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Environmental Product Declaration and circular economy of construction products in Portugal

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Ambiente e Sustentabilidade

CTCV

16 de Maio 2018
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- Centre for the promotion of **innovation** and development of **technical** and technological capacities of industries and services in the sphere of **habitat**.
- Entity of the **scientific** and **technological** system highly competent to support business innovation.
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Inovação e Desenvolvimento • Innovation and Development

- Gestão e Promoção da Inovação e Desenvolvimento • *Innovation and R&D management*
- Materiais e Produtos Avançados • *Advanced Materials and Products*
- Engenharia de Produto • *Design and Product Engineering*;



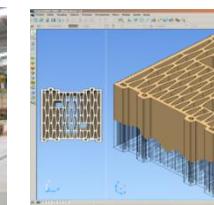
Medição e Ensaio • Measurement and Testing

- Laboratório de Análise de Materiais • *Laboratory of Materials Analysis*
- Monitorização de Ambiente e Segurança - *Environmental Monitoring and Safety*
 - Destaque - medições de **qualidade do ar exterior e interior**
- Laboratório de Ensaio de Produto • *Laboratory of Products Testing*
 - Destaque - **câmara de ensaios de COVs**
- Sistemas de Energia • *Energy Systems*



Sistemas e Processos • Systems and Processes

- Ambiente e Sustentabilidade • *Environment and Sustainability*
 - Destaque - diagnósticos, auditorias, SGA, licença ambiental - MTD, CELE, DAP, análise ciclo de vida, pegada de carbono, etc
- Sistemas de Gestão e Melhoria • *Management and Continuous Improvement Systems*
- Formação e Qualificação • *Training and Qualification*
- Sistemas de Informação • *Information Systems*



OUTLINE



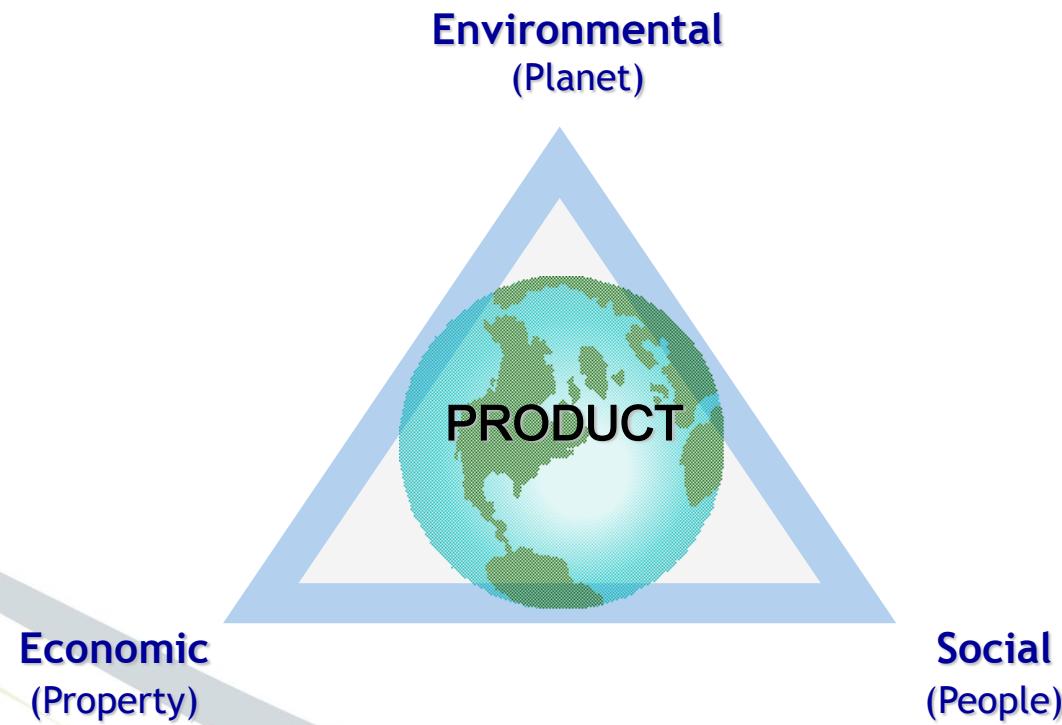
- EPD - Environmental Product Declaration
- Examples of circular economy - ceramic

