



Bausteine für eine ökologische Bauwende

**nachhaltige Architektur der
Zukunft- Biomaterialien &
Digitalisierung**

Jun. Prof. Dr.-Ing. M.Eng. Arch. Hanaa Dahy

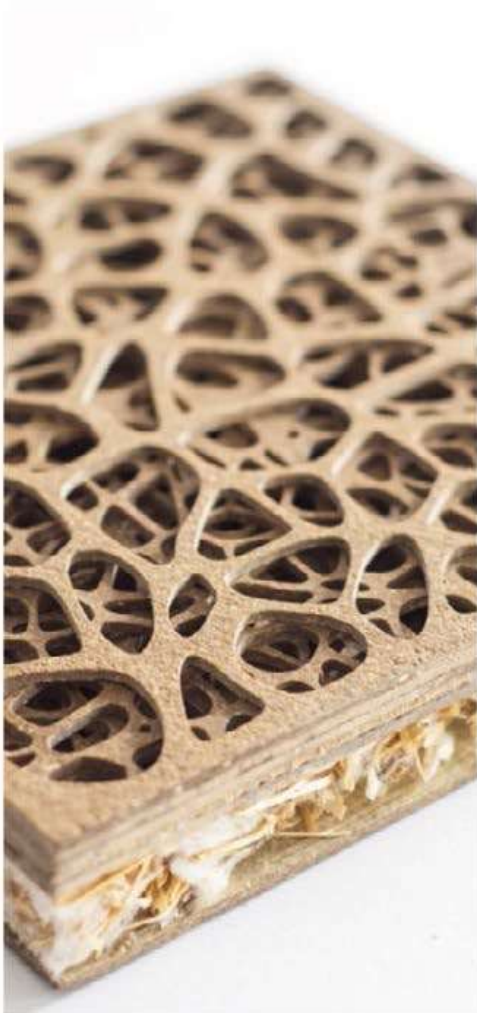
www.hanaadahy.com

BioMat.



Facade Panels

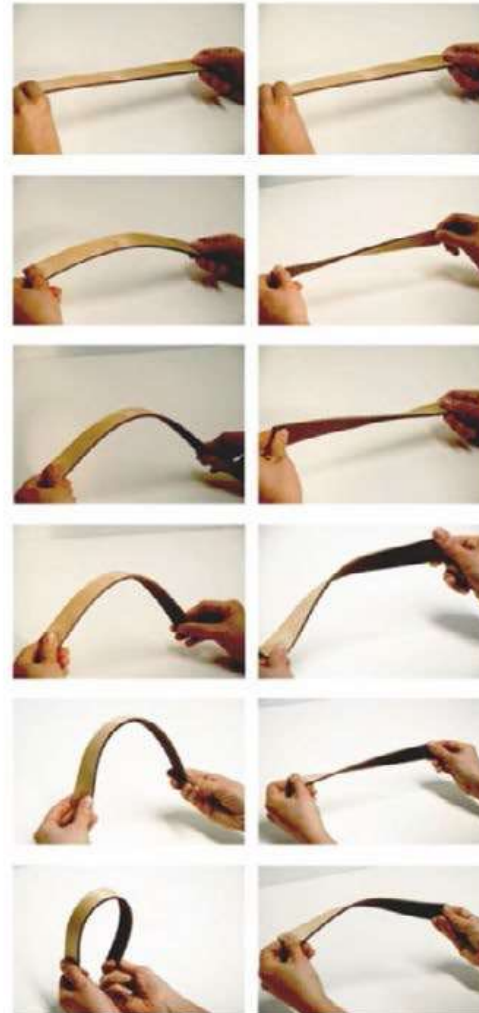




Biomaterials



Biomimetics



Smart Materials



Design & Fabrication

Sustainable Architecture ... 'Materials as a Design Tool'

