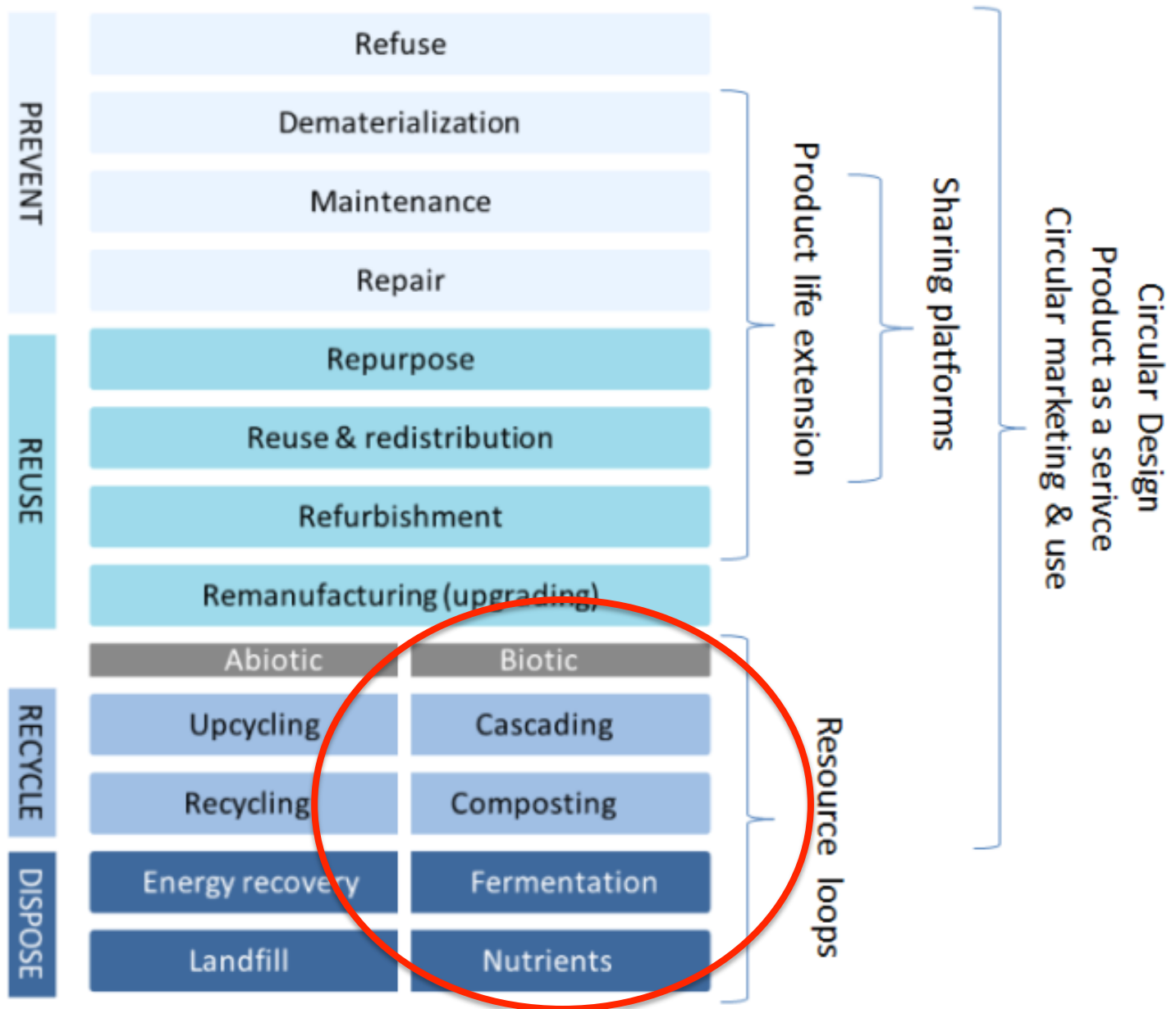
Skimmed milk is routinely wasted in large quantities at raw dairy farms in the UK due to the separation process required to make butter and cream. For her project Protein, designer [Tessa Silva](#) decided to save this material from being poured down the drain by turning the milk protein into bioplastic.

building
holland



The event for
construction

Ladder of circularity



ENGINEERING WOOD



Dukta



Bendywood



Accoya



Arboform

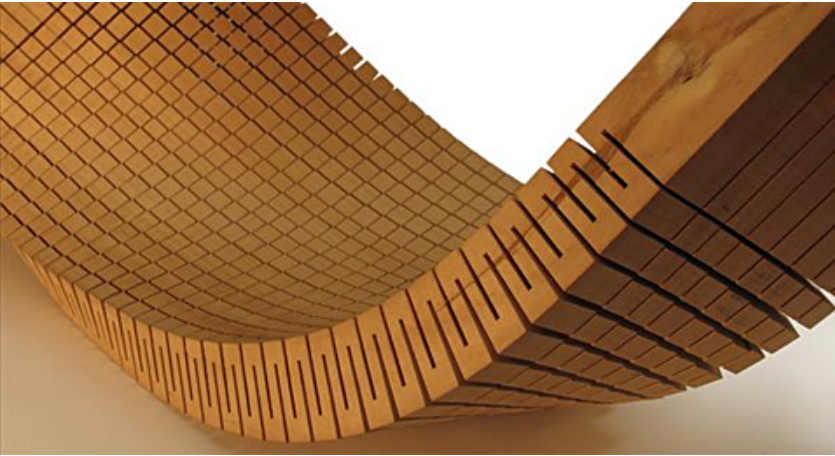


Kebony



Cross-Laminated Timber (CLT)

Dukta wood



Arboform: ``liquid wood``



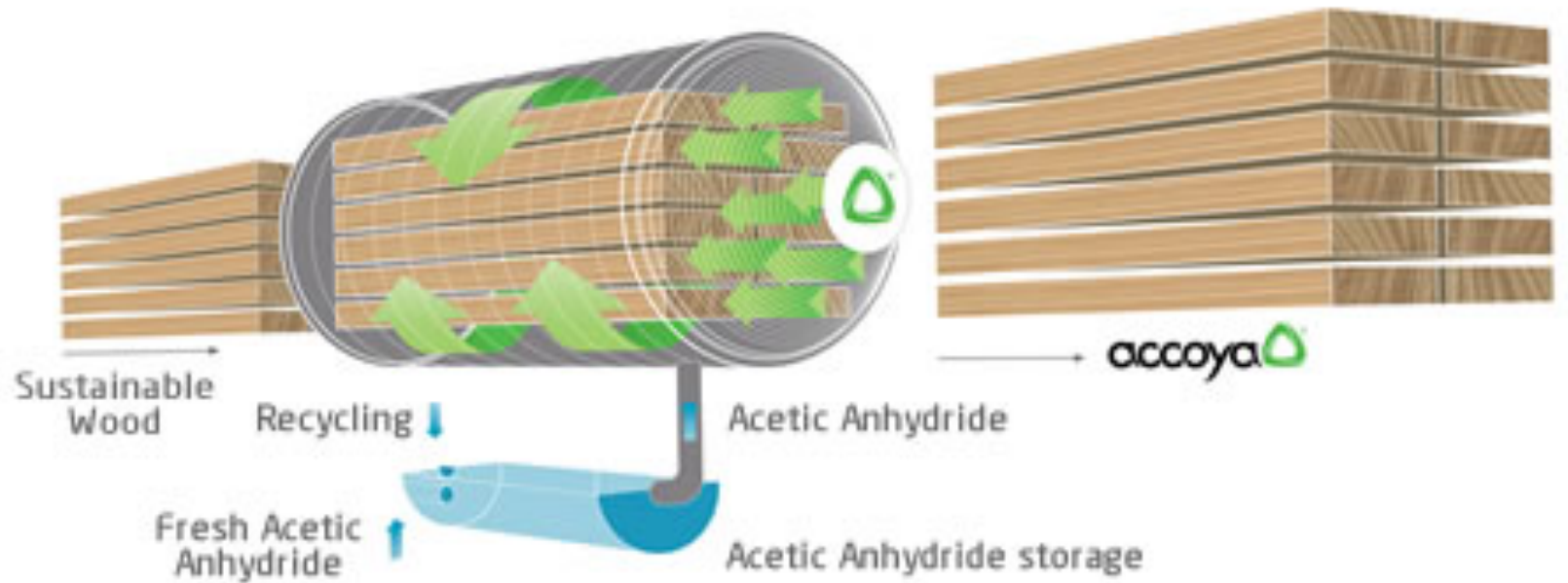
SR
Shred Ready



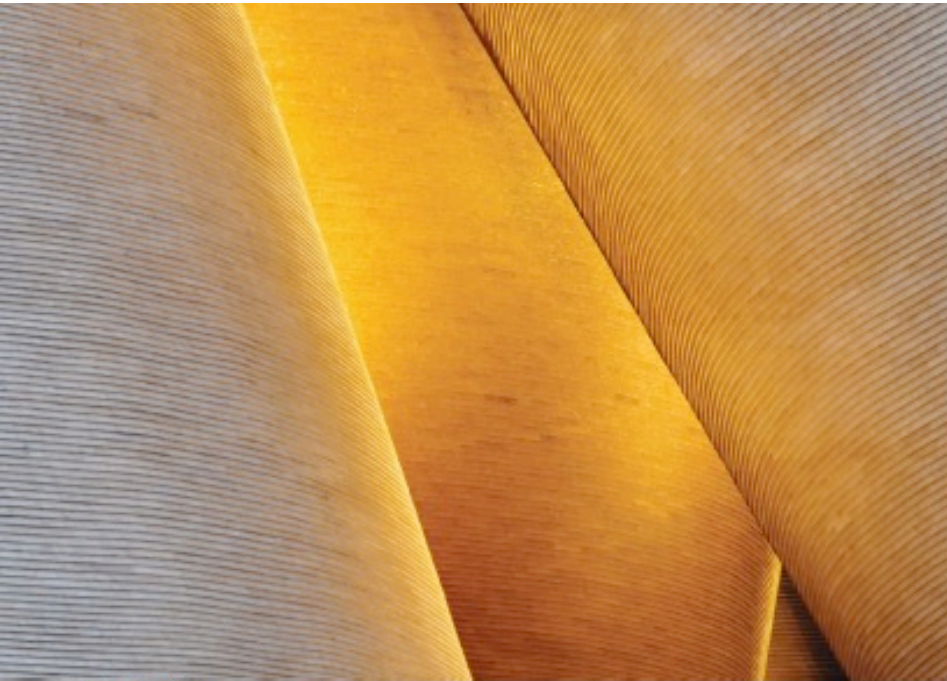
Dendrolight 270 kg/m³ (pine= 570 kg/m³)