Sustainable development

Development of a product

3 P's - *Triple Bottom Line*

4 P's



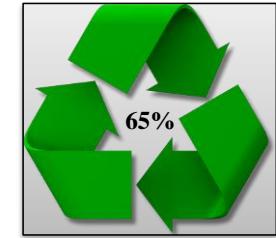
3 types of Environmental Labels/Declarations:

(EN ISO 14020:2005 - Environmental labels and declarations. General principles)

- Environmental declarations type I - **Ecolabelling**



- Environmental declarations type II - **Self-Declarations**



- Environmental declarations type III - **Environmental Product Declarations (EPD)**

What is a EPD for?

A EPD contains useful information for:

- A more judicious choice of products;
- Selection of more suitable solutions - **value chain**;
- Model alternative fuels, raw materials (glass, pigments, etc.), transport, energy - **Ecodesign**;
- Sustainable assessment of buildings or works.



They can be used by **designers**, engineers, architects and building designers.

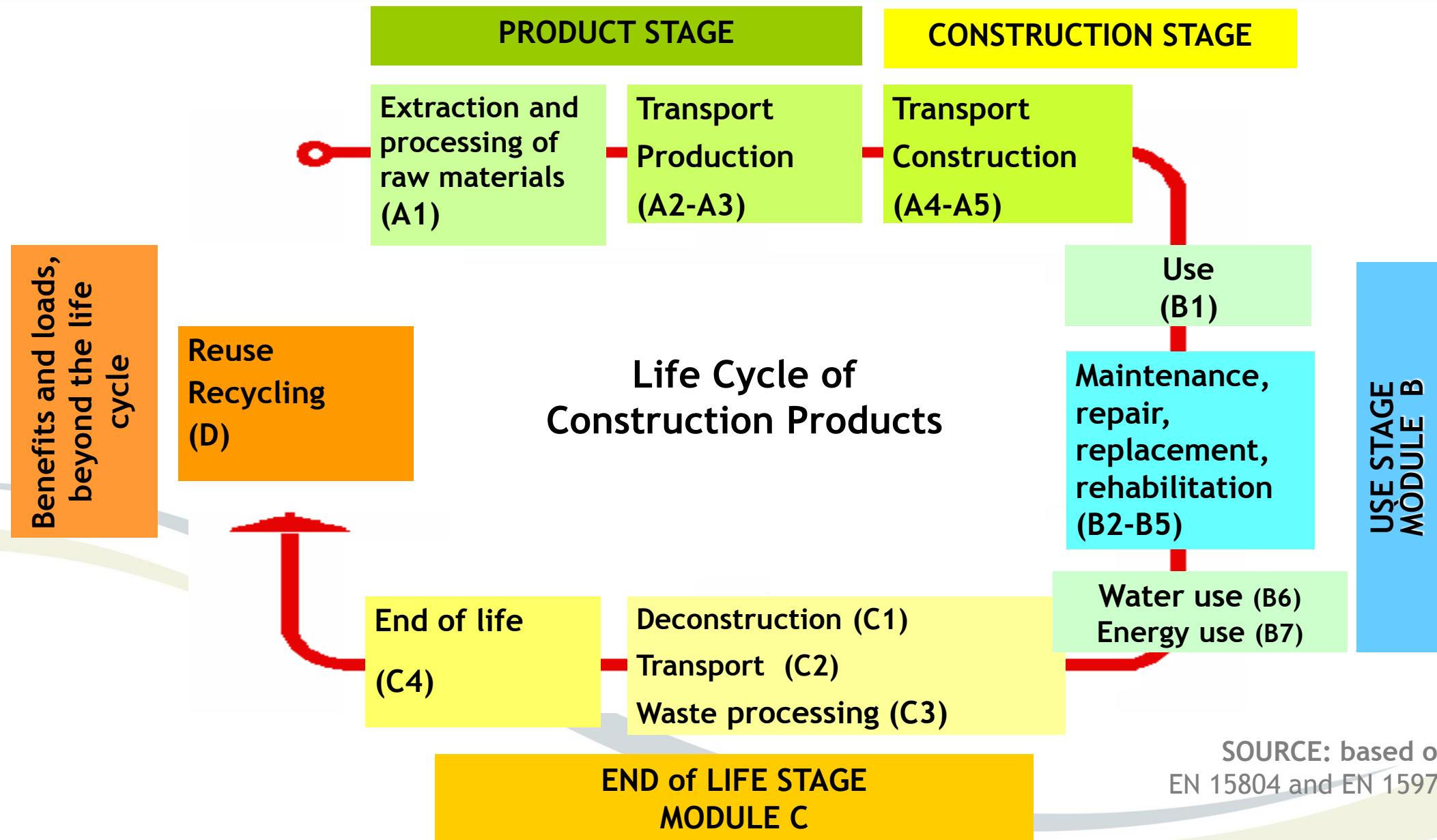
What tools exist to develop a EPD?