Effect of Buildings on the Environment

> 60% of global resources consumption

> 50% of global waste production

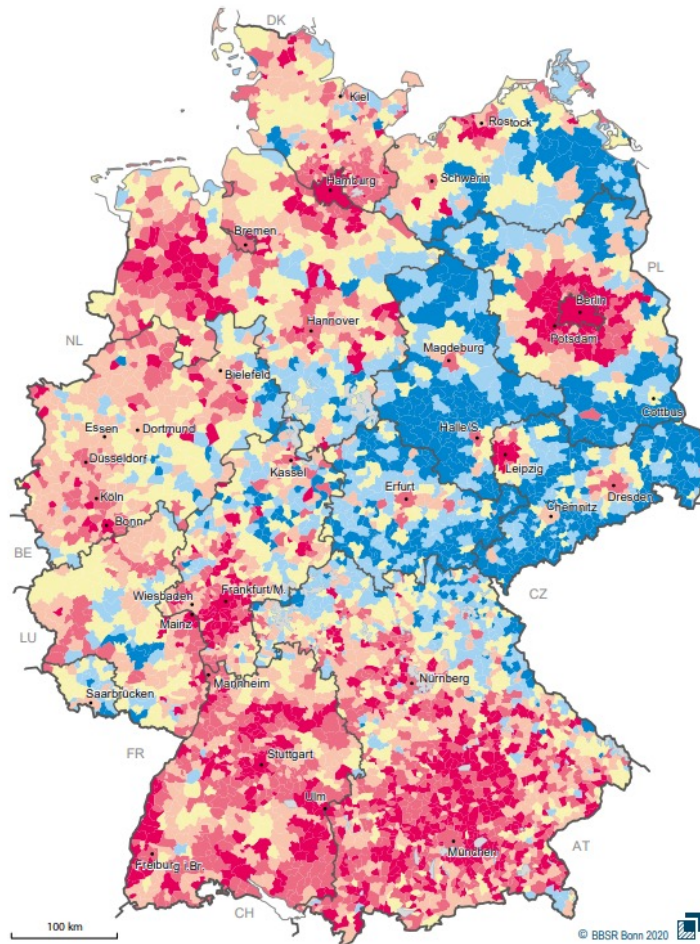
> 35% of global energy consumption

> 35% of global CO2 emissions

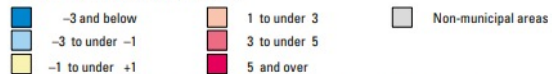
Germany's situation - FACTS

Map 1

Population development 2013 to 2018



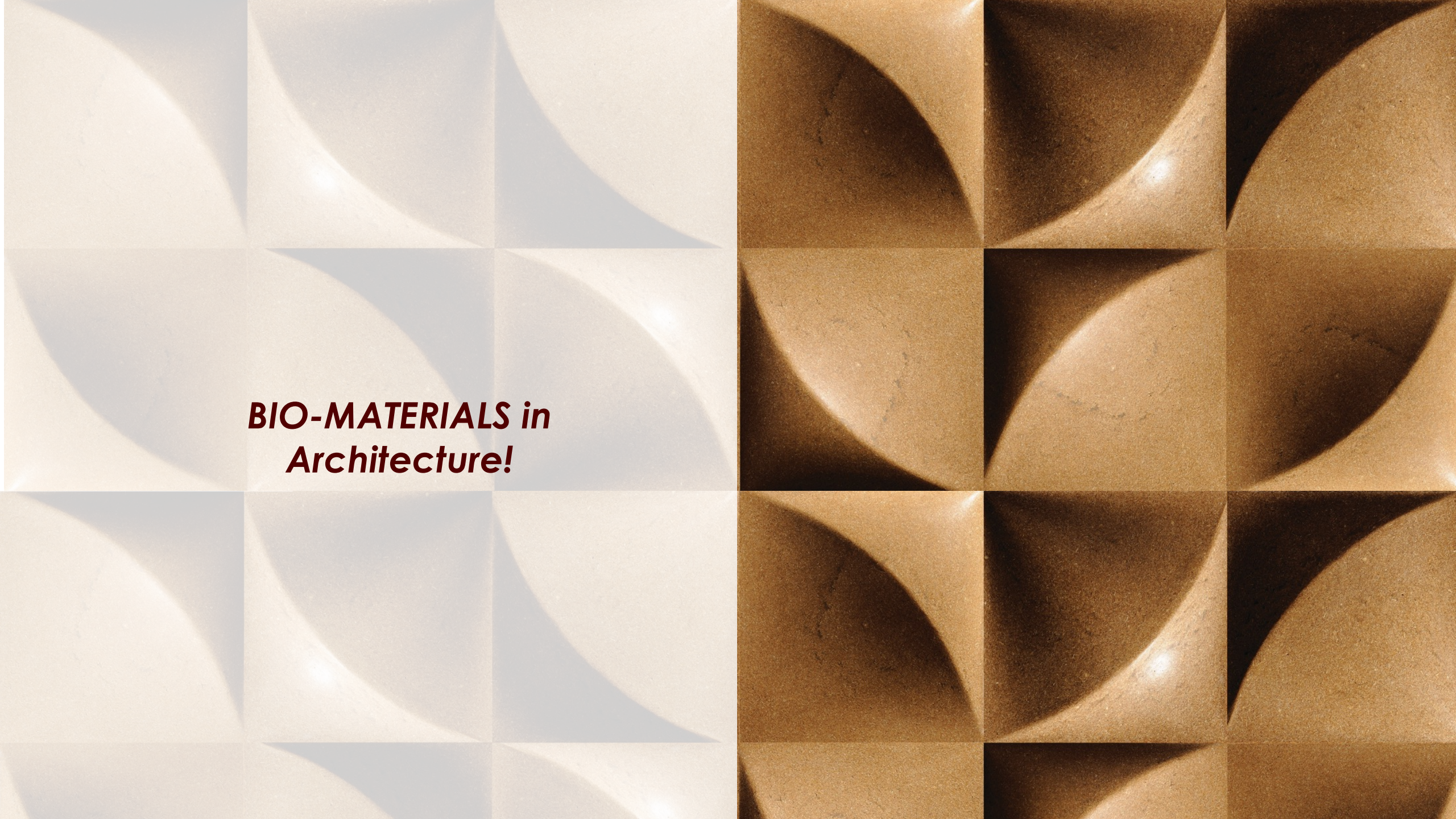
Population development 2013 to 2018 in %