Accoya / Accys



Biobased Non-wood



2049 Pavilion



Great (Bamboo) Wall



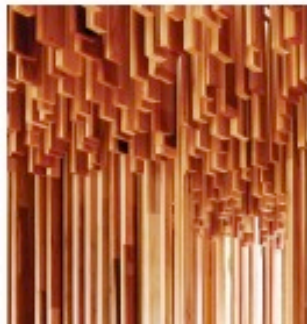
Call of the Wild



Final Wooden House



Spanish Pavilion



Sclera Pavilion



Paper Tower



Habitable Sculpture

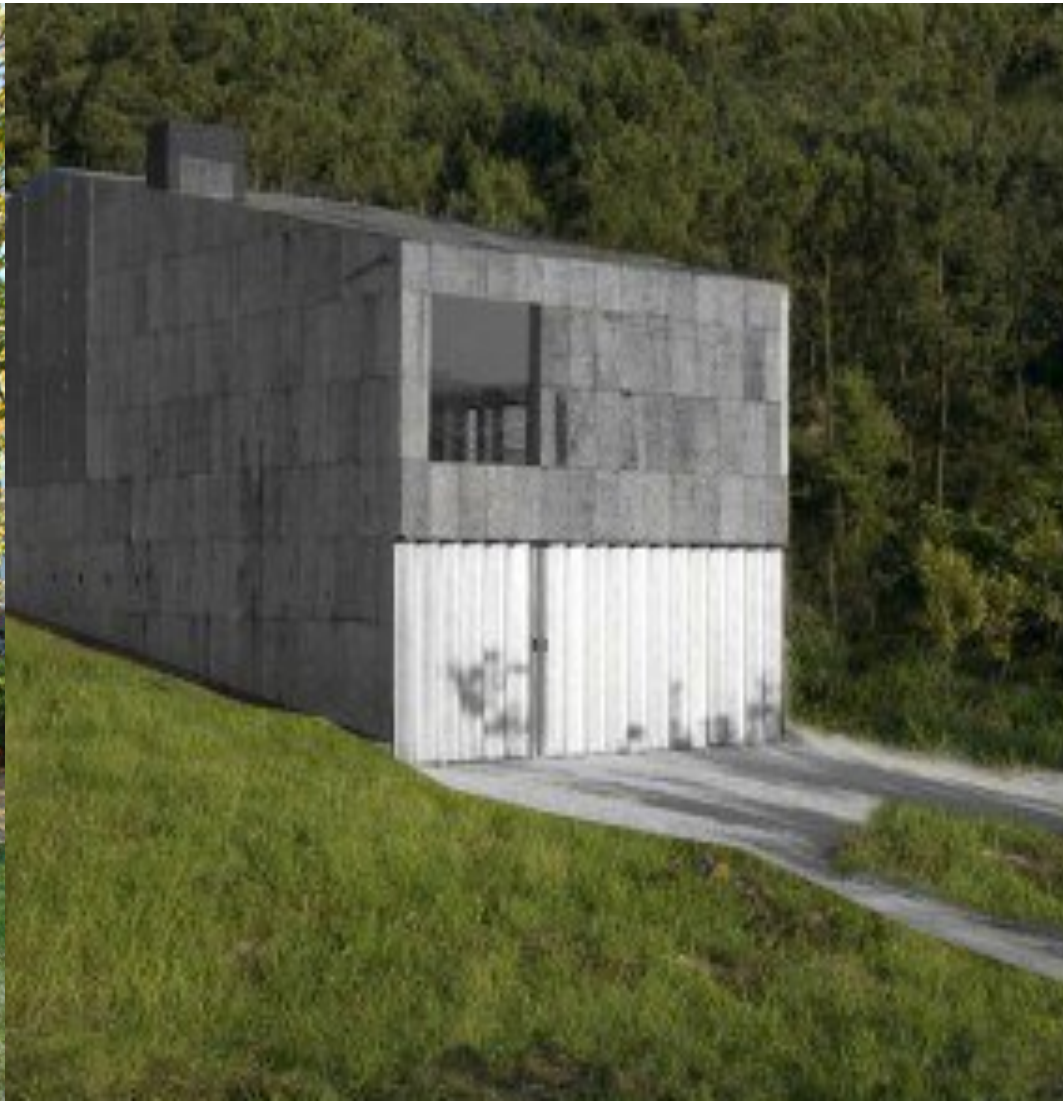
Cork



Cork textile



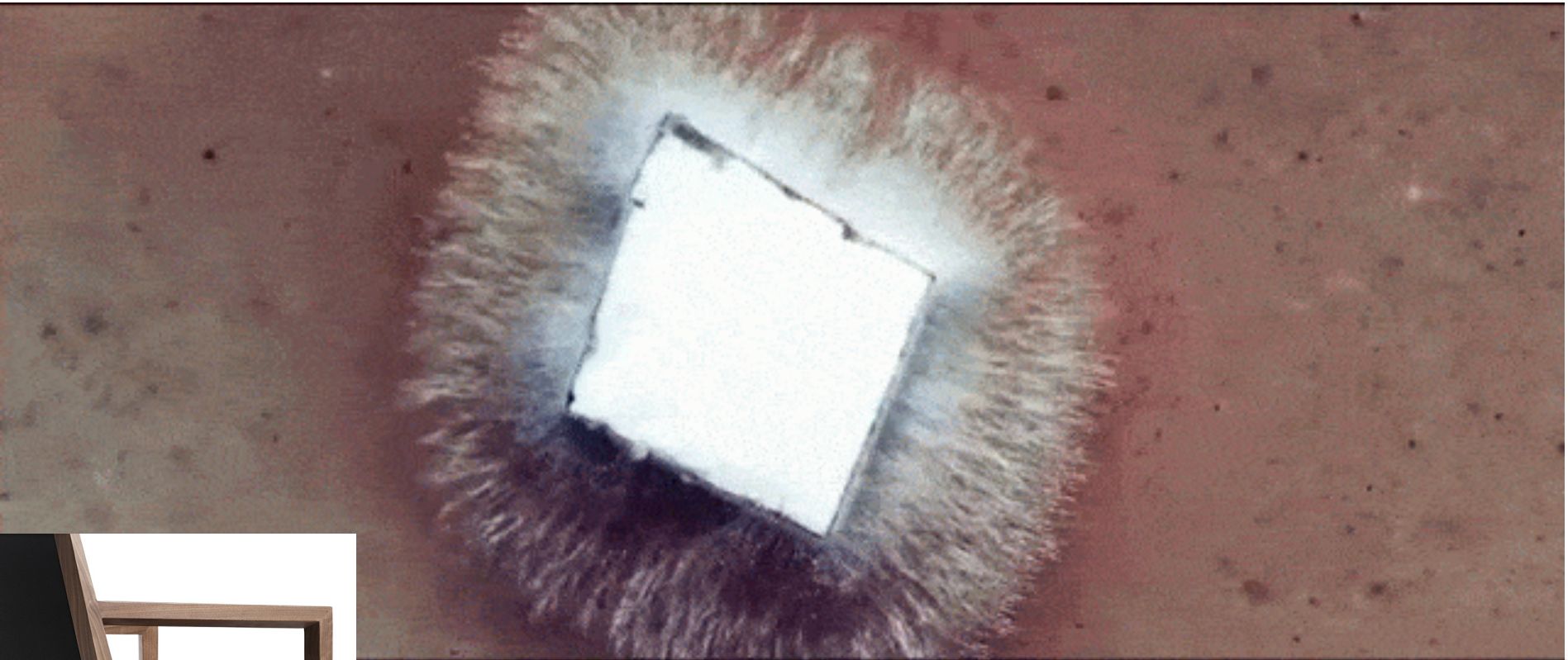
Cork facade



Mycelium



Myco board





Eric Klarenbeek



Muskin

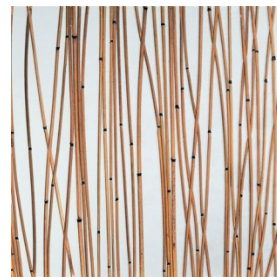


gze[®]

grad zero espace



Bamboo



Bamboo



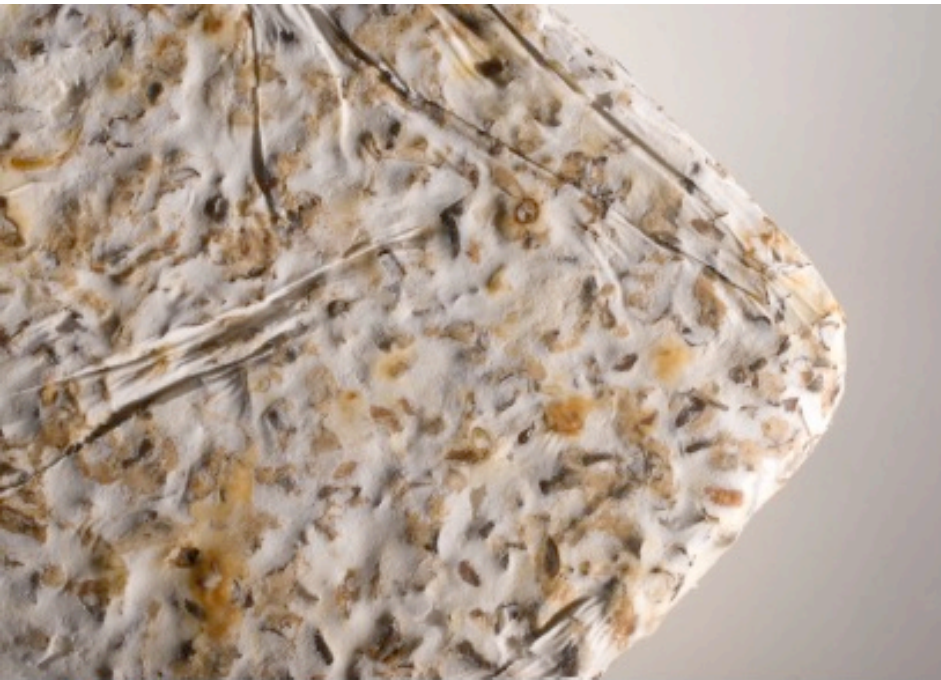
Paper



Bark - Rice&Lipka architects



NEW “GARBAGE”