Standards to develop a EPD:

- ISO 14025 - environmental declarations **type III**;
- ISO 21930 - rules for a EPD for construction works.
- EN 15804 - developed by CEN which defines Product Category Rules for EPD of construction works.
- PCR (Product Category Rules), are common for products with the same funtions;

EPD can be used by architects and building designers as a source of information for assessing the sustainability of buildings and other construction sites.

What is the life cycle of Construction Products? (based on EN 15804; EN 15942 and EN 15978)



What types of EPD exist?

Depending on the information provided by the manufacturer, the EPD may be:

- **Cradle-to-gate** - covers the product stage, from the extraction and processing of the raw materials to the manufacture of the final product, considering the transport;
- **Cradle-to-gate with options** - covers selected product life stages and lifecycle stages, such as end-of-life scenarios;
- **Cradle-to-grave** - covers the stages of product, installation in the building, use and maintenance, repairs, demolition, waste processing for reuse, recycling and end of life.

How to quantify environmental impacts?

LCA. Phases

LIFE CYCLE ASSESSMENT phases*

OBJECTIVE
AND
DEFINITION
OF SCOPE

ANALYSIS OF
INVENTORY
LCI

IMPACT
ASSESSMENT
LCIA

INTERPRETATION

APPLICATION:

- ▶ Strategies and Policies
- ▶ Innovation
- ▶ Product development
- ▶ EPD

*ISO 14040

What is the content of a EPD?

- Declaration of **general information - company and product**;
- Declaration of the **environmental parameters** derived from the Life Cycle Assessment (LCA):
 - Declaration of LCA information by module;
 - Parameters describing environmental impacts;
 - Parameters describing resource use;
 - Other environmental information describing different waste categories and output flows.
- **Scenarios and additional technical information:**
 - Construction stage;
 - Usage stage;
 - End of life stage.
- **Additional environmental** information about the release of dangerous substances to air, soil and water during the **use stage**;
- **Aggregation of module information.**

SOURCE: EN 15942

a) Output indicators of environmental impacts :

- Global warming potential;
- Ozone layer depletion;
- Acidification potential of soil and water;
- Eutrophication potential;
- Photochemical oxidation;
- Abiotic depletion potential (non-fossil resources).
- Abiotic depletion potential (fossil resources).

b) Input indicators of materials and energy flows:

- Use of non-renewable materials;
- Use of renewable materials;
- Use of non-renewable primary energy;
- Use of renewable primary energy;
- Use of water;

c) Output indicators of materials and energy flows :

- Materials for recycling;
- Materials for energy recovery;
- Landfill of non-hazardous waste;
- Landfill of hazardous waste;
- Landfill of radioactive materials.

SOURCE: CEN TC 350

How to develop a EPD?

Developing a EPD in the DAPHabitat System requires the following procedure:

1. Check available PCR / start the development of the appropriate PCR document;
2. Carry out data collection and LCA to be included in a EPD;
3. Compile the environmental information to be included in the DAP in the format provided by the System;
4. Submit the DAP to the verification procedure;
5. Register the DAP in the System - connected ECOPLATFORM;
6. Terms of use of the logo (see site <http://www.daphabitat.pt>).