Source of data: BBSR housing market monitoring, Update of the Federal and State Population Statistics Geometric basis: Municipal associations, 31.12.2018 © GeoBasis-DE/BKG
Processing: J. Nielsen

- *400 K new buildings are required per year*
- *Prices of housing have risen sharply in growing regions*
- *Continuous increase in housing demand*
- *In 2019, 293 k homes were built in Germany ca. 85 % more than in 2009*

>> More resources consumption & more CO2 emissions



***BIO-MATERIALS in
Architecture!***

Worley-Idaho – USA. Photo credit: Jessica Caplan



China's Guizhou province. Photo credit: (china.org.cn)



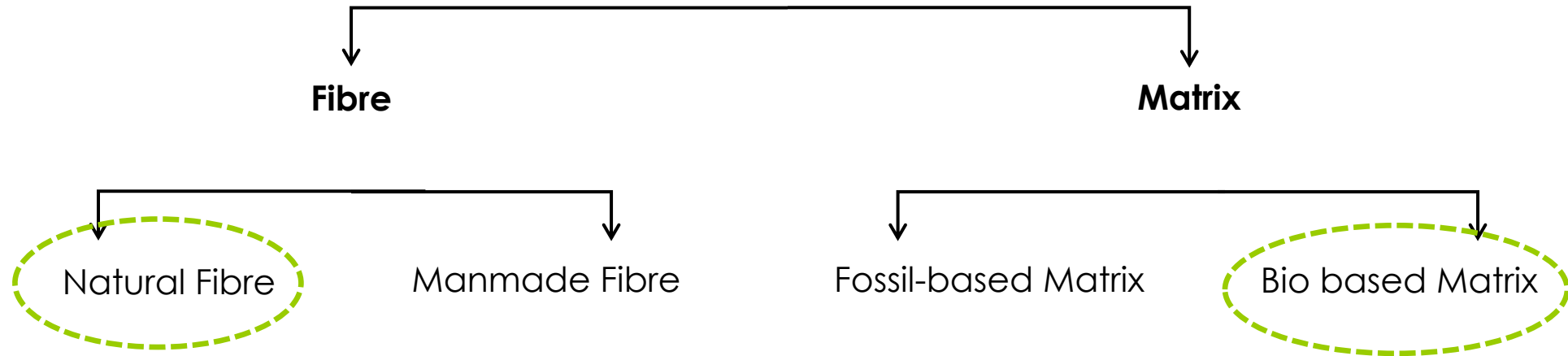
Sueca (Valencia)-Spain. Photo credit: Wong, A.- Arbokem Inc., 2011



Chile- South America. Photo credit: Matt, 2012

Biocomposites

Fiber Reinforced Composites with min. 1 bio-component



Green Biocomposites = Green Natural fibre reinforced composites (green NFRC)



BIOFLEXI[®]

Registered Market Name since June 2019

PATENT:

Titel: Flexible high-density fiberboard and method for manufacturing the same
DE: Flexible hochverdichtete Faserplatten und deren Methoden der Herstellung

