



Buildings as Material Banks

Luis Bragança (CTAC – UMinho)



Co-funded by the Horizon 2020
Framework Programme
of the European Union



BUILDINGS AS MATERIALS BANKS

BAMB - General Overview
IV Workshop ECO.NOMIA - 20 October 2017



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WHAT IS BAMB?

Developing Buildings as Material Banks, eliminating waste and establishing symbiosis in supply industries

Horizon 2020 - WASTE 1 2014 - Moving towards a circular economy through industrial symbiosis

- Starting date: 1st of September 2015
- Duration of 3,5 years
- Consortium of 15 partners from 7 EU countries



BAMB OBJECTIVES

Optimising the effective use of resources and more specifically of materials along the whole life cycle of buildings, for refurbishment as well as new construction reducing the use of virgin resources and the production of waste.

Enable a systemic shift where dynamically and flexibly designed buildings can be incorporated into a circular economy.

Important: Applicable to existing buildings, in order to have an immediate impact on the market / building sector.

BAMB STARTING POINT

Waste



Building sector:
**+/- 35 % of EU
waste**

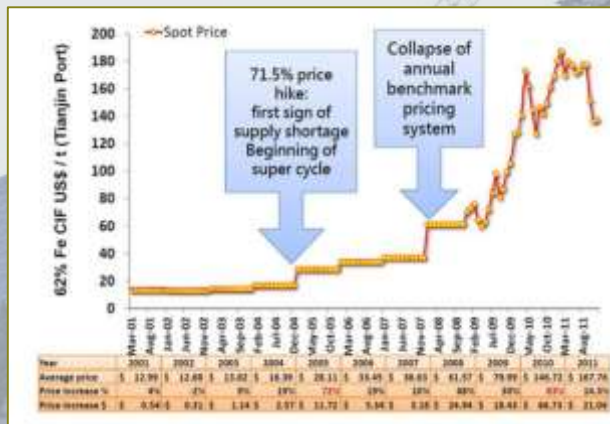
Virgin resources



Building sector:
**30 to 50% of natural resources
used in EU**

BAMB STARTING POINT

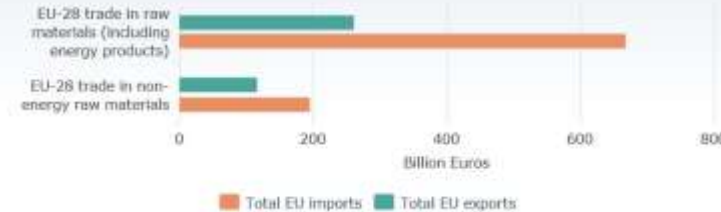
Increasing prices



Source: <http://www.mining.com/forget-gold-iron-ore-is-the-story-of-the-decade/>
Dec 2013

Resource dependence

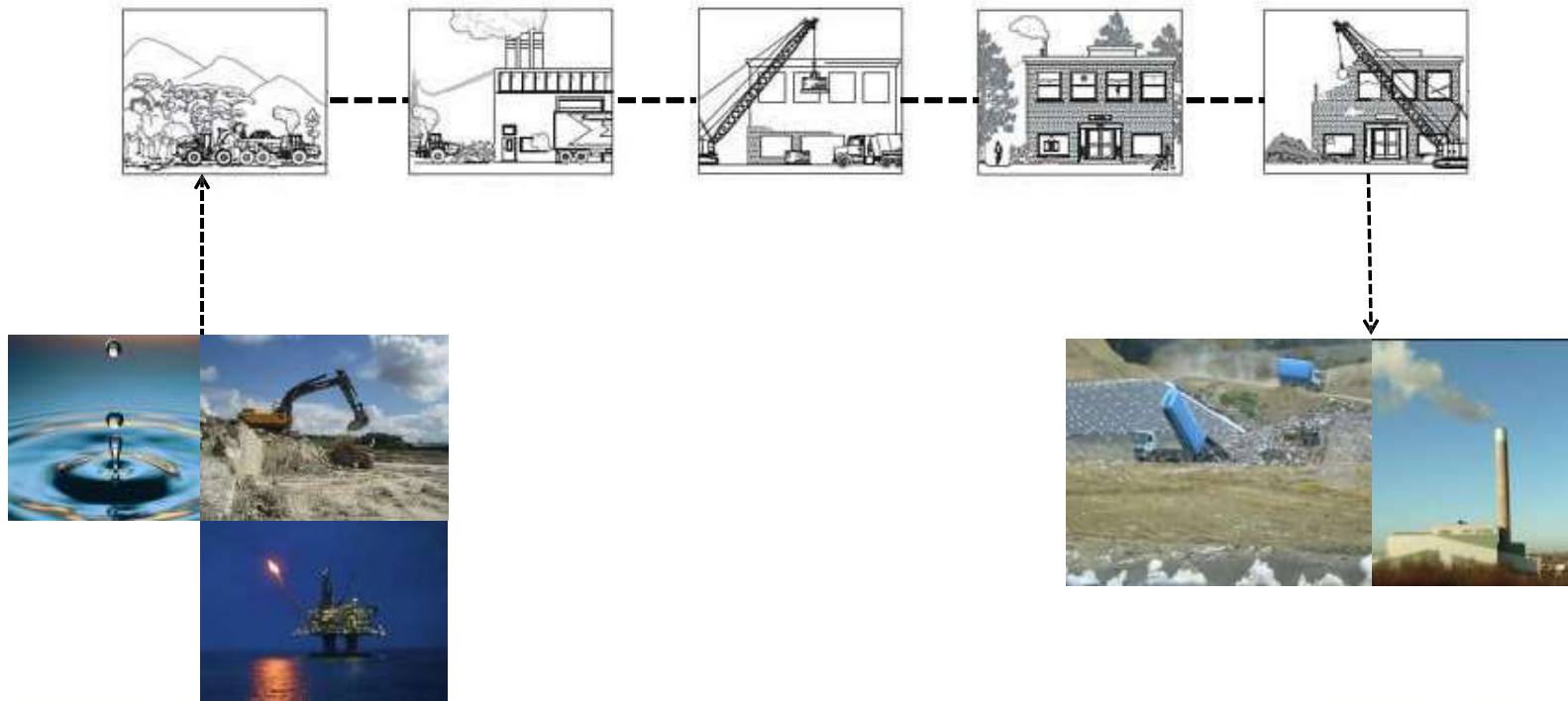
EU-Trade raw materials in figures (2011)



Source: ec.europa.eu/trade/policy/accessing-markets/goods-and-services/raw-materials/index_en.htm
Dec 2013