Inventory Analysis phase - Pavement's average LCI

ENTRADAS

ENERGIA

Electricidade	4,0 - 8,3	kWh
Gas Natural	0,09 - 0,15	GJ
Gasoleo	0,71 - 2,75	MJ

ÁGUA

Água	0,004 - 0,048	m ³
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MATERIAL DE EMBALAGEM

Paletes	0,231 - 0,253	kg
Cintas plasticas	0,023 - 0,025	kg
Filme	0,000 - 0,003	kg

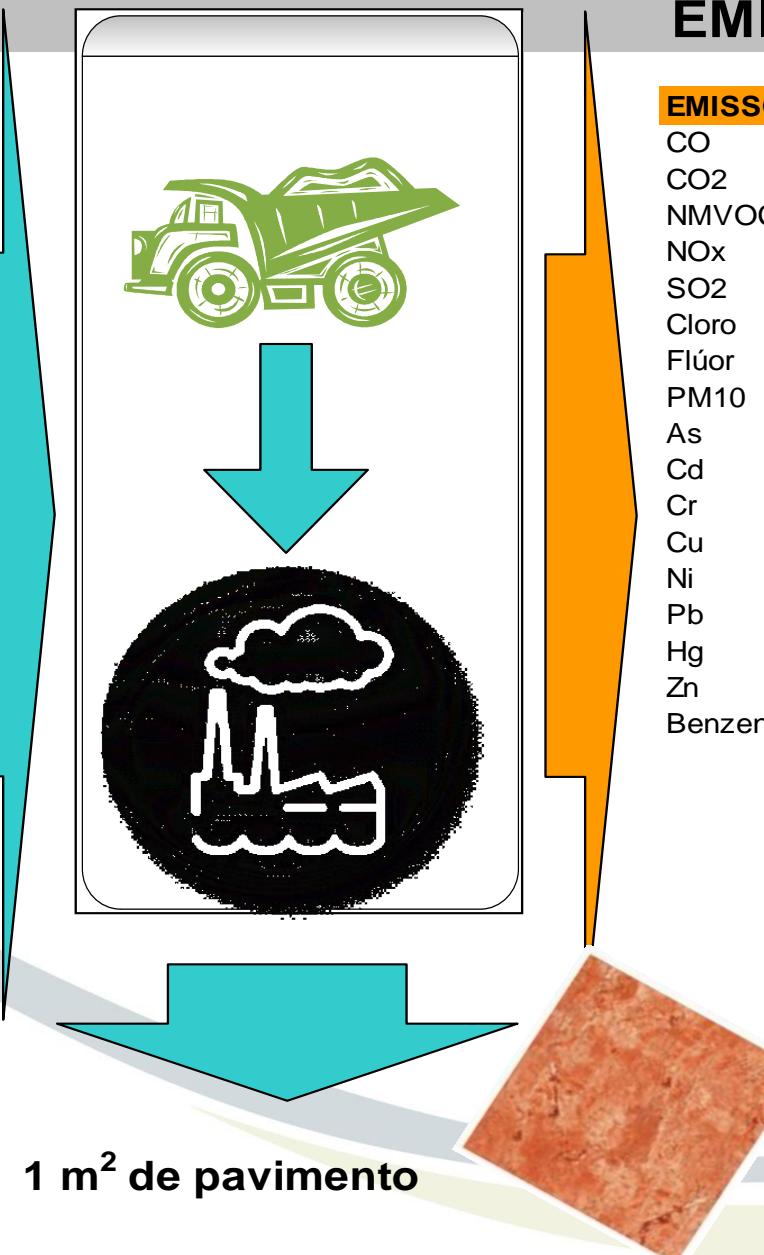
Matérias-Primas

Argila	6,66 - 21,31	kg
Areia	0,00 - 0,21	kg
Vidrados	0,00 - 0,60	kg
Corantes	0,01 - 0,37	kg
Talco	0,00 - 0,37	kg
Aditivos	0,0001 - 1,58	kg

EMISSÕES

EMISSÕES PARA A ATMOSFERA

CO	7,12E-03	-	4,54E-02	kg
CO ₂	6,06E+00	-	9,92E+00	kg
NMVOC	3,82E-04	-	7,08E-03	kg
NOx	1,36E-03	-	9,84E-03	kg
SO ₂	0,00E+00	-	1,87E-03	kg
Cloro	0,00E+00	-	1,17E-03	kg
Flúor	8,56E-05	-	1,16E-03	kg
PM10	3,35E-03	-	1,17E-02	kg
As	0,00E+00	-	0,00E+00	kg
Cd	0,00E+00	-	1,28E-06	kg
Cr	0,00E+00	-	4,29E-06	kg
Cu	0,00E+00	-	2,14E-04	kg
Ni	0,00E+00	-	4,29E-04	kg
Pb	0,00E+00	-	3,00E-05	kg
Hg	0,00E+00	-	0,00E+00	kg
Zn	0,00E+00	-	2,56E-04	kg
Benzeno	0,00E+00	-	0,00E+00	kg