Mycobond



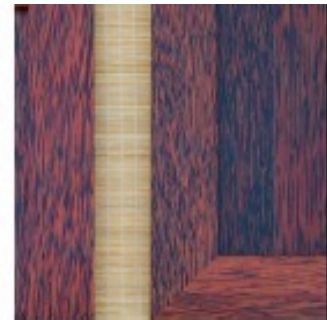
Tonecoon



Agriboard



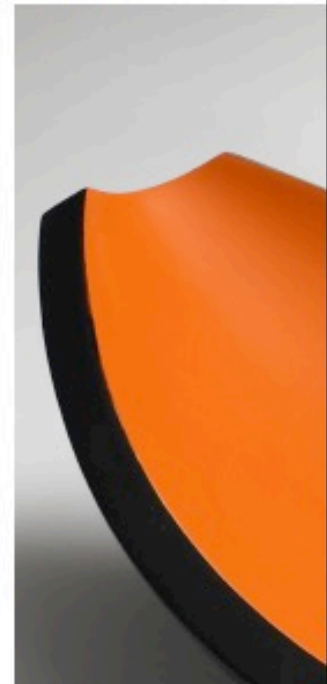
Disposable Office



Durapalm



Coco Tiles



Husque

Husque



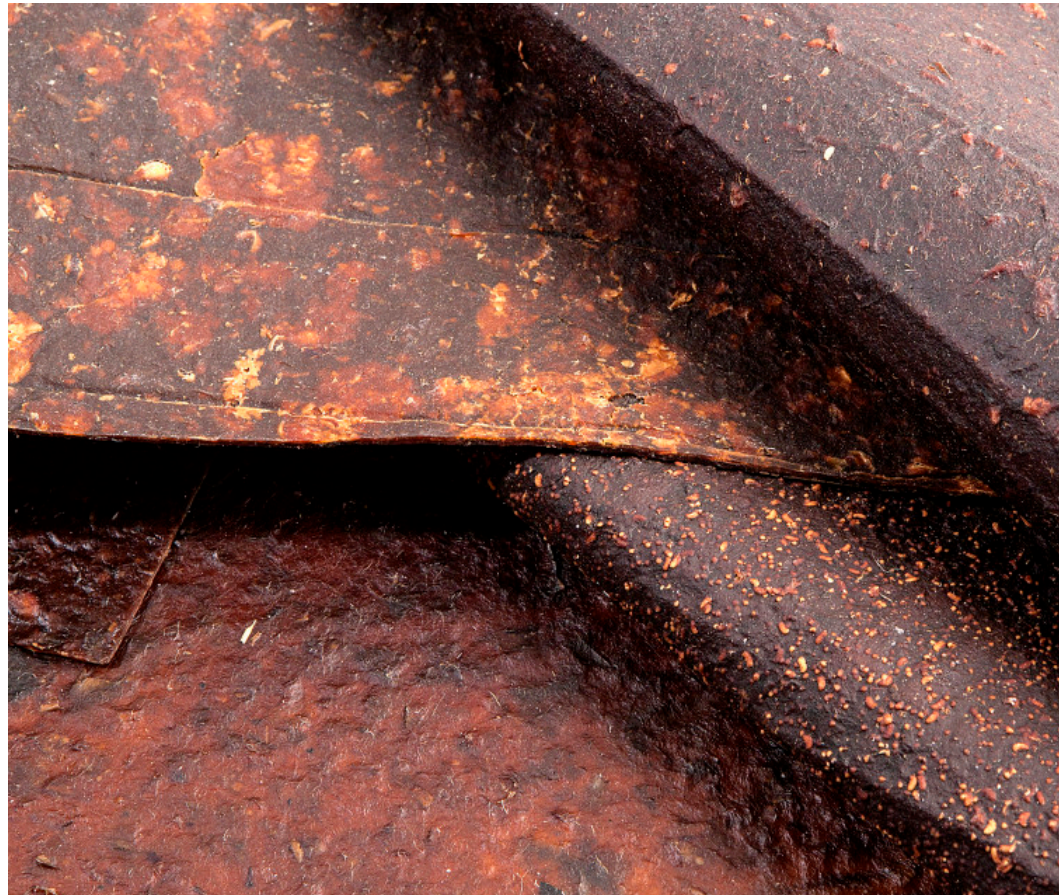
Mastalmond



Decafe Raul Lauri



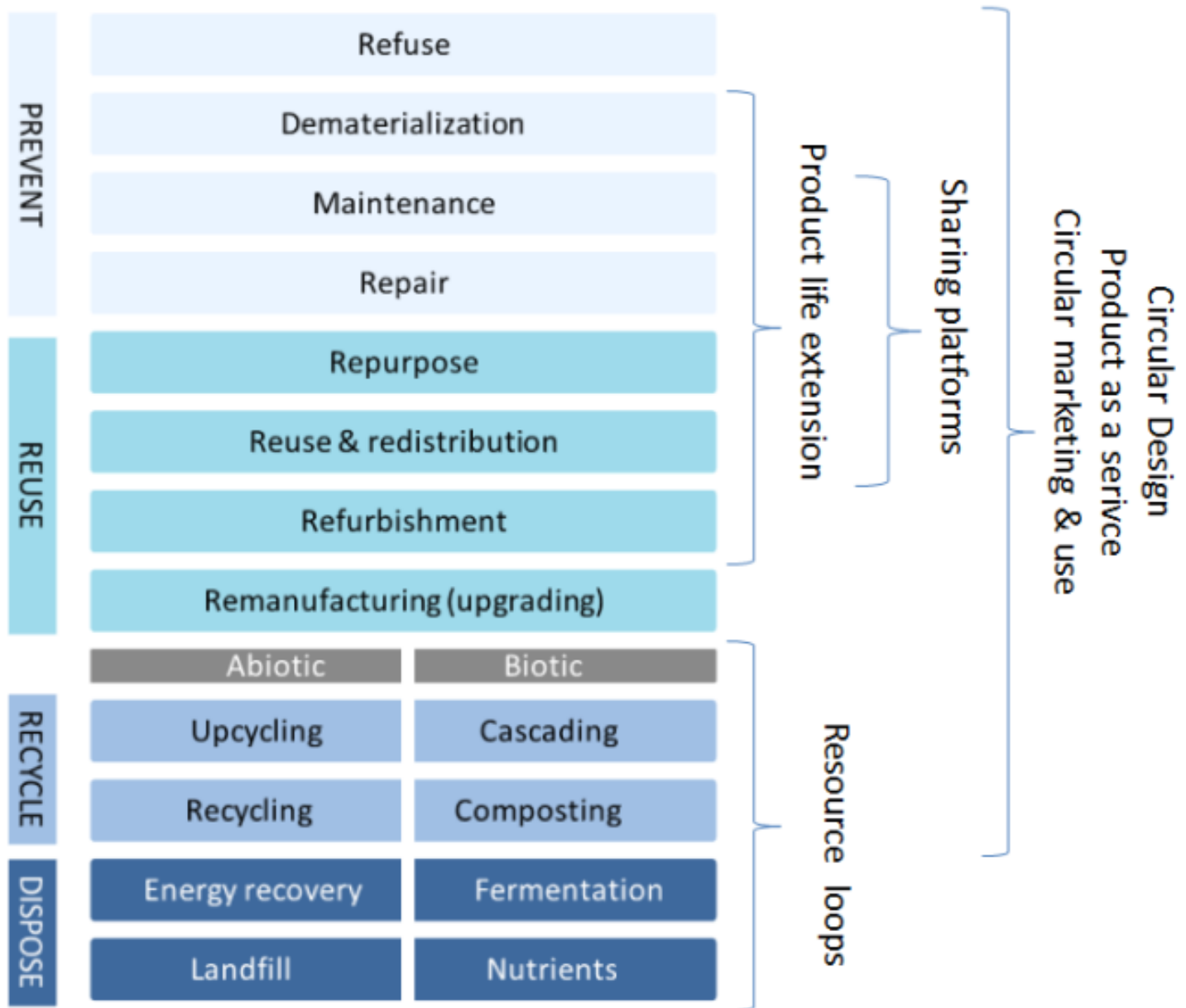
Vegan leather



Crustic Jeongwon Ji Design Products



Ladder of circularity



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Materia

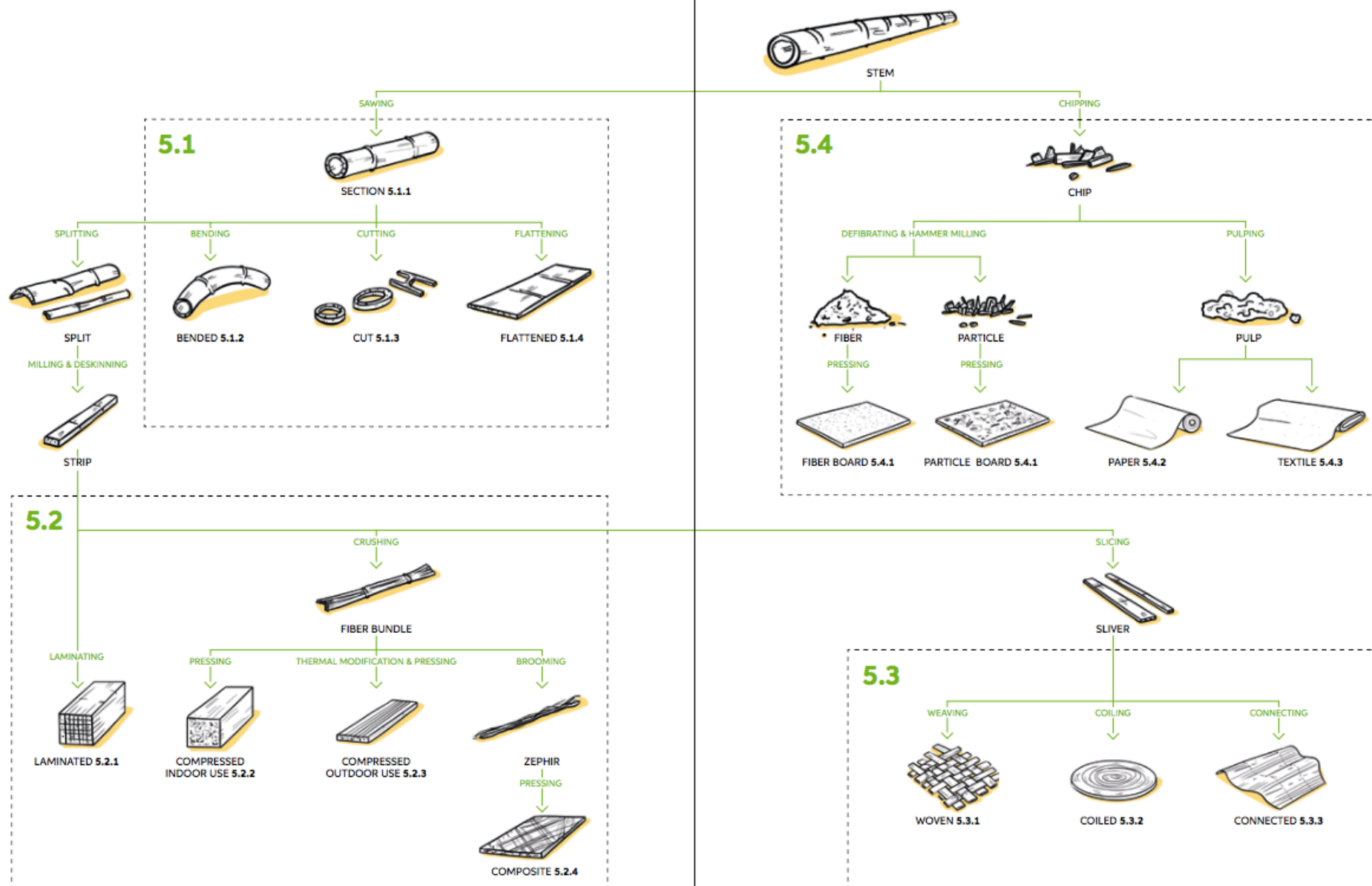


moo®

- 
- “1.000.000.000.000 people consider bamboo their symbol of poverty
 - 1.000.000 people refer to bamboo as a symbol of natural art and sustainability
 - 10.000 consider bamboo their preferred choice of construction material” *Gunther Pauli*

Only science and technology are able to increase the usage, image and application of bamboo

Figure 5.0 - Transformation paths of bamboo stem to many engineered bamboo materials^{4,5}



5.1 Bamboo Stem



Figure 5.1 - Bamboo stem variations

5.1.1 BAMBOO SECTION



5.1.2 BENDED BAMBOO



5.1.3 CUT BAMBOO



5.1.4 FLATTENED BAMBOO



The bamboo stem is the most well-known appearance of any bamboo material. It is the starting point of many different materials that can be made out of bamboo. Also by itself the bamboo stem can actually act as a sound building material. Nevertheless, due to its form, building with the stem can be challenging and making statements about the mechanical properties of the bamboo stem is complicated, as there are many differences between species and even between stems from the same species due to differences in specific climatic and soil conditions. However, some general statements can be made (see table below). Besides using the bamboo stem as a building/design element by itself, it can also be mechanically processed (sawn, sliced, bent, flattened, etc.) in several other forms, as shown in the remainder of this section.