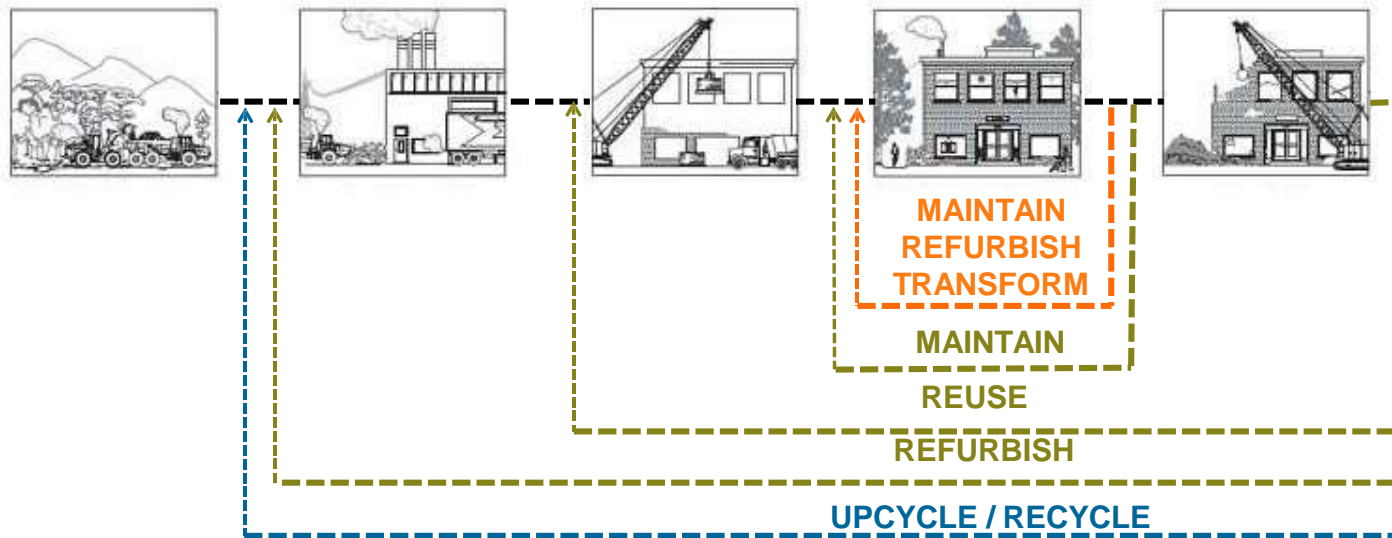
BAMB OBJECTIVES

FROM A LINEAR AND STATIC BUILT ENVIRONMENT ☞



BAMB OBJECTIVES

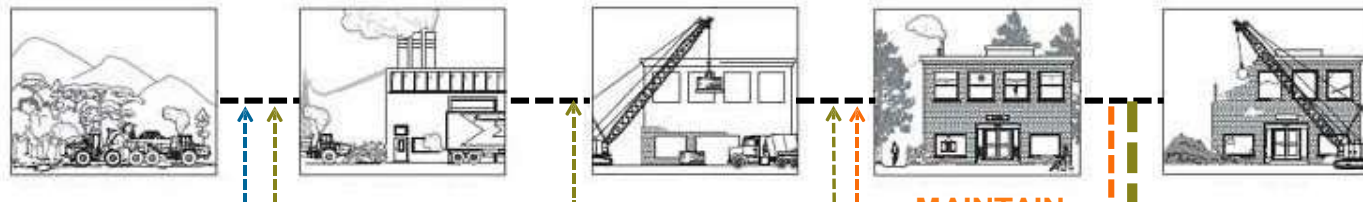
... TO A CIRCULAR AND DYNAMIC BUILT ENVIRONMENT



- **BUILDINGS**
- **BUILDING PRODUCTS & SYSTEMS**
- **MATERIALS**

BAMB OBJECTIVES

... TO A CIRCULAR AND DYNAMIC BUILT ENVIRONMENT



- Developing a sustainable life cycle management of materials, products and buildings, eliminating waste and reducing the use of virgin resources
- Reducing costs by managing resources rather than managing waste
- Preserving the buildings, its components and materials' residual value so that manufacturers and owners will be able to make money out of their "waste" by high quality reuse and recycling strategies

MAINTAIN
REFURBISH
REUSE

MAINTAIN
REUSE

REFURBISH

UPCYCLE / RECYCLE

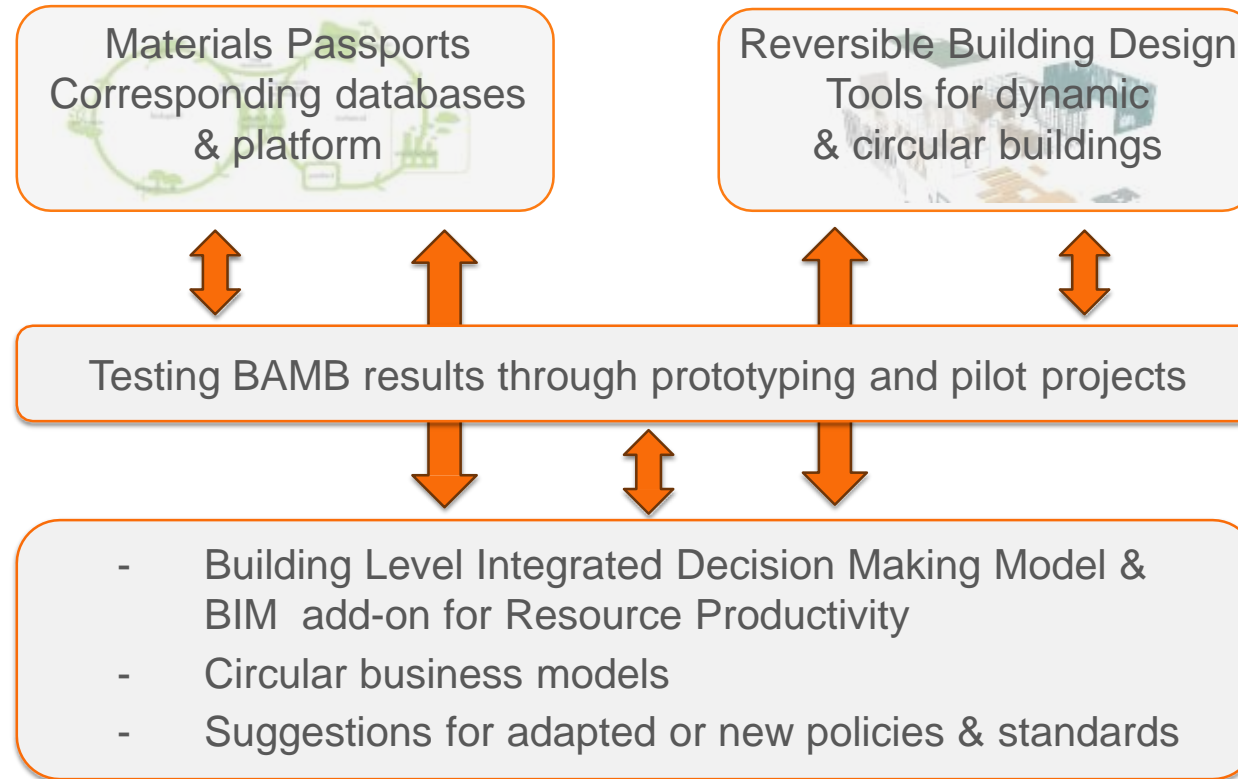
BAMB KEY DELIVERABLES

PU - Public deliverables are
available in the library section of
BAMB webpage:

www.bamb2020.eu

Deliverables	Deliverable name	Dissemination level	Status
D1	Description of key barriers and opportunities for Materials Passports and Reversible Building Design in the current system	PU	Done
D2	Blueprint of desired system configurations	PU/CO	Done
D3	Monitoring Report on Lessons Learned and Best Practices + Adjusted Blueprint	PU/CO	
D4	Materials Passports User Requirements Report	CO	Done
D5	Framework for Materials Passports	CO	Done
D6	Software Platform	PU/CO	Done
D7	Operational Materials Passports	PU/CO	Ongoing
D8	Re-use potential tool	PU/CO	Ongoing
D9	Transformation capacity tool	PU/CO	Ongoing
D10	Design protocol for dynamic & circular building	PU/CO	Ongoing
D11	Reversible Building Design User Requirements Report	PU	Ongoing
D12	Feasibility study + Feedback report	PU/CO	Done
D13	Prototyping + Feedback report	PU/CO	Ongoing
D15	Building Level Integrated Decision Making Model	CO	Ongoing
D16	BIM Resource Productivity Prototype	CO	Ongoing
D17	Recommended business models	CO	Internal reviewing
D18	Recommended target operating models	CO	Ongoing
D19	Framework for regulations and standards	PU/CO	Ongoing
D20	Innovation and Exploitation Framework	CO	Ongoing

RE-THINKING THE DESIGN AND BUILDING VALUE CHAIN



REVERSIBLE BUILDING DESIGN

- Reversible design is a design strategy and approach that enables to design building that can be easily adapted, transformed and disassembled:
 - Building level
 - System level
 - Product level

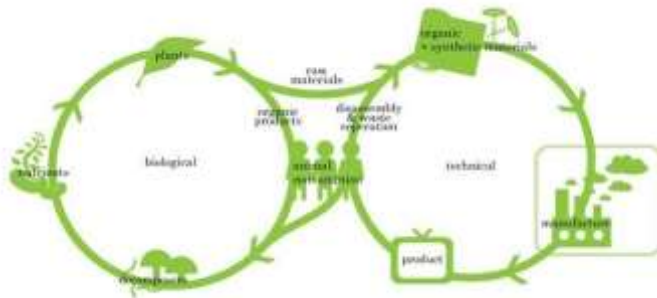


Retrofit Lab – transformation scenario's

Increase flexibility, quality of use, comfort, ease of maintenance and refurbishment

BAMB MATERIALS PASSPORTS

- Materials passports (MP) are electronic sets of information describing defined characteristics of building materials, products, and systems which make them suitable for resource recovery and re-use.
- MP describe the value for recovery and re-use of buildings materials in ways which allocate added value for stakeholders across the value chain.

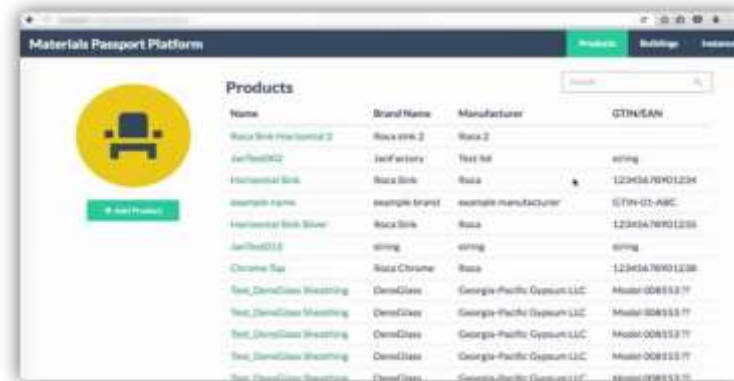


BAMB MATERIALS PASSPORTS PLATFORM

The BAMB Materials Passport Platform is the software to create materials passports.

This IT solution enables multiple stakeholders two major purposes:

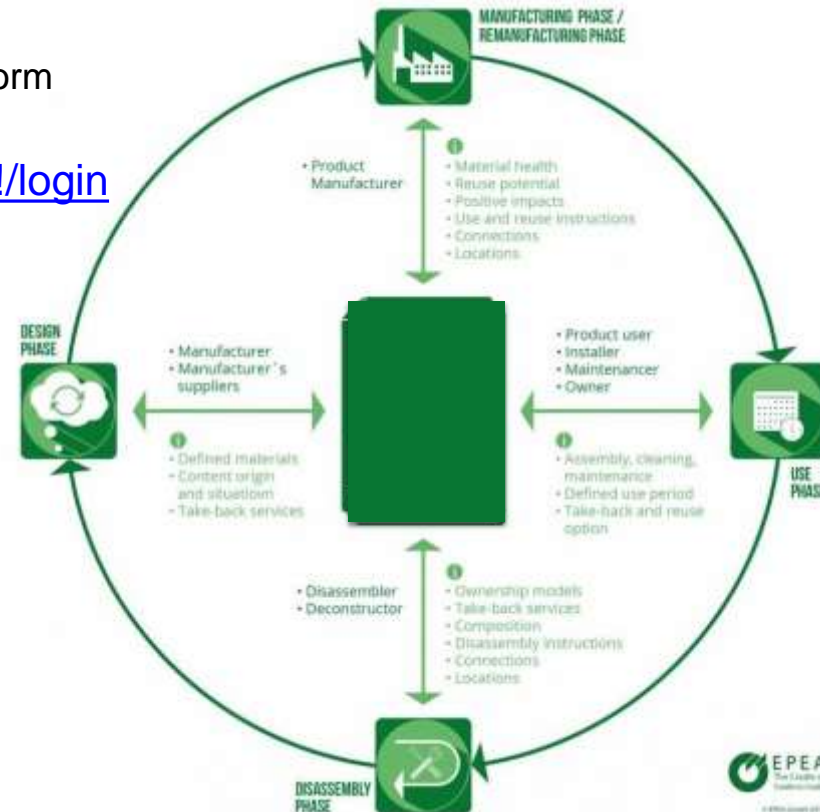
1. generate materials passports;
2. provide data during all the product and building usage phases.