SOURCE: Rel APICER, Dez 2009

RESULTS:

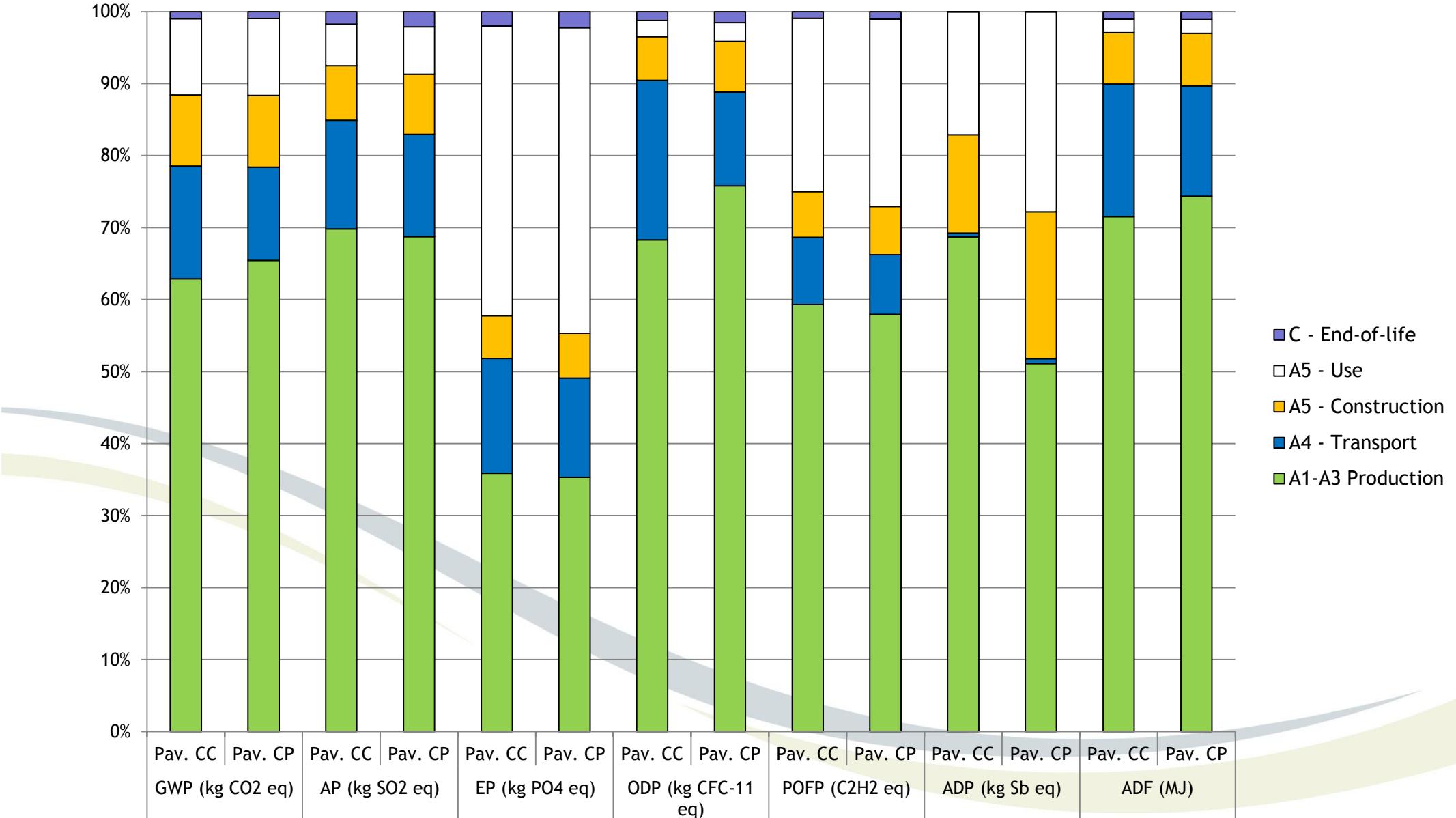
❖ EN 15804+A1 - CML