Strengths

- Very efficient structural design from nature (strong, hollow tube with most fibers on the outside, see also box 2.1)
- Relatively high bending strength and tensile strength
- Light-weight, flexible material i.e. high linear elasticity (the stem will bend further without breaking) ideal for construction in earthquake prone areas
- Tough, hard outer skin providing protection
- If used locally (no transportation burden), most environmentally friendly material around

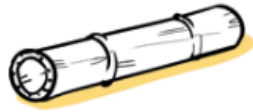
Weaknesses

- Relatively low compression strength
- Risk of shear in structural joints (can be solved by filling last bamboo compartments with concrete or wood props for larger contact area with metal connection parts)
- Irregular material (hollow, round, tapering, protruding rings) making standardization and connections difficult and thus labor-intensive and costly
- Lack of building codes and classification systems
- Low biological durability: in (semi) outdoor applications needs to be kept away from sunlight and moisture (rain/ground contact)
- Image problem, either as 'poor man's timber' (Africa, Latin America) or as rustic/traditional (Western countries)



5.1.1 Bamboo Section

Figure 5.1.1 - Bamboo section



How It's Made

The production process of the bamboo stem is very simple: grown by nature! There is hardly any other building material in the world that can just be cut with a machete and then act directly as structural beam or column in a construction or piece of furniture. After harvesting, it is recommended to preserve the bamboo culm through chemical (e.g. borax solution), heat or smoke treatment.

Application Area

The distinct form does give the bamboo stem a very rustic appearance, which so far has prevented large-scale application in the West, and in some bamboo growing countries bamboo stems also have a questionable image as 'poor man's timber'. Nevertheless, the use of the bamboo stem with its efficient natural structural design offers some interesting opportunities, in particular for building and civil engineering projects, but also for product design and furniture.

However, due to lack of building codes, classification systems for quality and strength, and the irregularity of the material, the use of the bamboo stem in Western countries will most likely be limited to specific purposes such as temporary constructions, sculptures and tents. Note that in bamboo-growing countries the situation is often completely different, where it has a far higher potential for mass application in the building industry.

! Design Challenge

A promising development area in Western countries is in standardizing the ends of the bamboo stem to solve the normally labor-intensive connections, thus yielding a light-weight space structure system that is easy to mount, ideal for temporary constructions.

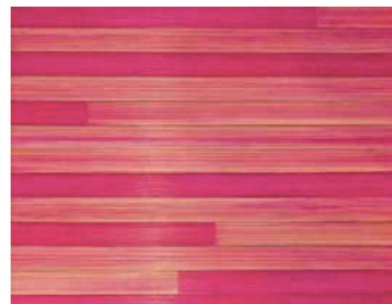
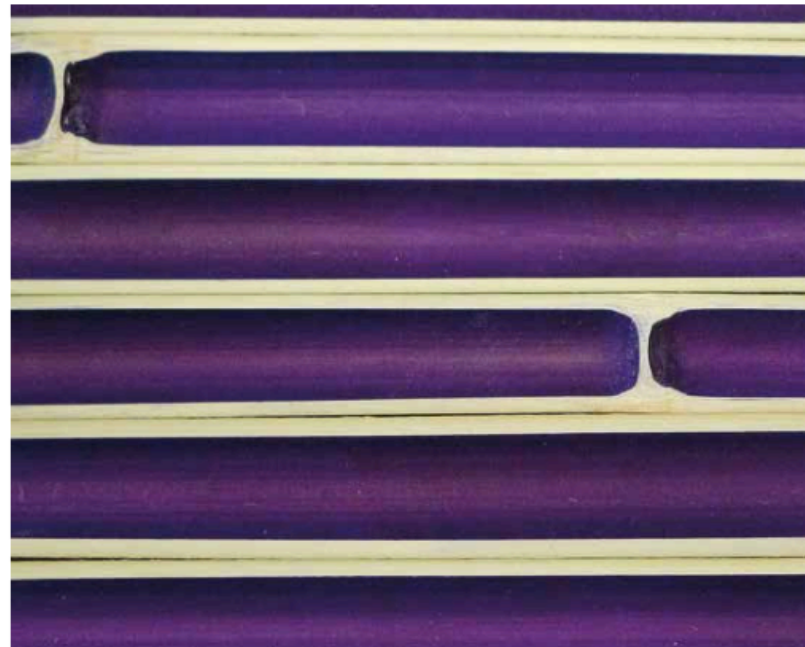
bamboo preservation
For more information about
bamboo preservation,
see the Bamboo Preservation
Compendium.^{2,3}





Native Bamboo is a fabric in which bamboo and stainless steel are combined. The fabric consists of stainless steel rods of 2-3 mm thickness interspersed with thin bamboo stems. Depending on the required look, the ratio between the number of stainless steel rods and bamboo stems varies. A sheet is maximum 3 m wide and 15 m long and available in both horizontal and vertical orientation. The bamboo metal mesh is suitable for indoor and outdoor applications.

By GKD



These bamboo panels are created by first immersing bamboo stems in a paint bath. The paint sticks mainly to the inside. After washing and drying, the stems are sliced in two, making the color inside visible. The split stem is kept natural to accentuate the shape of the colored spaces. Added together, the split stems create an organic line pattern with the recognizable image of bamboo. The inside of bamboo is covered with a thin film, which is sometimes used for flutes. After the painting process, this thin film is also stained, but it can also easily be removed and used in textile as decoration. Because all films are different, every square meter is unique. The panel dimensions are 30 x 60 cm (120 cm upon request).

By LAMA concept

5.2.1 Laminated Bamboo

Figure 5.2.1 - Laminated bamboo



How It's Made

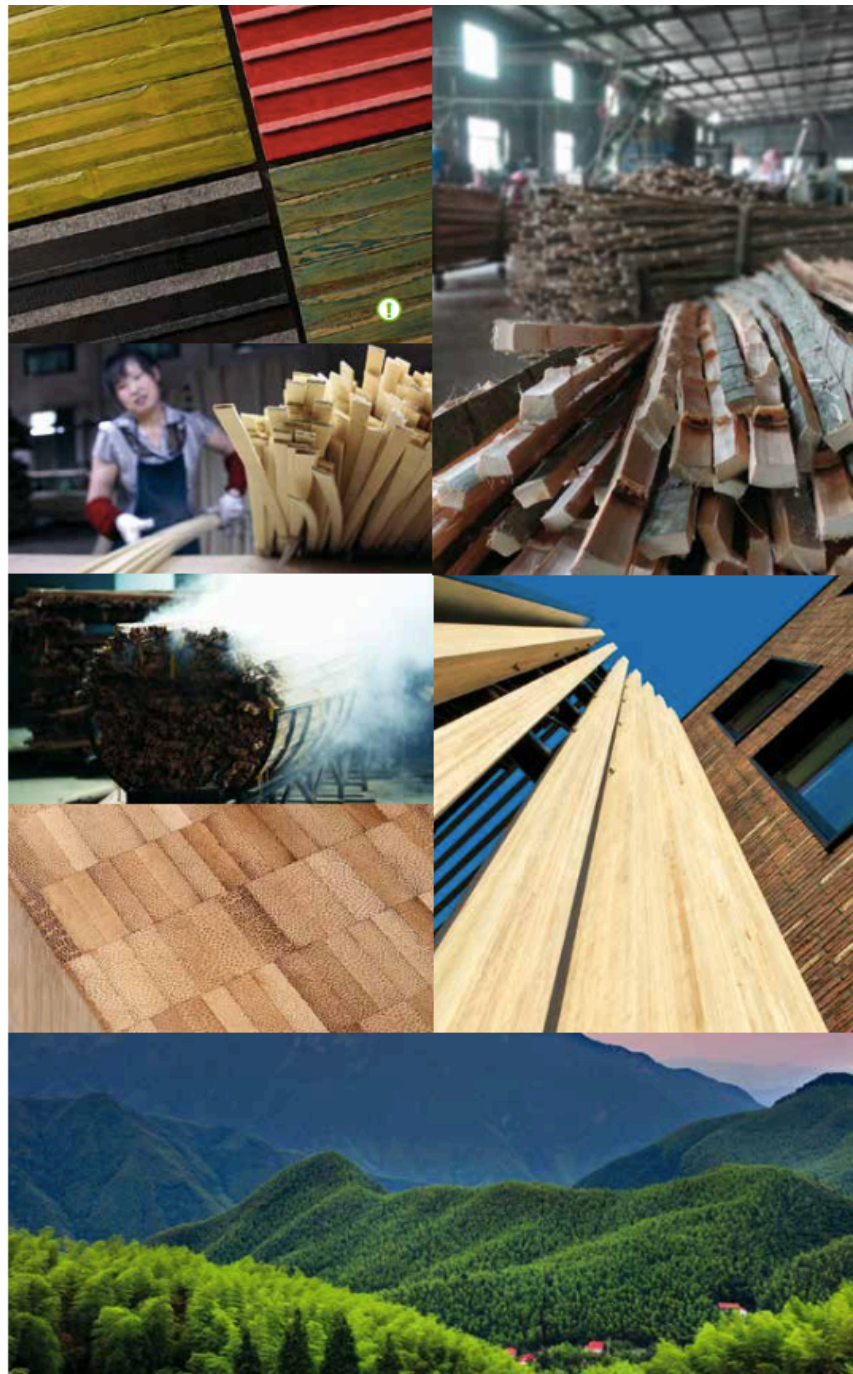
After planing the strips, they are sorted according to color and size, after which they are dried. Glue is applied on the dry strips, which are then hot-pressed to produce a one-layer panel. Subsequently, glue is applied on the separate one-ply panels to press them into a multilayer panel or beam. The panel/beam is then sawn and sanded to become the final product. A new development in China is finger-jointing (hook joint) on strip level instead of on beam level, resulting in a beam with a more homogeneous strength distribution, seemingly very interesting for structural applications. These beams, also available as panels/boards, can be impregnated by EU approved biocides to increase the outdoor durability, enabling outdoor application. See box 3.3 for more information. An alternative production path for laminated bamboo is to slice thin sheets of veneer from a giant laminated bamboo block. Rotary veneer in bamboo is also possible, although its quality and output is considerably lower than that of block veneer, explaining its lower popularity.