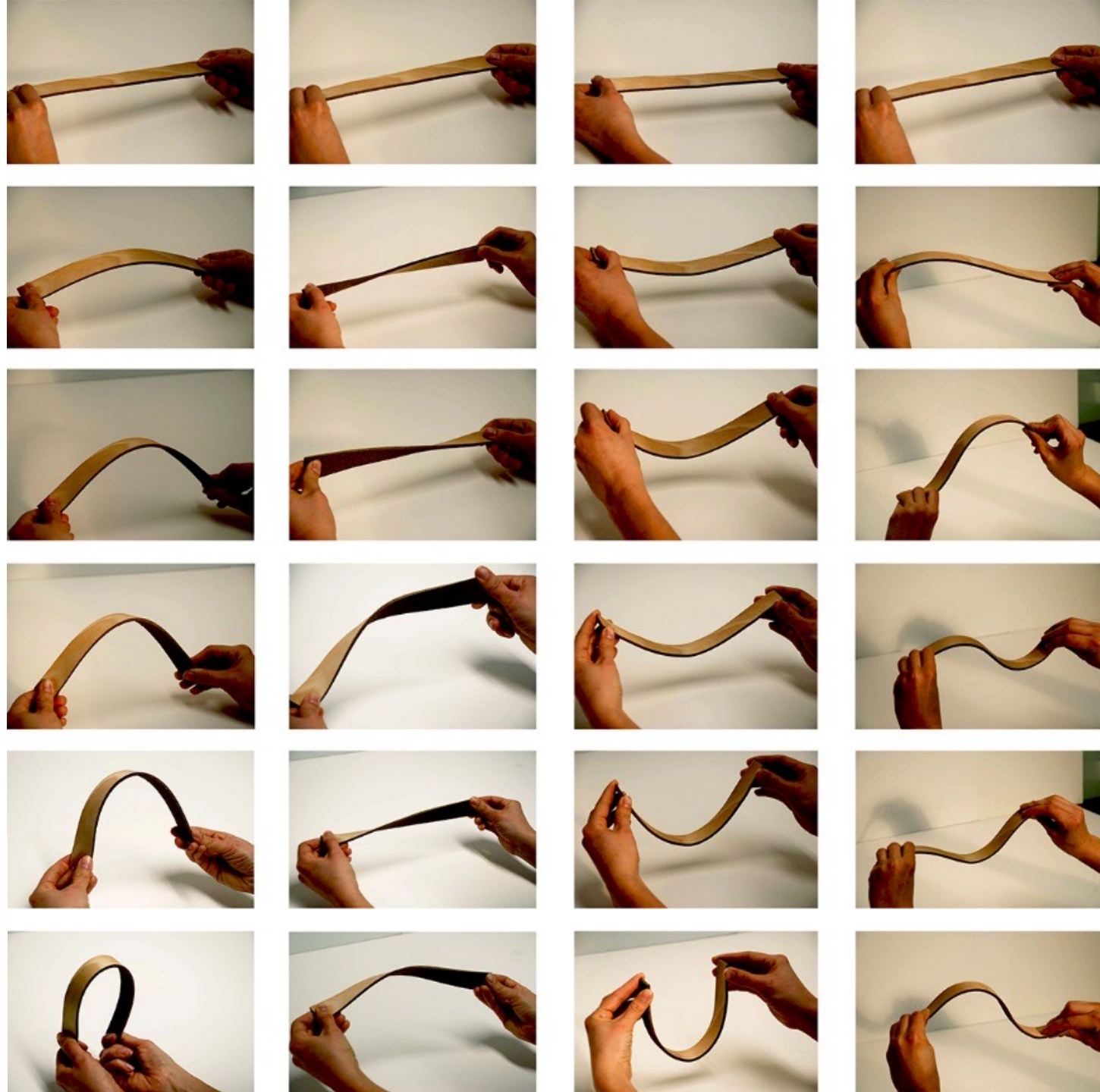
Development of a HDF fibreboard with elastic binders- with high NF contents 80-90%

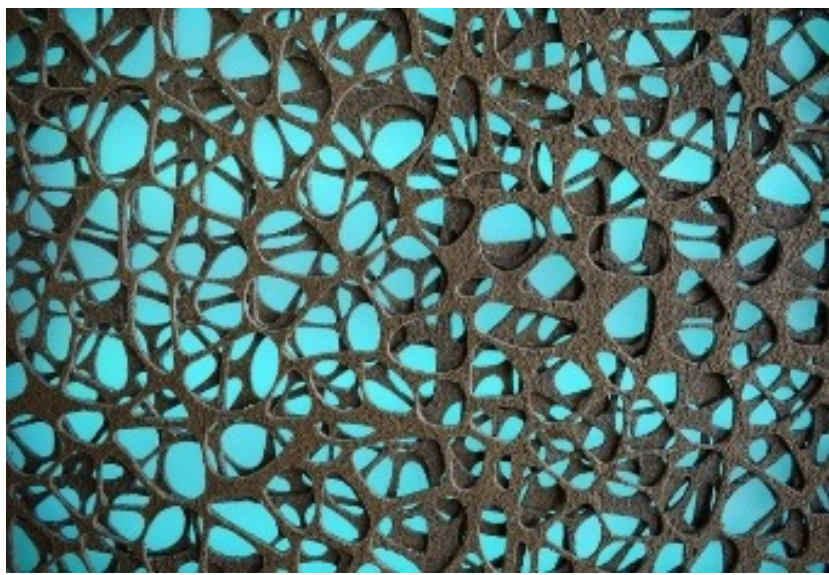
European Patent - (No. EP 14 002 343.3), registered and published in 2018 as: EP 2 965882 B1, EP2965882 A1

International Patent - (WO2016005026A1)- Amerikanisch US20170144327



materialPREIS2016
1. Auszeichnung Studie





Contours, haptics and translucency

Organic and ornamental designs

Geometry profiles and colours



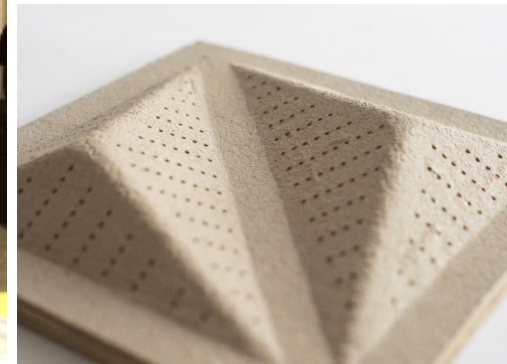
PLUS Partner. PLUS project (sandwich elements made of agricultural residues with integrated sound absorption and heat insulation functions)

2015-2018

Fabrication: laser cutting and vacuum thermoforming



Fabrication: CNC milling and thermoforming



Sustainable constructions through biocomposites and digital fabrication technologies