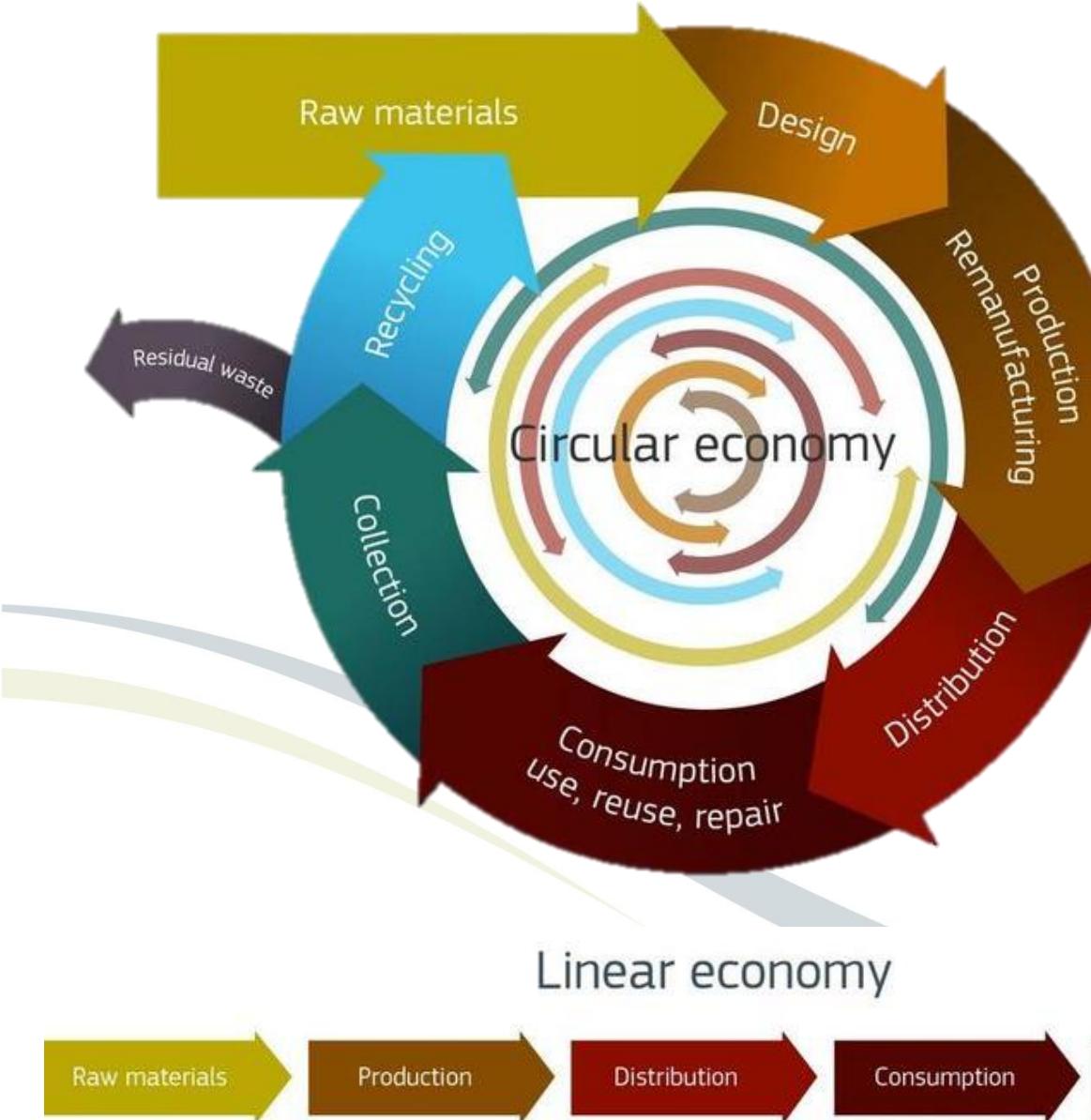
The functional unit is 1 m² of floor tile