Application Area

Because it is made of thin strips serving as building blocks, laminated bamboo can be used to create aesthetical, high-quality, semi-finished materials in many different dimensions, from thin veneer sheets to medium-size flooring planks to large panels and beams. It can therefore serve as base material for many architectural and interior design applications, such as flooring, walls, ceilings, window frames, table tops, but also for several user goods ranging from cutting boards to computer housings.

! Design Challenge

A promising niche market is to combine laminated bamboo with several kinds of color finishes as well as other materials, such as fabrics.



5.3.2 Coiled Bamboo

Figure 5.3.2 - Coiled bamboo

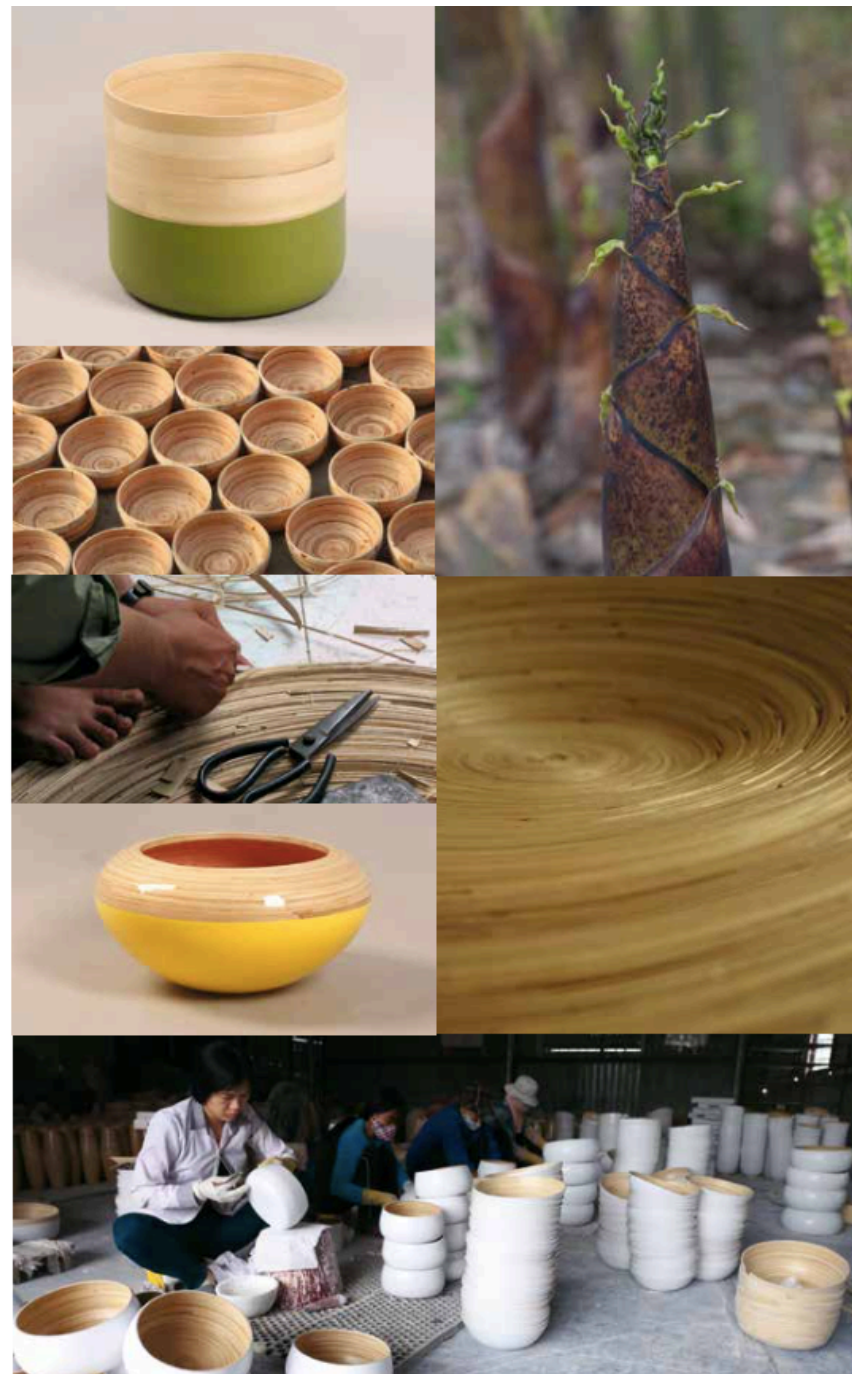


How It's Made

Coiled bamboo is a technique that derives from Vietnam, in which 1-mm thick bamboo slivers are first curved in a roller. Next, they are assembled tightly in a mold (usually a bamboo ring), after which they can be put over another 3-dimensional mold to create the eventual form in the final product. Finally, an adhesive is applied to both sides and the coiled structure can be finished (sanding and coloring). Although this process is quite labor-intensive, the aesthetic quality of coiled bamboo, especially if combined with colors, is generally appreciated in Western markets.

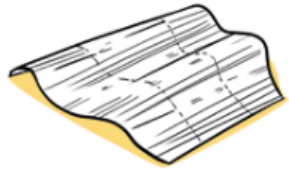
Application Area

Coiled bamboo is commonly used in various decorative household products such as bowls, vases and trays. Because of the fine aesthetic qualities it is worthwhile to further explore application of coiled bamboo in larger interior design objects such as furniture and lamps.



5.3.3 Connected Bamboo

Figure 5.3.3 - Connected bamboo

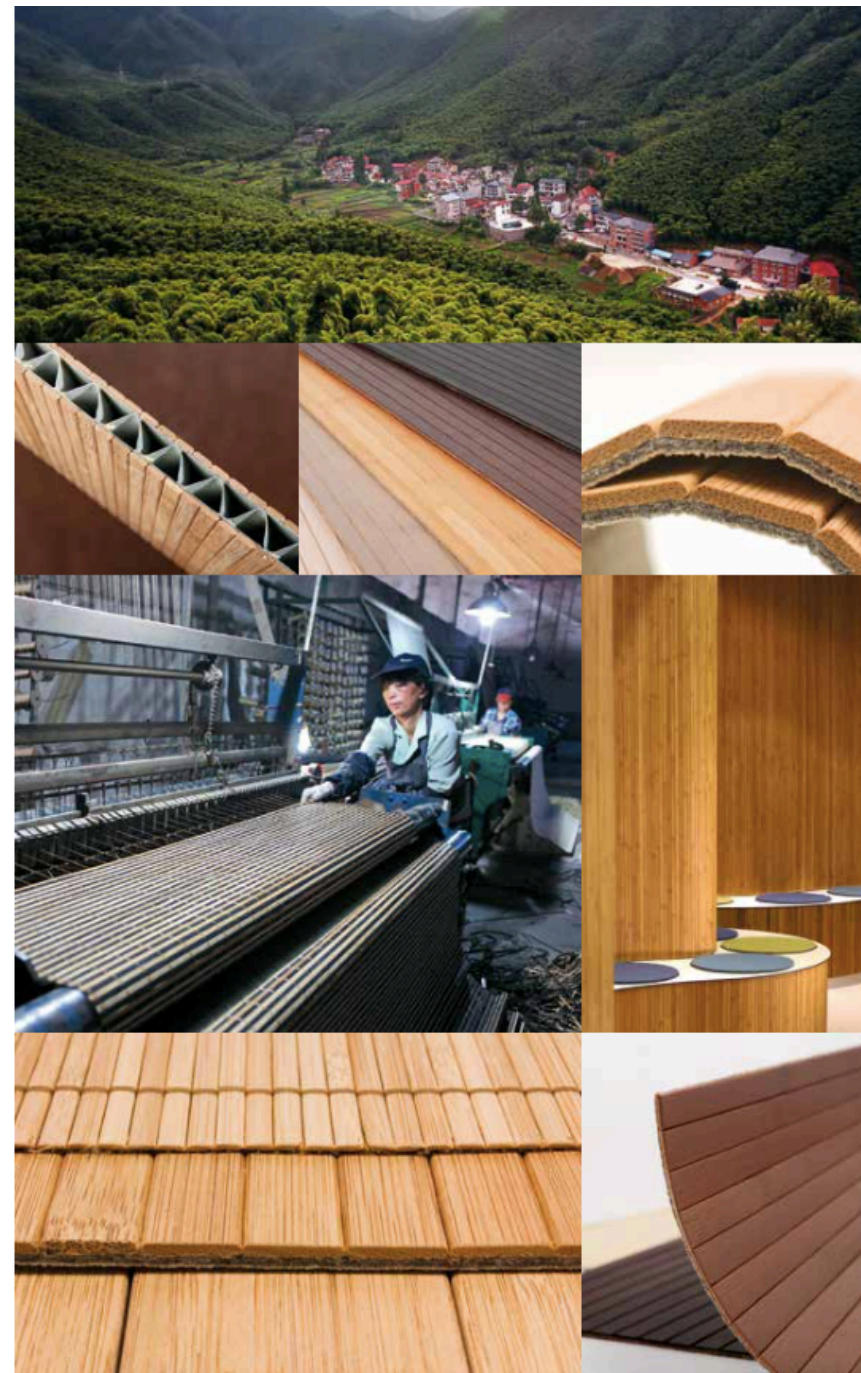


How It's Made

Instead of weaving the slivers, they can also be aligned side by side and stitched together by means of a thread to produce a large preform or mat, which is often called a bamboo curtain. In China, this process is highly industrialized, using specially developed machines that produce vast amounts of bamboo curtain mats every year. Instead of a thread also a flexible fabric or latex backing can be used to connect the separate bamboo elements.

Application Area

Typical applications of bamboo curtain are as a table, bath or floor mat, but it is also used as window curtain or car seat cover. If combined with a latex backing it is very suitable for use as (sound-insulating) floor carpet or floor tiles. Because of its flexibility, application on curved elements (e.g. lamps, cabinets, furniture) and walls is also an interesting design possibility.



5.4.1 Bamboo Fiber Board & Particle Board

Figure 5.4.1 - Bamboo fiber board & particle board



How It's Made

The production process of bamboo particle board and MDF is very similar to that of its wood-based counterpart. However, instead of using full trunks as input material (as is often the case in the wood industry), more often waste streams of other bamboo industries (preprocessing or final-product manufacturing factories) are used as feedstock.

First of all the bamboo chips are washed, after which they are refined in a thermo-mechanical pulping process using steam to soften the chips. After this, they are grinded and mixed with resin. After drying, the fibers are formed and transported on a conveyor belt feeding a continuous hot press, which presses the bamboo chips into a uniform board of medium (approx. 700 kg/m³) or high (> 800 kg/m³) density. After formatting and conditioning, the MDF/HDF boards are ready for shipment.