BAMB MATERIALS PASSPORTS

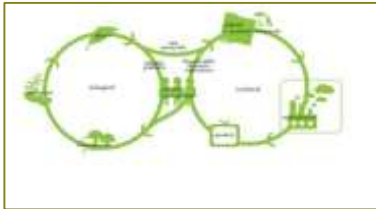
The BAMB Materials Passports Platform
proof of concept is available at:

<http://passports.bamb2020.eu/#!/login>

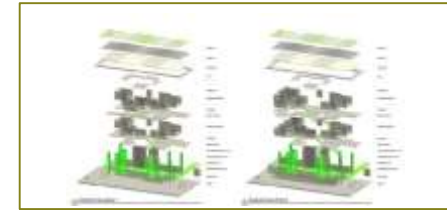


BAMB BUILDING INFORMATION MANAGEMENT

BAMB Material Passports



Reversible Building Design



Environmental impact assessment

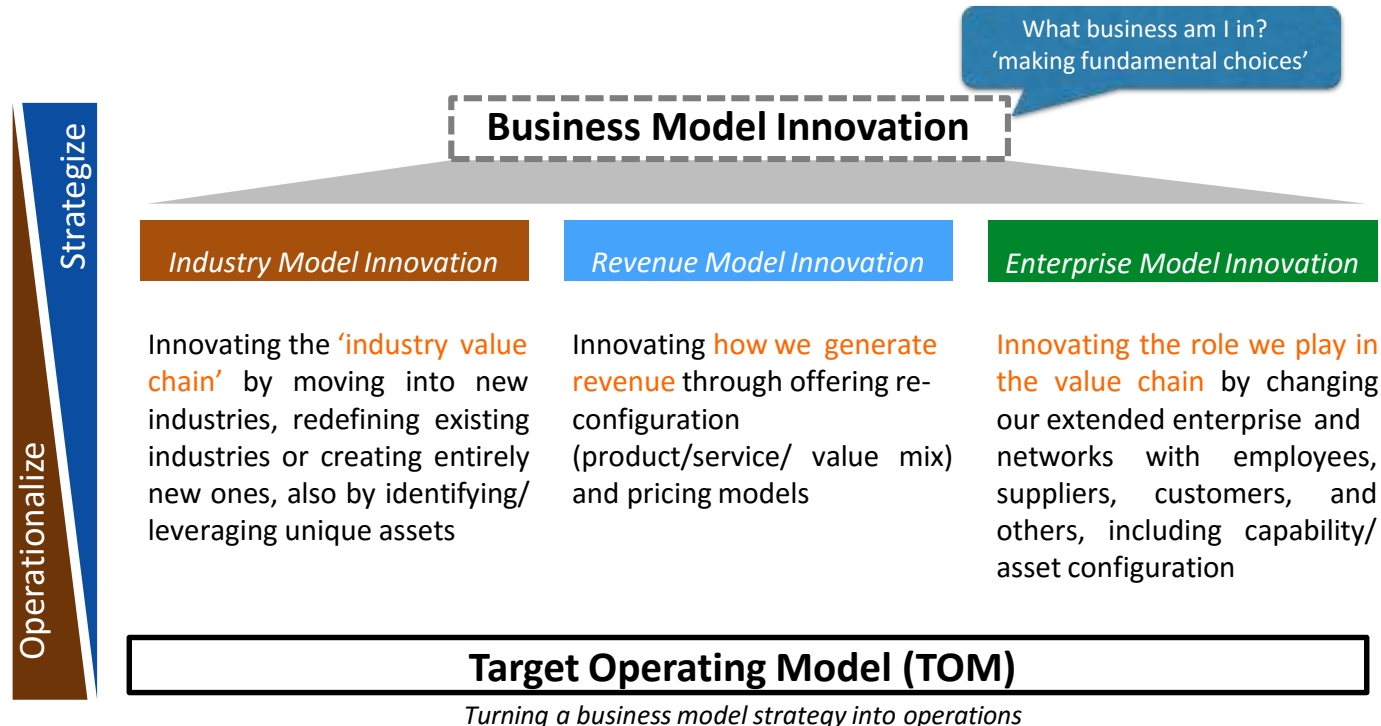


Life Cycle Costing

- Building Level Integrated Decision Making Model
- BIM Resource Productivity Prototype

BUSINESS MODELS

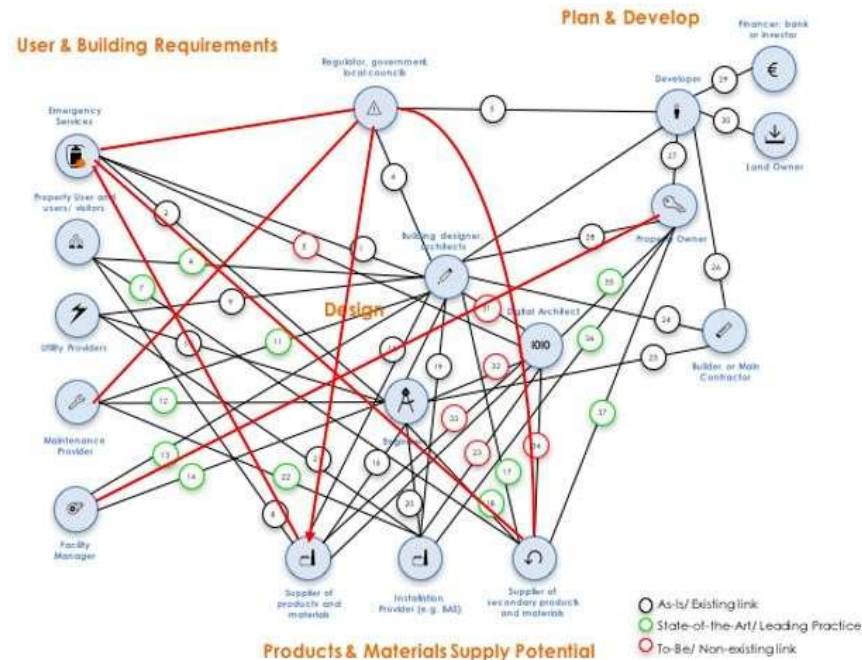
When innovating the business model in the digital era, 3 dimensions need to be managed



RE-THINKING THE DESIGN AND BUILDING VALUE CHAIN

Business Models

Example of a value network in a circular construction industry



POLICIES & STANDARDS

Analysis of the state-of-the-art and opportunities and barriers

Impact analysis

Best practices

Learning from the pilot projects and stakeholders



BAMB will make suggestions for policy recommendations
(new policies and / or adaptations)

SYNERGIES WITH THE BUILDING SECTOR

THROUGH THE BAMB GENERAL STAKEHOLDER NETWORK



Next general stakeholder assembly :
22 January 2018, in Brussels

BAMB - Final Conference
January 2019, University of Minho - Portugal

The BAMB Stakeholder Network (SN) gives the opportunity to gain further insight into the BAMB project and to take part in the innovation.