BioMat Biocomposite Pavilion 2018



Active-bending LightPRO Biocomposite Shell Structure, 2021



Active-bending LightPRO Biocomposite Shell Structure, 2021




BioMat Biocomposite Pavilion 2018



Tailored Biocomposite Mock-up 2019



Minimal Surface; Modular Biocomposite Structure, 2020

An aerial photograph of a modern pavilion. The pavilion's facade is a complex, three-dimensional lattice structure made of light-colored wood and biocomposites, creating a series of interconnected, irregular shapes. The structure is supported by several thin, dark metal legs. The pavilion is situated on a paved area with a decorative pattern of large, light-colored, organic shapes. The pavilion casts a long, dark shadow onto the ground, mirroring its intricate lattice structure. In the background, there is a patch of green grass and a paved walkway.

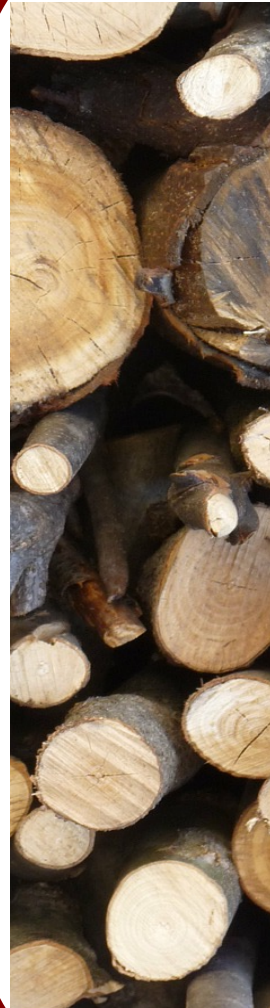
FLEXIBLE FORMS
Wood & Biocomposites PAVILION

Materials/Biocomposites

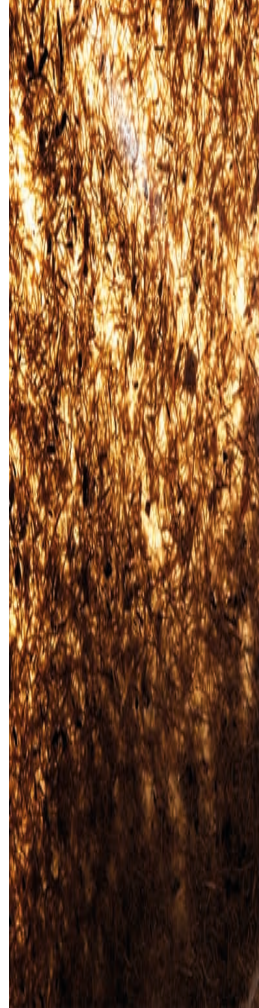
Masonry



Wood



BIO-Composites



Composites in
automotives: 1947

Shell Structures

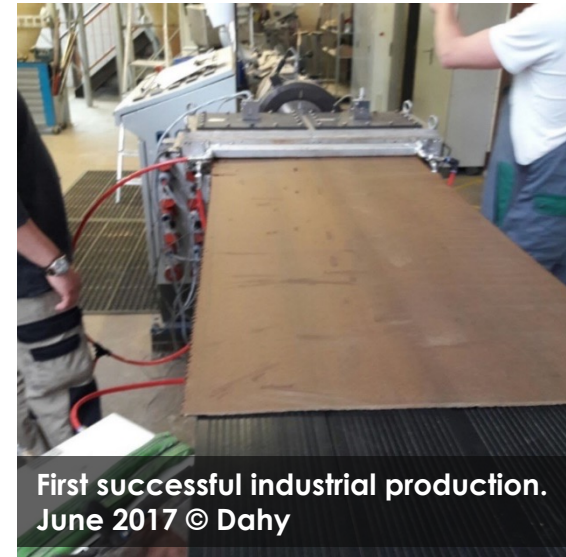
Shell Structures





Bioprofile Partners. Bioprofile project (extruded and co-extruded profiles from plant residues-based fibre reinforced bioplastics for windows and other architectural applications).

2017-2020



First successful industrial production.
June 2017 © Dahy



Fabrication of alternative free-form architecture components



Kath

P



materialPREIS 2019
Anerkennung Studie & Vision



TAILORED Biocomposite CANOPY_BioMat 2019

Tailored BioComposite CANOPY (BioMat 2019)



FAB
RICA
TE

UCLPRESS
JANE BURRY / JENNY SABIN / BOB SHEIL / MARILENA SKAVARA

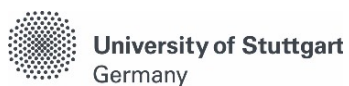
Tailored BioComposite CANOPY (BioMat 2019)

1 Semester LP1-9 except LP4! (no building permit was necessary!) – Other process in the planning and execution of building constructions



Flax plant (annual renewable resource)

Made by:

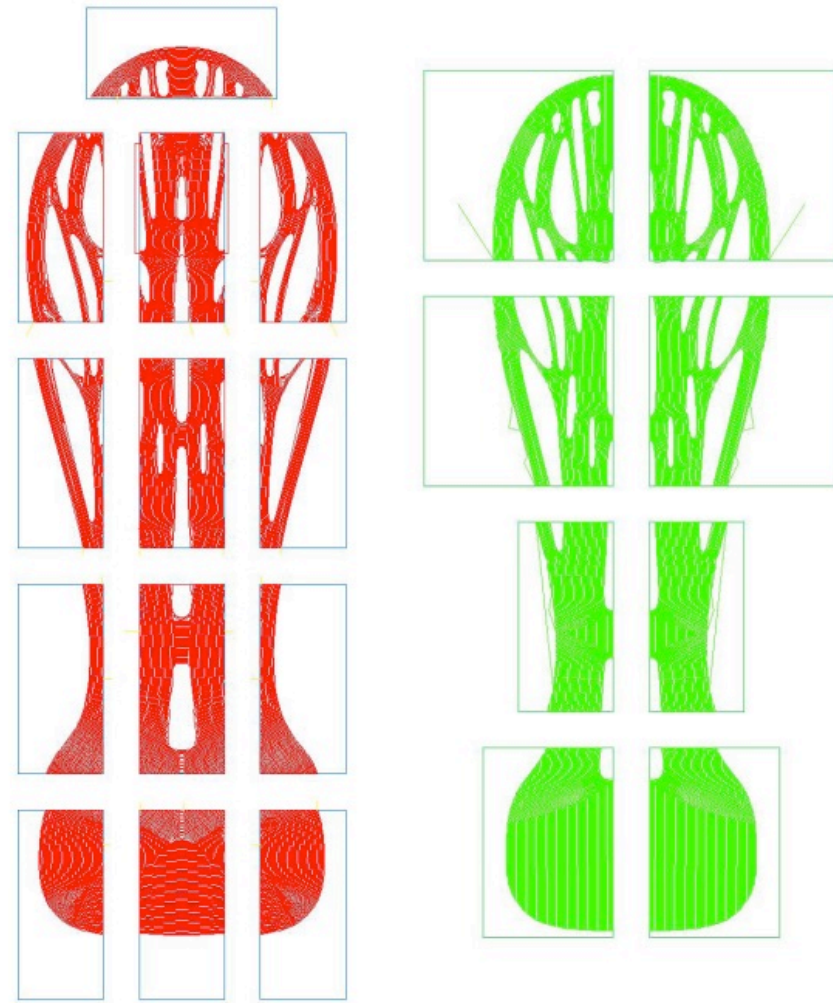


In Cooperation with:





Fibre Placement- IFB



Fabrication time: 2 days, Curing: 28-40 h
1- TFP, 2- Impregnation, 3- Moulding

Size:

1,5 x 2,3 x 2 m

Weight:

35 Kg

Amounts and Types of flax applied:

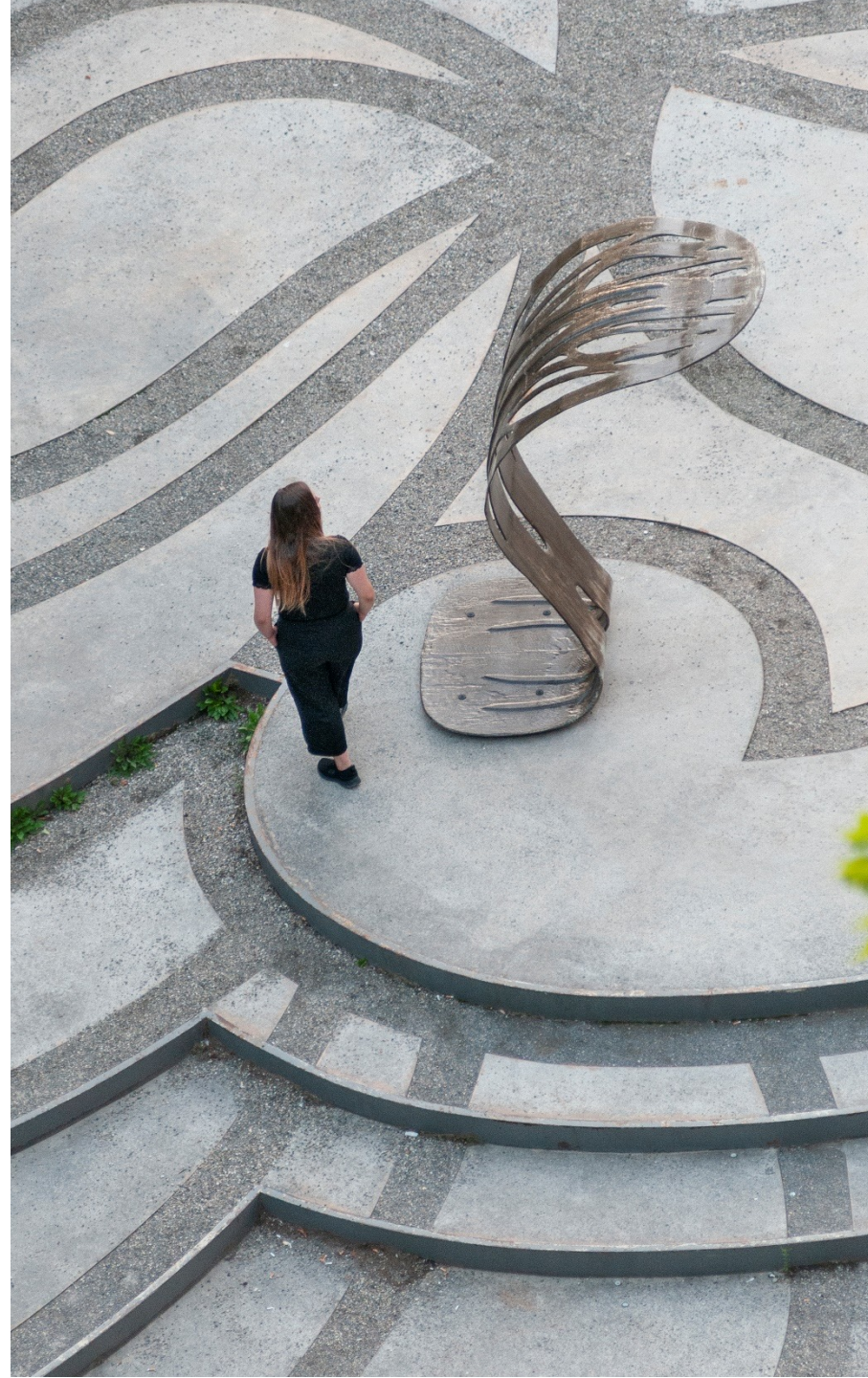
5 yarns of:

Flax rovings for TFP (Tailored Fibre Placement) non-twisted, (2400 Tex)

+

1 yarn of:

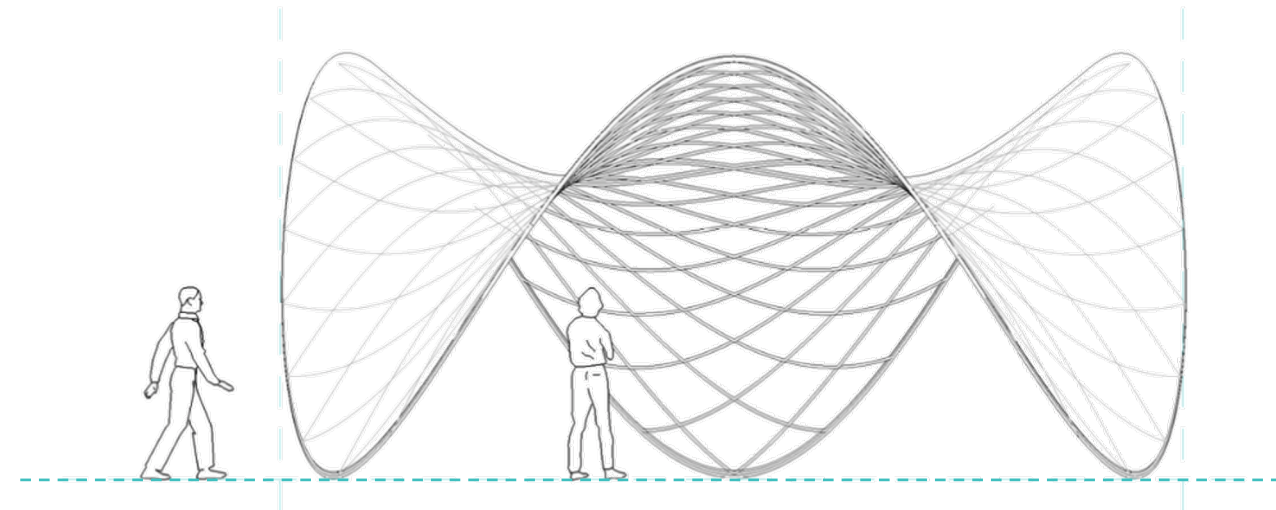
flax tapes, (60 cm wide)



FNR Förderprogramm Nachwachsende Rohstoffe

Titel: Pultrudierte tragende Leichtbauprofile aus Naturfaserverbundstoffen

Akronym: LeichtPRO



LeichtPRO



First pultruded profiles





S78 ES

580

mateco

0800 20 11 600
free

mateco











Sustainable constructions through biocomposites and digital fabrication technologies



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Active-bending LightPRO Biocomposite Shell Structure, 2021



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Tailored Biocomposite Mock-up 2019

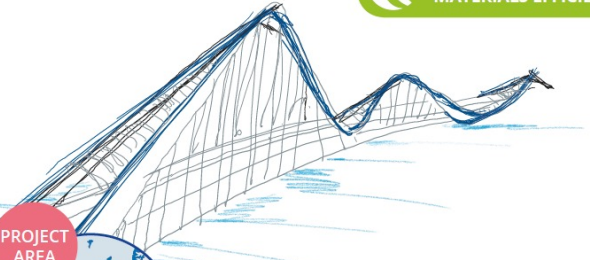


Minimal Surface; Modular Biocomposite Structure, 2020


Interreg Project (Bridges out of Biocomposites) – EU Project (Germany, Netherlands, Belgium, France) 2020-2023 (3 Bridges)