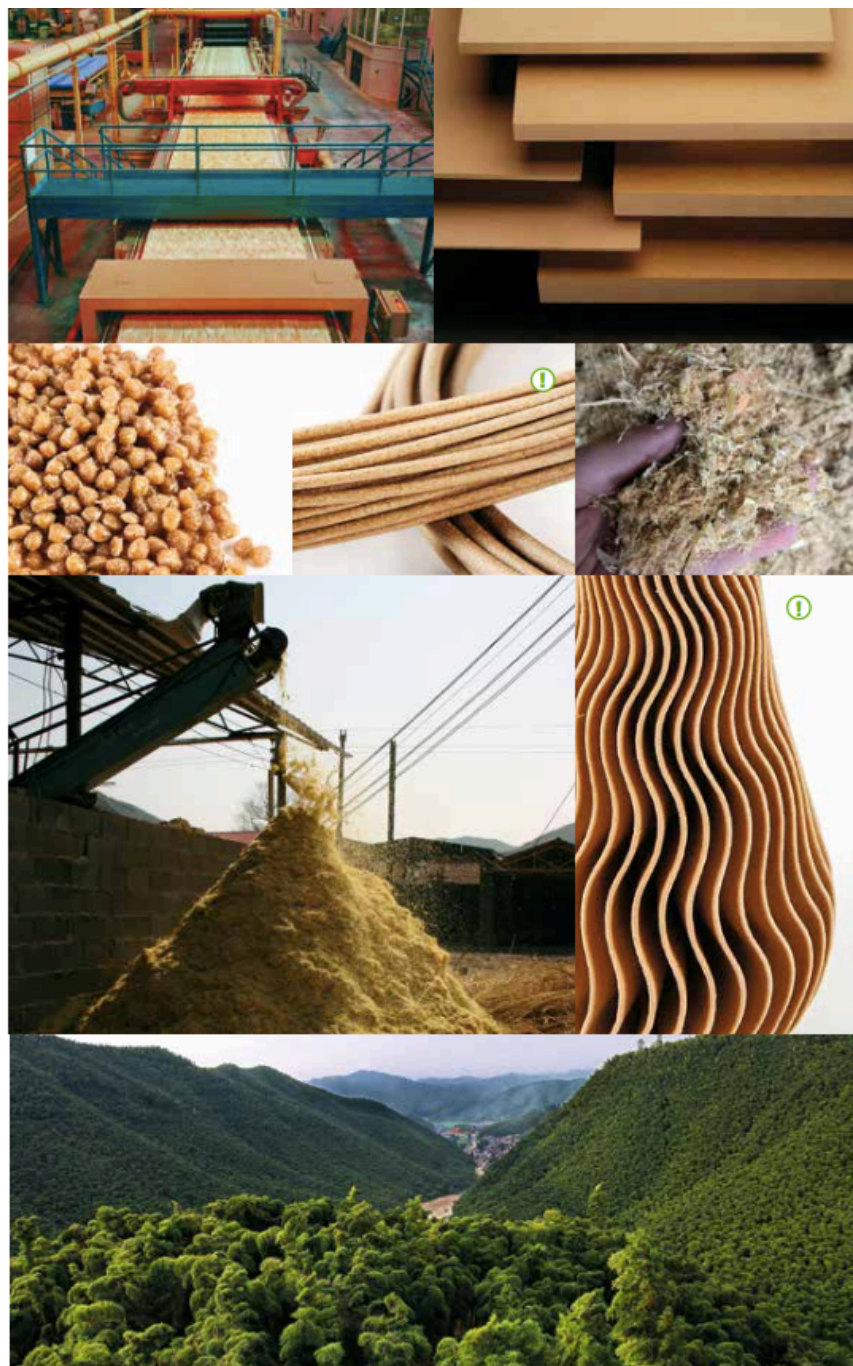
Production of bamboo particle board is similar, only the chips for particle board are larger, ranging from 1-5 mm in width/thickness and 1-20 mm in length, made through flake or hammer milling. It can be produced in a continuous press or in a multilayer press.

Application Area

Bamboo fiber and particle boards are used in similar areas as wood fiber boards, i.e. for internal sheeting in the building industry but most commonly in furniture construction (cabinets), flooring underlayment and as non-decorative semi-structural panels.

! Design Challenge

A more innovative application of the bamboo fiber is as filler in granules suitable for 3D printing or compression molding, especially when combined with a bio-based resin such as PLA. This provides an eco-friendly, potentially fully bio-based alternative for plastics in multiple applications where biodegradability is an issue (e.g. biodegradable vases, packaging, temporary drainage sheets, etc.).



6.1 Structural



6.1.1

Project
Bamboo Hostels

Location
Baoxi, China

Architect
Anna Heringer

Anna Heringer was one of the 12 architects invited to build habitable structures from bamboo for the occasion of the Inaugural Bamboo Biennale in 2016 in the village of Baoxi, China. Baoxi has a rich cultural tradition and heritage, which influenced the characteristic shapes of the three buildings: one male and one female hostel and a guesthouse. Heringer was inspired by the shapes of local woven baskets and ceramic vases, which she translated into the vessel-like form of the structures. The rammed-earth core is surrounded by an expressive woven skin, to which the sleeping units are attached. The latter are designed like Chinese lampshades that glow at night.

Photos
Studio Anna Heringer



6.1.4

Project German-Chinese House

Location
EXPO 2010, Shanghai

Architect
Markus Heinsdorff

Nature and space are the principal themes in the work of international installation artist Markus Heinsdorff. The German-Chinese House constructed during EXPO 2010 is one of the first buildings in which engineered, laminated bamboo was used for the bearing structure. For the roof-supporting construction, Heinsdorff used 8-meter-long stems of Julong bamboo, a rare and particularly long type of bamboo from Southern China. Before use in the actual construction, the bamboo was treated with a special fire-retardant, earning it a certification for fire resistance. In the interior of the building, the artist used laminated bamboo beams. For both materials, new connecting and finishing techniques were used that were especially developed for this project. The supporting beams of the bamboo segments, measuring up to 6 m in length, made a self-supporting room possible on the upper floor. Connecting joints of steel on the roof hold the bamboo supporting-frame structure together. The building is completely mobile: it can be taken apart and reassembled elsewhere. All materials are either reusable or completely recyclable.

Photos
Nic Lehoux



6.1.5

Project BMW Solar Carport

Location
Johannesburg, South Africa

Architect
BMW Designworks

This fancy solar carport makes it possible for electric and plug-in hybrid cars to be charged using green energy only. The structure is made of structural laminated bamboo beams (Bamboo N-finity) and stainless steel. The bamboo beams are made by laminating impregnated strips into beams or slats. A special impregnation process gives the product the highest durability class possible (Class 1 following EN 350). This material can be produced in various dimensions and is available up to a maximum length of 5800 mm.

Photos
BMW Group South Africa

6.2 Architecture



6.2.1

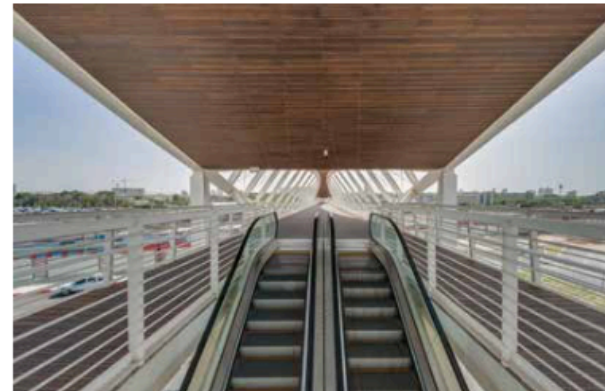
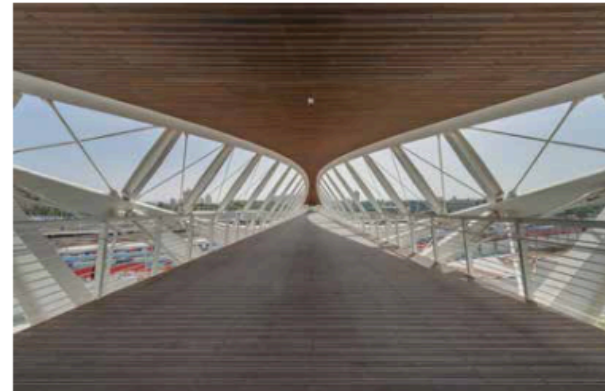
Project
Beer Sheva Bridge

Location
Beer Sheva, Israel

Architect
**Bar Orian Architects &
Rokach Ashkenazi**

Commissioned by the municipality of Beer Sheva, this pedestrian bridge spans the railroad and connects the local university with an industrial zone on the other side. The bridge achieves its 180-meter span over the city's train station with only three anchors. The full length of the bridge is covered, both on the ceilings and on the walkway, with thermally modified strand woven bamboo boards (Bamboo X-treme) for a beautiful, homogenous appearance.

Photos
Lior Teitler



6.2.2

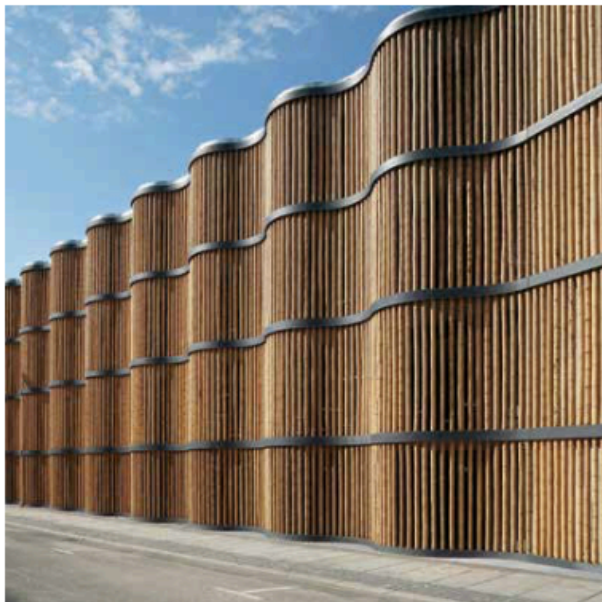
Project
Parkhaus Zoo

Location
Leipzig, Germany

Architect
HPP Architects

With around 1.3 million visitors per year, Zoo Leipzig is one of the favorite animal parks in Germany. This new garage was completed in 2004 to provide the zoo's visitors with enough parking space. The project's focal point is its 'wrapper' made of thousands of bamboo stems. The result is not only an eco-friendly facade for a type of construction that is typically un-green and un-attractive, it also strengthens the relationship with the adjacent zoological gardens, preparing people for their visit to the exotic world of Leipzig's zoo before they even leave the parking lot.