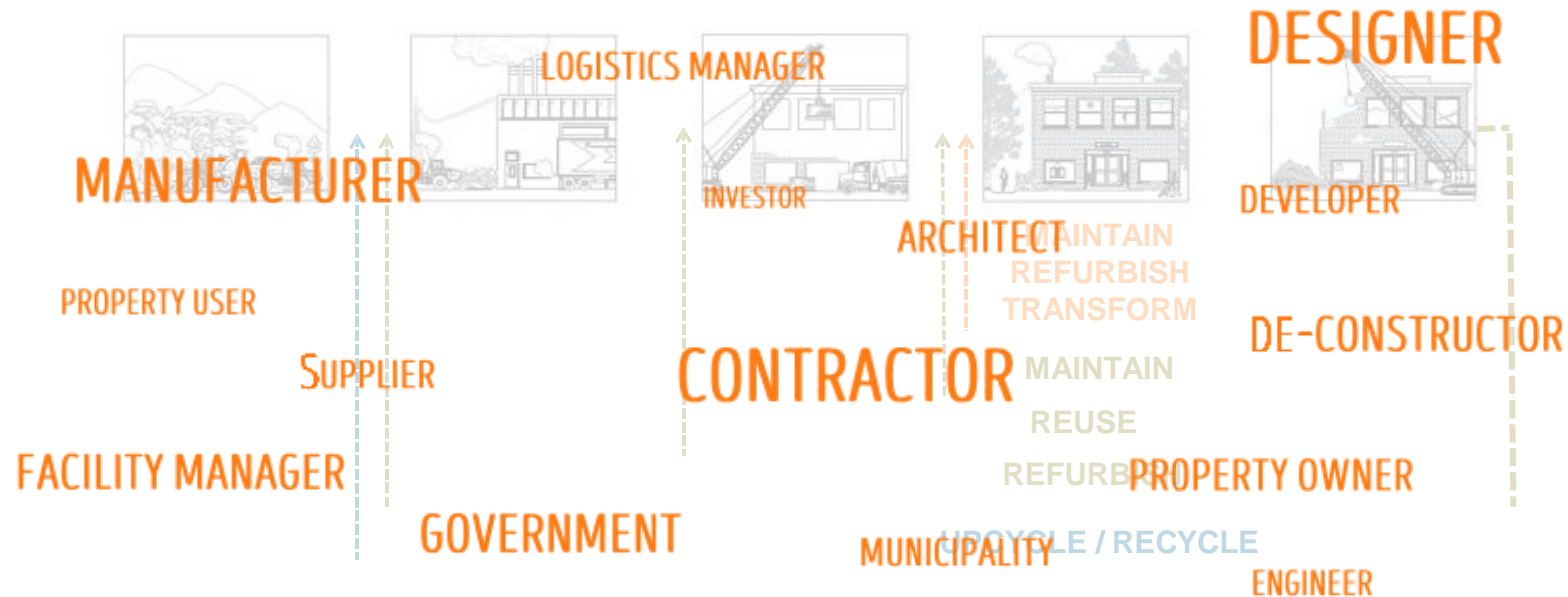
Open to all stakeholders in the building and construction industry, interested in exchanging ideas, knowledge and discussing the information and data needs.

The Stakeholder Network is invited to take to an Annual Stakeholder Network Meeting, as well as workshops and consultations as needed.

All participants are welcome.

SYNERGIES WITH THE BUILDING SECTOR - BAMB STAKEHOLDER NETWORK

TOWARDS A CIRCULAR AND DYNAMIC BUILDING DESIGN



BAMB STAKEHOLDER NETWORK HAS ALSO 6 SPECIAL INTEREST GROUPS (SIG)

1.
Materials Passports



2.
Reversible Building
Design



3.
Data management
(including BIM)



4.
Business Models



5.
Policies and Standards



6.
Case Studies
and Pilots



The Special Interest Groups allows the BAMB Consortium to interact directly with smaller groups of stakeholders, more specifically interested in the topics throughout the project. The interaction may be as workshops, feed-back on results and developments, etc.

IMPLEMENTATION & REPLICABILITY

Pilot projects objectives:

In order to maximize the BAMB project's innovation potential, dissemination impact and stakeholder involvement, practical real-life examples are vital to test and demonstrate the project outputs in various settings.

Demonstrate and support market opportunities.

Give feedback.

Note: Part of the investments for the constructions will be funded foremost by private partners.

DESCRIPTION OF THE NEW OFFICE BUILDING PILOT PROJECT

LOCATION	World heritage site "Zeche Zollverein" Essen, Ruhr- area, Germany
FUNCTION OF BUILDING	Office building of private, commercial company, approx. 200 workplaces, cantina, conference and meeting rooms and rooftop garden. No major underground facilities.
Spatial Dimension	Total gross area: 10,000 m ² ; Total gross volume: 39,000 m ³
OWNER/ USER	RAG AG/ RAG Stiftung
PROJECT DEVELOPER	Kölbl Kruse 13 GmbH & Co.KG
ENGINEERING	Drees & Sommer



Visualisation of building „Neubau Zollverein“, kadawittfeld architecture, Aachen 2016



Construction site on "Zeche Zollverein" Essen, Germany



Construction site as Brownfield

NEW OFFICE BUILDING PILOT PROJECT - OPPORTUNITIES & BARRIERS

Barriers & Opportunities

- Greatest obstacle to high-quality recycling is **economic viability**



Recycled concrete size distribution



Uncoated concrete walls facilitate their future potential recycling

Use of Recycled Concrete

- Concrete is currently **not collected separately**
 - Only used for **low-grade applications** when recycling it

Goals for the pilot building:

- Using **recycled concrete** to the highest extent possible (was deferred later due to enormous increase in costs)
- Making all components **suitable for recycling** after dismantling

CONCLUSION NEW OFFICE BUILDING PILOT PROJECT

- Pilot was **successful** in **implementing and testing** key aspects of **BAMB** within a **realistic market environment**
- Many **insights** can be **transferred** directly to thousands of **comparable real estate projects**
- **Developed tools** (esp. "Material Passport tool") can be used as **reference** for development of appropriate tools in the **research project** and for a multitude of **comparable construction projects**.
- Project created a possibility to present "**powerful evidence**" for a warehouse of raw materials that is able to **withstand strict economic requirements**
- Added **value for the overall BAMB project**: practical and real market feedback generated within the pilot, especially for the material passport and its balance limit



UNESCO World Heritage "Zeche Zollverein"