Interreg 
EUROPEAN UNION
North-West Europe
Smart Circular Bridge
European Regional Development Fund

THEMATIC PRIORITY:
 **RESOURCE AND MATERIALS EFFICIENT**



PROJECT AREA



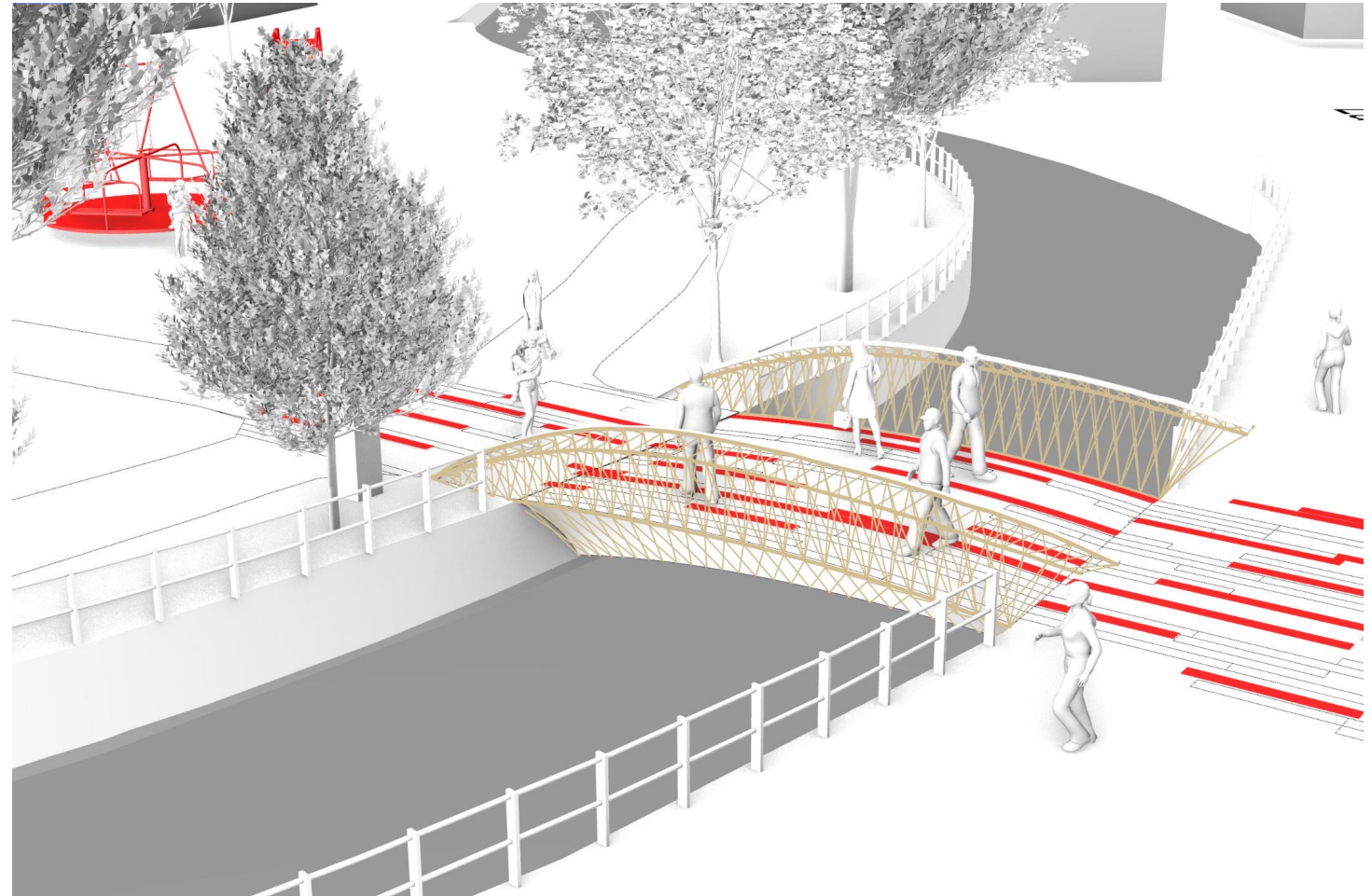
Project objectives: Promoting circular infrastructure
Realisation of a smart circular pedestrian/cyclist bridge system. Preparation of market penetration.

Total budget received from Interreg North-West Europe (2019-2023):
€3.93 million of ERDF

Total project budget:
€6.86 million

www.nweurope.eu

www.nweurope.eu



Design ©Dahy

Current Project in Progress! 2020-2023 Three Biocomposite Bridges in Europe ((EU-Interreg Project):

- 2 bridges in Netherlands: in Eindhoven and in Almere (Netherlands)
- 1 bridge in Germany: in Ulm (Germany)



DANKESCHÖN!

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BioMat.