Photos
HPP Architects, Punctum,
B. Kober



6.2.3

Project
Lotus Residence

Location
Minusio, Switzerland

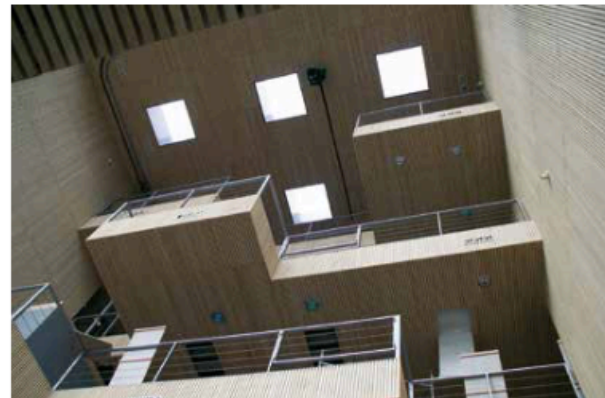
Architect
PK Studio di Architettura

These apartment buildings are located on the shores of the Verbanella Lake Maggiore in the town of Minusio in Switzerland. Each apartment boasts an enormous terrace, providing magnificent views over the lake. The terraces (altogether 1600 m²) are made of thermally modified strand woven bamboo decking (Bamboo X-treme) with head side tongue and groove. It is installed using clips with the flat side of the boards facing up, which results in a very clean look.

Photos
Danielle Kaehr



6.3 Interior



6.3.1

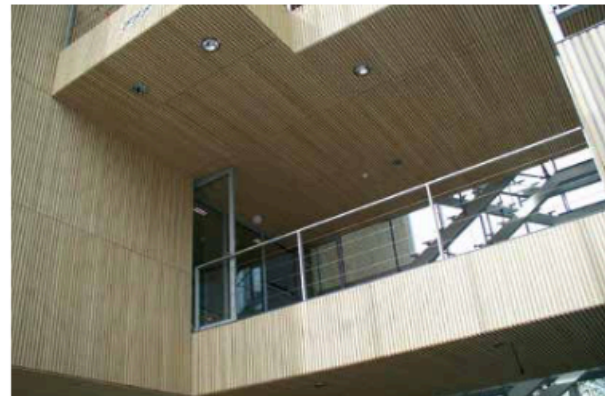
Project
Rijkswaterstaat
(Directorate General for
Public Works)

Location
Middelburg, the Netherlands

Architect
Paul de Ruiter

This project designed by Paul de Ruiter architects, an architectural firm well known for its green buildings, is recognized for its energy efficiency, its use of sustainable materials as well as the flexibility of the building itself. Whereas the facade and building structure feature many technical materials such as glass, steel and concrete, the laminated bamboo beams on the walls and ceilings of the central staircase hall provide a nice warm contrast.

Photos
Rob 't Hart



6.3.6

Project
Ripple Hotel

Location
Hangzhou, China

Architect
X+Living

Completed in just seven months, the architectural style of this hotel is contemporary and simple, with a pure and clean base as the starting point. The white floors and the whitewash walls bring out an intriguing dialogue between interior and exterior. The hotel integrates local materials, textures and fabrics into its architecture by only using the renewable materials wood and bamboo. The suspended woven canopy is made of locally produced thin bamboo stems through which light casts shadows on the white walls behind.

Photos
Hu Yi-Jie



6.3.7

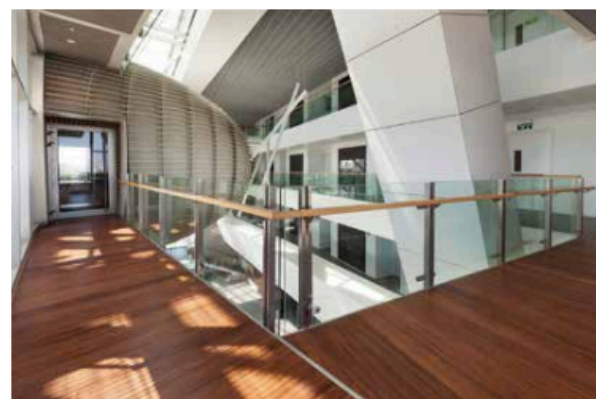
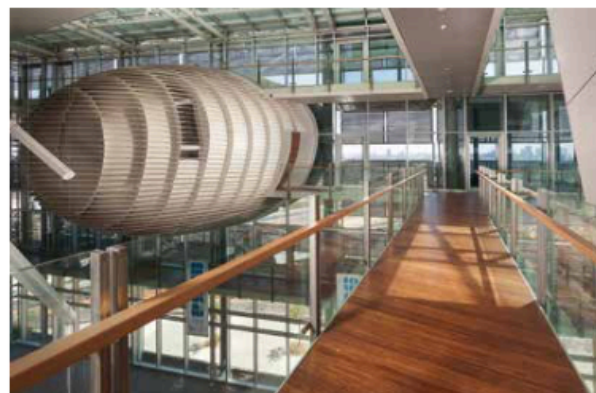
Project
Tel Aviv University
(PSES building)

Location
Tel Aviv, Israel

Architect
Geotectura & Axelrod
Grobman Architects
NC Architects
Braudo-Maoz Landscape
Architecture

As introduced on page 156, the Porter School of Environmental Studies (PSES) was the first truly 'green' building on the campus of Tel Aviv University. Inside and outside the building, several different bamboo materials were applied (see page 156 for exterior applications). Most noteworthy is the captivating 'capsule' conference room completely covered with bamboo and outfitted with bamboo furniture. In the hallways, strand woven bamboo flooring (high density caramel) and bamboo wall coverings were extensively applied.

Photos
Elad Gonen



6.4 Furniture



6.4.1

Product Bamboo Chair

Designer
**Tejo Remy &
René Veenhuizen**

Dutch designers Tejo Remy and René Veenhuizen wanted to plait laminated bamboo slabs similarly to traditional plaiting or weaving techniques with bamboo strips and slivers, as often applied in Asia. The lightness of the material is expressed in the design and full use is made of its flexibility. Laminated bamboo slabs with a width of 14 cm and a thickness of 10 mm were bent into semi-circles to form the basis of the product. This Dutch Design chair resembles a tub chair, reminiscent of deck-chairs on a passenger ship, and combines sitting-comfort with an aesthetically unique character.

Photos
Stan Koolen



6.4.2

Product Infinity Bench

Designer
**Thomas Huang &
Andrew Williams**

This bench explores the possibilities of creating structures based on bamboo strips. Using a similar method of construction as used in canoe building (see page 198), the designers were interested to see if the bamboo strips were mechanically strong enough to be implemented in a small structural application. The Infinity Bench was originally designed to be used as public seating in the lobby of a museum or gallery.

Photos
Thomas Huang &
Andrew Williams



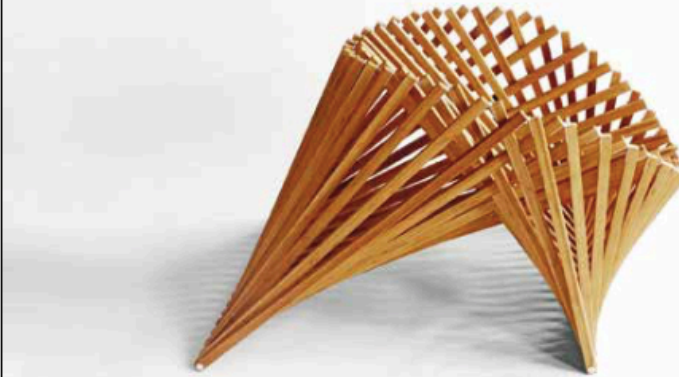
6.4.3

Product Rising Chair

Designer
Robert van Embricqs

Robert van Embricqs is fascinated by the aesthetically pleasing yet intricate complexity of forms found in nature. The foundation of any chair is the flat surface you will eventually sit down on. Using this notion as a starting point, he made several cuts in the flat surface of laminated caramel bamboo panels and pulled up the different beam-like strands of the cut surface. This created the preliminary but already distinct features of any chair: back, seat and legs. The rhythm of the bamboo beams gives the chair an organic shape.

Photos
Goran Turnsek



6.5 Sports and Mobility



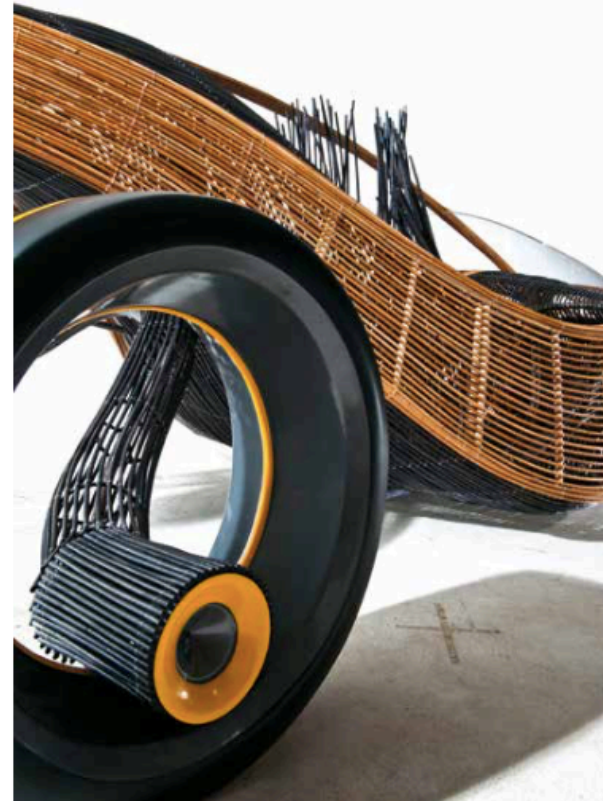
6.5.1

Product
Phoenix Concept Car

Designer
**Kenneth Cobonpue &
Albrecht Birkner**

This project attempts to unveil the future of green vehicles using woven skins from organic fibers combined with composite materials and powered by green technology. The designers wanted to create a lightweight yet economically viable concept car largely made of bamboo and rattan. The concept car was constructed entirely by hand by a team of skilled weavers and craftsmen in only 10 days. Phoenix is inspired by forms and structures found in nature. Utilizing a single spine as found in vertebrae and plants, the concept car uses an exterior structure similar to that of a leaf. The interior is formed by a single woven surface that starts at the front and incorporates the dashboard, floor and seats. The flowing exterior weaving meets the interior lines in a single bundle at the back.

Photos
**Kenneth Cobonpue &
Albrecht Birkner**



6.5.2

Product

Bamboo Longboard

Designer

Bamboo Skateboards

Bamboo Skateboards wanted to get away from using a traditional material such as maple to produce an innovative skateboard. Bamboo is an ideal material for skateboards from a sustainability point of view but also because of its flexibility. The company produces pre-assembled skateboards made from various layers of laminated bamboo sheets. For the experts among us: the bamboo longboards include drop-throughs, pintails, double-kicks, square tails and mini cruisers.