Visualisation of the New Office Building

CIRCULAR RETROFIT LAB PILOT PROJECT

REFURBISHMENT OF STUDENT ROOMS

- surface: 200m²
- functions: dissemination space / eco-guestrooms / plugin office
- location: VUB University Campus, Pleinlaan 2, Brussel, Belgium
- budget: € 325.000 (of which € 60.000 within BAMB-project)
- status: (preparation) prototyping

CIRCULAR RETROFIT LAB PILOT PROJECT OBJECTIVES

- BAMB: Development and introduction of innovative reversible construction techniques within a renovation context
- Vrije Universiteit Brussel (VUB): Catalyst and exemplary project for the further renovation of the student rooms

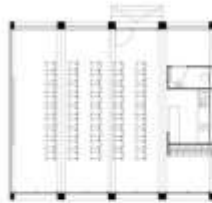
VUB - EXISTING STUDENT HOUSING



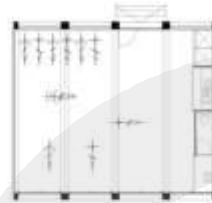
VUB - EXISTING STUDENT HOUSING STRUCTURAL SYSTEM



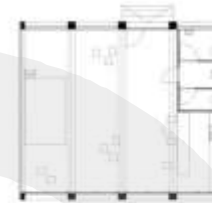
CIRCULAR RETROFIT LAB. PILOT PROJECT - STUDY OF SEVERAL POSSIBLE FUNCTIONAL SCENARIOS



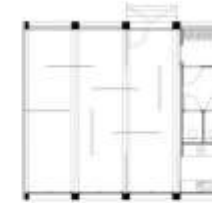
Dissemination Space



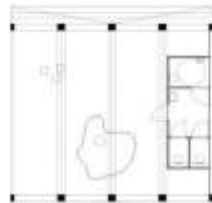
Bicycle Repair Shop



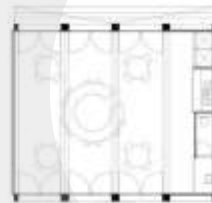
Concert Space



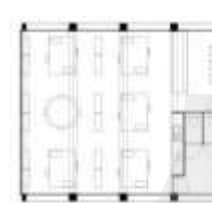
Exhibition Space



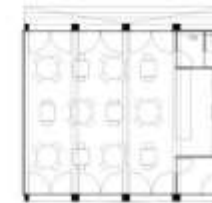
**Multifunctional Open Air
Space**



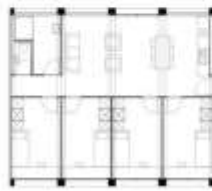
Information Office



Plug-In Offices



Bistro / Resto



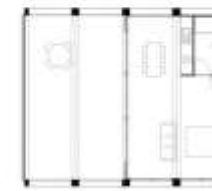
Updated Student Housing



Eco Guesthouse

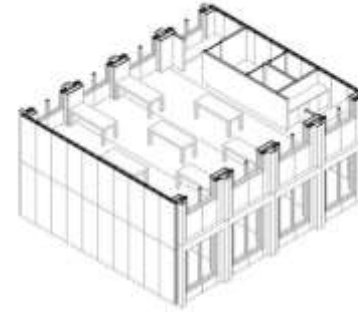
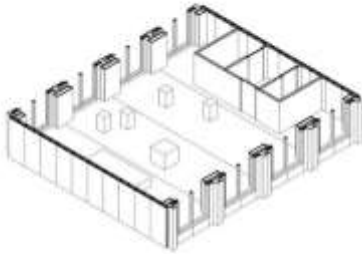


Sandwich Bar / Coffee shop



'Kavelkamer'

CIRCULAR RET. LAB. PILOT PROJECT - FUNCTION SELECTION FOR INTERNAL TRANSFORMATIONS



**dissemination space
(public)**



**eco Guestrooms
residential**



**temporary plugin offices
(professional)**

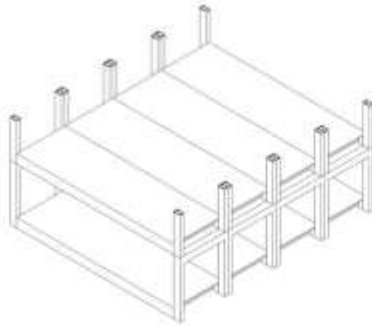
CIRCULAR RETROFIT LAB. PILOT PROJECT - OPPORTUNITIES

- Discovery of existing reversible systems (GIS Geberit)
- Some partners brought expertise on leasing-models (Desso)
- Some partners brought other partners (Van Roey)
- Development of new systems (Wall Linq)
- Application of reversible building solutions in renovation context
- Application of innovative materials

CIRCULAR RETROFIT LAB. PILOT PROJECT - BARRIERS

- Some partners abandoned the consortium
- Every program and building structure is specific
- Current policies and standards mainly address/support traditional renovation
- Current energy regulations only focus on energy used during use of the building

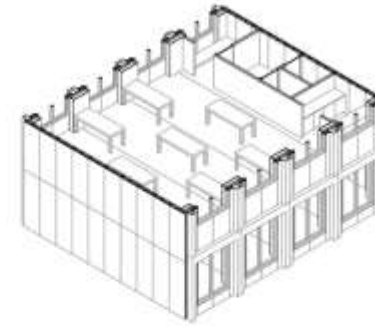
CIRCULAR RETROFIT LAB. PILOT PROJECT - WHAT'S NEXT?



Stripped Down Structure
(beginning 2017)



Dissemination Space +
Eco Guesthouse
(end 2017)



Dissemination Space +
Temporary Plug-In Offices
(beginning 2018)



CIRCULAR RETROFIT LAB. PILOT PROJECT - CONCLUSIONS

- Circular economy is still unknown in current building industry
- Many stakeholders are willing to discover new opportunities
- Innovative stakeholders enrich the research project

BAMB IMPLEMENTATION & REPLICABILITY

- Synergies with other Research Projects
 - Bâti Bruxellois Source de Matériaux (BBSM) FEDER 2015-2022
 - HISER (H2020)
 - FISSAC (H2020)
- Synergies with ProGroup. Two projects have been discussed
 - Parking garage with take back option for the materials. Guidelines have been transferred already to analyze the reuse options of the building/components/materials.
 - Social Housing projects. Reversible design guidelines have been transferred.
- Synergies with Montea (real estate company specialized in logistics). They rent out buildings and remain the owners, therefore they are in search of flexible, reusable buildings. Interested in application of BAMB tools in new and existing buildings.

BAMB IMPLEMENTATION & REPLICABILITY

- Synergies with EU & International Platforms
 - DG ENV - BAMB presentation during EC Workshop on C&D Waste (May 2016)
 - European network on technical aspects of resource efficient construction and renovation
 - UNEP 10-Year of Framework Programmes (10YFP) on Sustainable Consumption and Production (possible joint event and other joint activities)

BAMB IMPLEMENTATION & REPLICABILITY

- Synergies with other Stakeholders
 - ROTOR: Pioneering company in the field of salvaged building components.
 - EVR - Architecten
 - Centre de Référence de la Construction (CDR): Cofounded by the regional public authorities and the private sector. It works with the building sector, Actiris, Bruxelles-Environnement and the Brussels training bodies to improve the employment opportunities of jobseekers and improve the qualifications and knowledge of construction personnel in the Region.
 - BC Architects & Studies
 - Triodos Bank.