Photos

Bamboo Skateboards



6.5.3

Product

HERObike

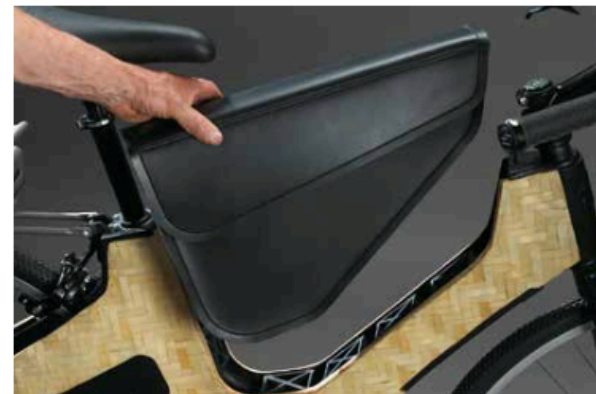
Designer

Lance Rake

Woven Tube Bamboo is a composite material that combines woven bamboo and carbon fiber. Most bamboo bicycles make use of the bamboo stem for the frame, but industrial designer Lance Rake believes this wicker weave could change bamboo bike design for the better. Bikes these days have to be both light and dynamically rigid. With this in mind, Rake developed a laminated woven bamboo tube that offers many of the appealing strengths of carbon fiber with added resilience and a more resource-conscious footprint. Compared to common bamboo bike tubing it has a much thinner wall.

Photos

Bruce Wagman



6.5.4

Product **Bamboo Boat**

Designer
Marcel La Fond

Based in Minnesota, Marcel la Fond of Symphony Boat manufactures electric boats. For this boat he used several panels made from laminated bamboo sheets. As far as the designer knows, this is one of the first instances of bamboo being used for constructing the hull of a marine vehicle. The interior, siding, trimming and doors were made from the same bamboo panels, which are recommended to be finished with lacquer to maintain aesthetics and further increase durability.

Photos
Symphony Boat



6.5.5

Product **Bamboo Ski Helmet**

Designer
Bogner

Because of the specific characteristics of bamboo, in particular its hardness, flexibility and durability, it is very suitable for use in the construction of a ski helmet. Impact tests with sharp objects produced a surprising result: the shell crafted from bamboo was more resistant to puncture than high-tech carbon.

Photos
Bogner



6.6 Product



6.6.1

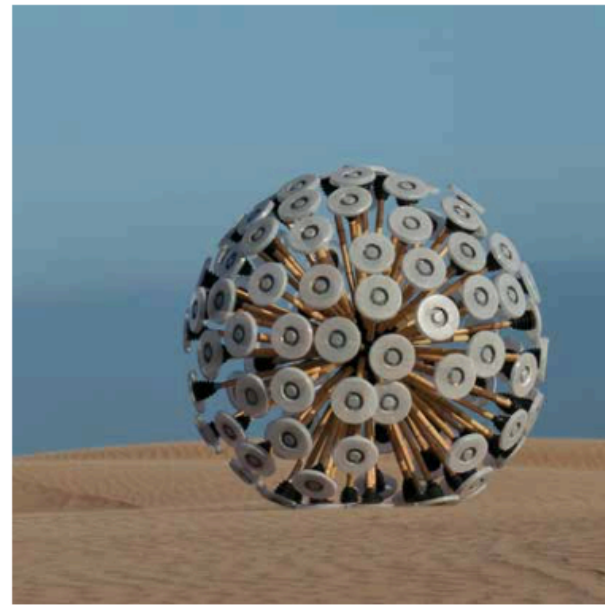
Product
**Mine Kafon Wind-powered
Minesweeper**

Designer
Massoud Hassani

The Mine Kafon Minesweeper is designed to be blown around in the wind, detonating landmines in its path. Each device has a GPS tracking device linked to a website to show which areas have been cleared. Made of 70 bamboo legs, a metal sphere and biodegradable plastic 'feet', each mine-sweeper is relatively cheap to produce and can withstand the impact of up to 4 bombs before being too damaged for further use.

Massoud Hassani grew up in Afghanistan. As a child he would take small toys out into the hills to play with, but as the wind picked them up, they rolled faster than he could run. Eventually he would have to let the wind take his toys, because the land was covered in millions of land mines. Some children would attempt to get their toys back, often with fatal consequences.

Photos
Massoud Hassani



6.6.2

Product Bulb Lamp

Designer
**Studio Chris Kabel with
Blendix Design & PACC**

A tiny LED light source illuminates a braided basket made out of waver-thin translucent bamboo strips, offering a light alternative to the traditional light bulb. The bamboo bulb (prototype) is a result of the project 'The World of Bamboo', a collaboration between Dutch product designers and Chinese bamboo craft masters. The project aims to develop new products with innovative designs based on traditional techniques such as weaving and braiding.

Photos

Studio Chris Kabel



6.6.3

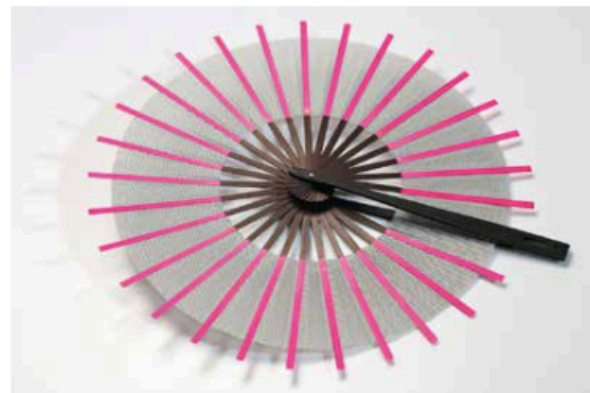
Product Bamboo Hand Fan

Designer
**Lama Concept with
Blendix Design & PACC**

These hand fans are the result of a user research of the movements that are made when opening and closing a hand fan in combination with the tiny bamboo strips the fan is made of. Traditionally, a fan consist of identical strips, but what happens when the strips are differently shaped or colored? The movement of opening and closing the fan inspires either more complex or simpler folding techniques. It was also investigated to what extent the wind cooling functionality remained intact when holes were carved in the fan blades.

Photos

Zhu Ye



6.6.4

Product
Ethiq Guitar

Designer
Jean Yves Alquier

The Ethiq guitar series focuses on the novel use of bamboo for building a guitar. The body of the guitar consists of several panels of laminated bamboo that were sculpted to give the body its shape. Also many of the other guitar elements, such as neck, fretboard and pickup covers, are made of bamboo, resulting in a musical instrument that consists for 65-100% of bamboo.

Photos
Jean Yves Alquier &
Mohamed Karbouch



6.6.5

Product
ChopValue

Location
Vancouver, Canada

Designer
ChopValue / Felix Böck

This start-up based in Vancouver, founded by German engineer Felix Böck, puts bamboo upcycling into practice. Because of the large Asian community in Vancouver, over 100,000 disposable bamboo chopsticks are thrown away and sent to a landfill every day. ChopValue gives these chopsticks a high value-added second life by collecting them, cleaning them and pressing them into beautiful laminated bamboo beams and tiles, to be used for many items, including wall tiles and yoga blocks. The most interesting part is the replicable character of the business model: any city with a decent amount of Asian restaurants can be a suitable starting place for another ChopValue (like) franchise.

Photos
Joleen Sandvar

6.6.8

Product 3D Print Bamboo Filament

Designer
Colorfabb & Bambooder

3D printing is rapidly gaining popularity, also among private consumers through desktop 3D printers. Yet there are concerns regarding the environmental impact of the materials used to 3D print. Colorfabb investigated several composite materials for their suitability for 3D printing at home, including sustainable alternatives such as bamboo as filler with bio-plastic (PLA) as resin. The bamboo filaments come in thicknesses of 2-3 mm and have a processing temperature of 195~230 °C. What makes this bamboo filament, produced by the company Bambooder, special is its composition (80% PLA and 20% bamboo fiber) and its availability on a spool. In this case, a small vase was 3D printed with the bamboo/PLA combination.

Photos
Materia



6.6.9

Product Bamboo Packaging

Designer
Dell

Regular paper/cardboard and plastic may be the most common packaging options, but they are not the only ones. Dell has pioneered the use of bamboo-based cardboard to protect certain devices and cushion some of its lightweight products. The bamboo used for this packaging material is grown close to the facilities that manufacture the products, which should further reduce the packaging-related carbon footprint. According to Dell, the bamboo packaging is easy to recycle and should even be compostable following ASTM standards.

Photos
Dell



6.6.10

Product

Layers Bamboo Lamp

Designer

Daphna Laurens

This is a lamp with three different layers of shapes made from woven bamboo slivers, produced in Vietnam by a company specialized in bamboo weaving. Different weaving techniques are combined in one lamp. These kinds of high value-added product developments can help stimulate the local Vietnamese craftsmanship industry, potentially creating jobs for thousands of people in the highlands of Vietnam.

Photos

Daphna Laurens



6.6.11

Product

Grain Bamboo Composite Lamp

Designer

Jens Fager for Muuto

The Grain lamp takes its name from a new composite material that blends bamboo fibers with polypropylene, while allowing the natural color and textures to remain visible. The result is a matted surface that pairs the smoothness of plastic with the fibers of bamboo. Flecks of bamboo grain can be seen across the shade, which lends subtle color variations and effects to the light.

Photos

Muuto



6.6.12

Product **Begin Bamboo Stool**

Designer **Cheng-Tsung Feng**

Cheng-Tsung Feng adopts traditional techniques, contemporary designs and modern treatments for his innovative bamboo art and furniture. It is bamboo's strength, flexibility and versatility that inspires him to give his furniture a new meaning. Trained by experienced craftsmen, he has hand-crafted several works in bamboo himself. He exploits the lumber weaving technique and employed a hexagonal cavity structure for this stool, which stands on pointed legs.

Photos Cheng-Tsung Feng



6.6.13

Product **Circle Bamboo Mirror**

Designer **Cheng-Tsung Feng**

With this mirror, Taiwanese designer Cheng-Tsung Feng reveals how traditional bamboo craftsmanship can be transformed into modern design. Circle is a hand-made and self-standing mirror that uses the Moso bamboo species for its whole structure. The tube acts as the bottom support and two strips of the same material surround and hold the mirror. The joint space in the bamboo can be used to keep small pieces of jewelry in.

Photos Cheng-Tsung Feng



6.6.14

Product Bamboo Hair Dryers

Designer
Samy Rio

This range of hair dryers is unique in the use of bamboo for this particular application. A short section of the bamboo stem is taken as exterior shell, with the rings of the bamboo still clearly visible and fixated on an elastomer base. The bamboo exterior shell is then sanded and depending on the edition is color-finished or kept in its natural color.

Photos
Samy Rio



6.6.15

Product Bamboo Glasses

Designer
Roots

Instead of making glasses from regular, colored, industrially processed bamboo veneer, as is done with most bamboo glasses, this designer has taken the irregularities and individual peculiarities of the bamboo stem as point of departure for the design. This results in unique designs, where dark spots, curved parts and even natural malformations give extra character to each individual pair of glasses. Roots uses various Japanese bamboo species from Kyoto for its designs.

Photos
Roots



Pablo van der Lugt

Booming Bamboo

The (re)discovery of a sustainable material
with endless possibilities

Materia



**MATERIAL
DISTRICT.
TALKS**



WBCMEXICO