BAMB IMPLEMENTATION & REPLICABILITY

- Ongoing talks with Eurogypsum on how BAMB tools could support the needs of the gypsum industry.
- Eurogypsum represents the European manufacturers of gypsum products in Europe.
- Eurogypsum aims to secure sustainable growth of the market for gypsum products and solutions whilst maintaining and improving the image of the industry.



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www.bamb2020.eu



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Geodesign Project Diogo Frias

workshop eco.constroi

20 outubro 2017 | Politécnico de Leiria

eco.nomia

GEODESIGN

valorização de resíduos pelo design
de produtos de valor acrescentado

Cofinanciado por



Parceiros



Investigação em Design



providencia design

Consultor



Investigação

```
graph TD; A[Investigação] --> B[Materiais]; A --> C[Design];
```

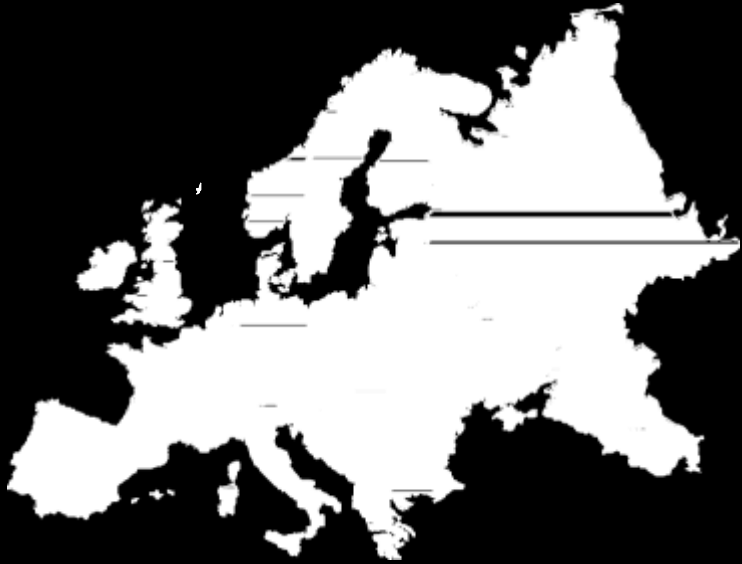
Materiais

Universidade do Minho
Universidade de Aveiro
UTAD
W2V
CVR

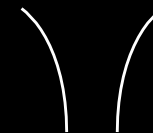
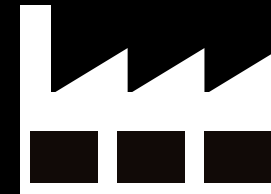
Design

Diogo Frias
Providência design

resíduos industriais



300.000.000
ton. / ano*



* - Fernando Castro /CVR

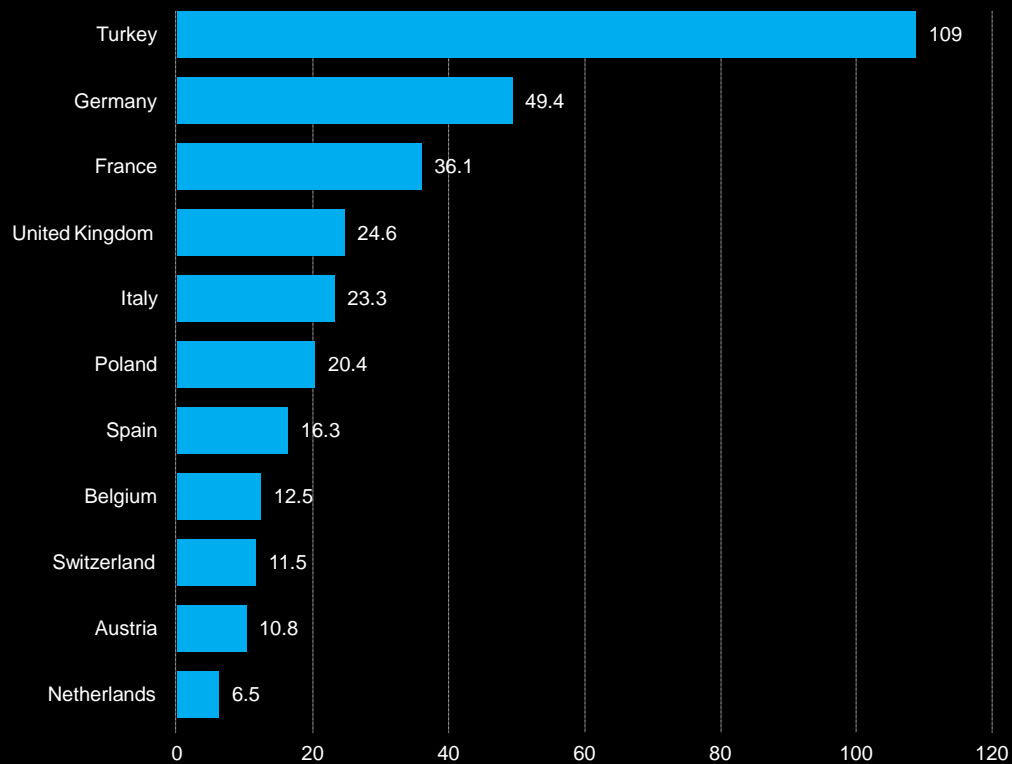
resíduos industriais



10.000.000
ton. / ano*



* - Fernando Castro /CVR

produção de **cimento**

Produção Europeia de cimento em milhões de m³(2016)

produção de cimento

consequências ambientais

- . produção de CO₂**
- . contaminação das águas**
- . total destruição e/ou alteração das terras**
- . redução da população de animais selvagens devido à destruição do seu habitat**

resíduos obtidos



50.000 ton/ano

cinzas volantes das centrais
termoelétricas (classes C e F)



30 ton/ano

lamas da anodização de alumínio
e do polimento de vidro

geopolímeros



investigação

e desenvolvimento em geopolímeros



potencial

de aplicação



barreiras acústicas de auto-estrada
e vias rápidas urbanas



retenção de taludes
com jardim vertical



mobiliário urbano

potencial

de aplicação



pavimento



baías inclusoras de referências
tacteis



sanitários

turismo

em números

. aprox. 60 milhões de turistas em 2016

. aprox. 984 mil hóspedes em janeiro 2017

. 2.4 milhões de dormidas (+ 14% face a 2016)

aumento de turismo em pousadas em 37%

proveitos de aposento crescem 14.9% em janeiro 2017
(84.1 milhões de euros)

turismo na região do Alentejo com forte potencial
de criação de eco-resorts

Zmar, Cocoon Eco Design Lodges, Ecorkhotel,
Ecosuites Hotel, A Terra EcoCamping...

dados do INE, Jornal de Negócios e Turismo de Portugal



estética

“sustentobrutalista”

princípios da

arquitetura sustentável

influência estética da

arquitetura brutalista

integração dos

resíduos industriais

novamente na indústria

geodesign

brutalismo

origem da estética

surge inserido no movimento de arquitetura Modernista

tem o seu pico entre 1960 e 1970

popular no Reino Unido, França, Alemanha, Japão, Estados Unidos da América, Canada, Brasil, Israel e Austrália

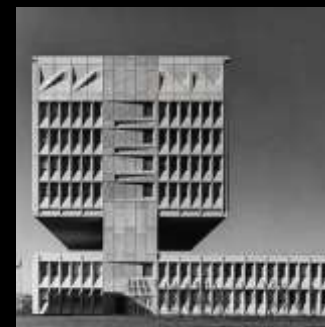
impulsionado por Alison and Peter Smithson, Le Corbusier, Marcel Breuer, Kevin Roche, Eero Saarinen, Paul Rudolph, Arata Isozaki, Louis Kahn, Justo García Rubio, Zaha Hadid entre outros

carateriza-se pela utilização austera de um único material

reduz os ornamentos históricos presentes na arquitetura grega e romana ao mínimo, de forma a que o exterior possa refletir a estrutura interior ao invés de a esconder

“in order to be brutalist, a building has to meet three criteria, namely the clean exhibition of structure, the valuation of materials “as found” and memorability as image”

Reyner Banham



arquitetura

sustentável

redução do impacto negativo dos edifícios no meio ambiente

adequação do desenho do edifício às áreas circundantes

utilização maioritariamente de materiais locais e técnicas de construção tradicionais como a taipa, adobes e tabiques

recurso a mão de obra local

praticada por Francis Kéré, Mierta & Kurt Lazzarini,
Atelier Biome, Tekuto



desenvolvimento

de produto



cofragem simples



cofragem + gesso



teste de textura 1



teste de textura 2



teste de textura 3

desenvolvimento de produto



Muro Inca, Cusco, Peru



Pedras Inca, Cusco, Peru



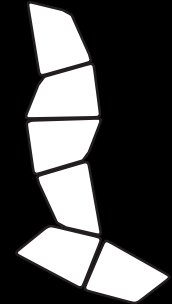
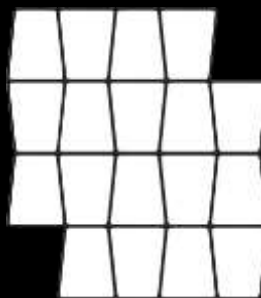
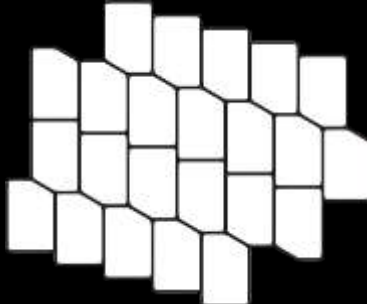
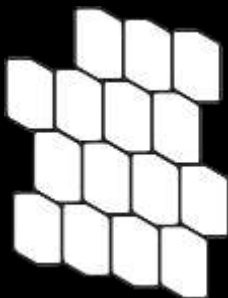
Pedras Inca, Cusco, Peru



Modelo de Otl Aicher
Olimpiadas de Munique, 72



Adaptação de Belkow
Olimpiadas de Moscovo, 80



desenvolvimento

de produto



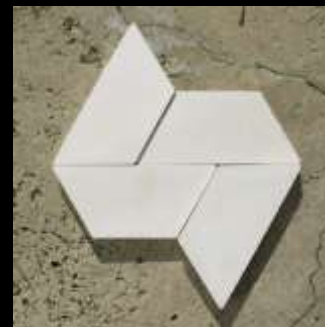
moldes 2 e 3



moldes + gesso rápido



moldes poliuretano



teste de padrão



teste de padrão



teste de padrão



teste de padrão



teste de padrão

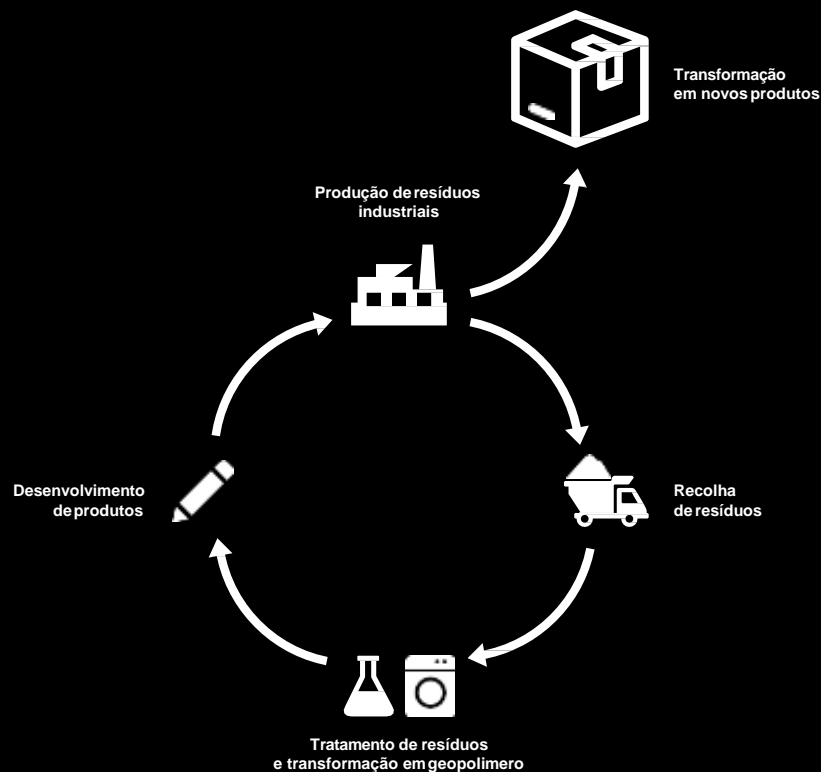


testes em geopolimero



testes em geopolimero

promoção da **economia circular**



Obrigado.

Diogo Frias
Francisco Providência
Fernando Castro
Ana Velosa





DEBATE

Moderador: José Vítor Malheiros



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Secretária de Estado da Habitação
Ana Pinho



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CIRCULAR ECONOMY ELEVATOR PITCH

15:00 – 17:00