Impact category	Cradle to gate (A1-A3)		Cradle to grave (A1-C4)		Unit
	CC	CP	CC	CP	
Global warming (GWP)	1.52E+01	1.57E+01	2.41E+01	2.39E+01	kg CO ₂ eq
Acidification (AP)	6.08E-02	5.23E-02	8.72E-02	7.61E-02	kg SO ₂ eq
Eutrophication (EP)	5.55E-03	5.18E-03	1.55E-02	1.47E-02	kg P0 ₄ ³⁻ eq
Photochemical oxidation formation (POFP)	3.09E-03	2.79E-03	5.21E-03	4.82E-03	kg C ₂ H ₄ eq
Depletion of abiotic-elements (ADE)	2.50E-06	1.14E-06	3.64E-06	2.24E-06	kg Sb eq
Depletion of abiotic-fossil flues (ADF)	2.26E+02	2.32E+02	3.16E+02	3.12E+02	MJ
Ozone layer depletion (OD)	2.18E-06	2.05E-06	3.19E-06	2.71E-06	kg CFC-11 eq

RESULTS: another exemple - ceramic floor tile

❖ EN 15804+A1 - CM





Circular Economy is a new way of thinking about our growth model in the face of a global competition for resources and the environmental impact of their use.

Transition to a stronger and greener economy - close the loop of a product life cycle

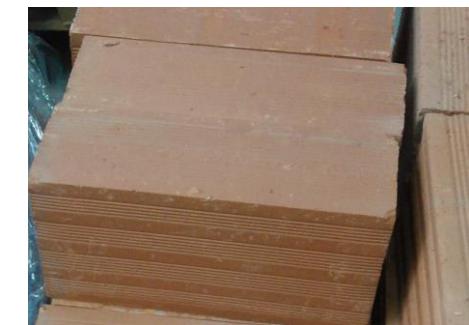
Waste incorporation in ceramic products - ceramic bricks and ceramic tiles

- **ECOBRICK** – Development of ceramic bricks with thermal and acoustic properties based on the incorporation of sludge and sawdust (European Project – CRAFT - project nº BRE-CT94.1575 Proposal Cr-1209-91)
- **PRAI** - Forest Row waste recovery for lightweight aggregates production - industrial application of waste from the pulp industry in lightweight aggregate production process
- **ECOCCEL** – Development of ceramic Bricks and lightweight aggregates from pulp sludges



Waste incorporation in ceramic products - ceramic bricks and ceramic tiles

- Development of ceramic products from waste recycling of fluorescent lamps – [Vale de Inovação 2016](#)
 - Feasible although the vitrifying material must be controlled
- Development of new ceramic products from recycled glass products (glass fragments)
- Development of new ceramic products from with tanning waste (the quantity must be small, otherwise there are quality problems on ceramic materials like efflorescence)
- Development of new ceramic products from with foundry waste



Waste incorporation in ceramic products - ceramic bricks and ceramic tiles

- **Development of lightweight aggregates from air pollution control (APC) residues from municipal solid waste incineration**
 - ✓ a washing treatment for removing soluble salts is need
- Development of new ceramic products from wastewater treatment (WWTP) sludge from automotive industry
- Waste from the extractive industry (stone cutting sludge). The quantity must be adjusted to the ceramic product



Main constraints on Waste incorporation in ceramic products - ceramic bricks and ceramic tiles (new life cycle – circular economy)

- Need for waste Pretreatment (separation, mixing, grinding)
- The waste composition variability and occasional hazard risks (eg. sludge with glazed material)
- Chemical charge (flocculants, colorants) of wastes
- Particle size of waste
- Can occur Gaseous effluents (transfer medium)
- Licensing

Main advantages on Waste incorporation in ceramic products :

- Ceramic industry has large capacity installed (above 150 t/d till 800 t/d)
- Ceramic products are subjected to high temperatures which encapsulate the materials in the silicate matrix (inert products)
- New ceramic product with absent or negligible leaching potential

Ceramic products with phase change materials to improve energy efficiency in buildings



http://www.ctcv.pt/projdi_thermocer.html



2012-2014

- Development of ceramic floor tiles with improved thermal characteristics, by incorporating phase change materials (PCM).
- This innovative product for passive management of energy consumption in buildings makes possible to reduce the buildings energy costs and to decrease the emission of greenhouse-effect gases.



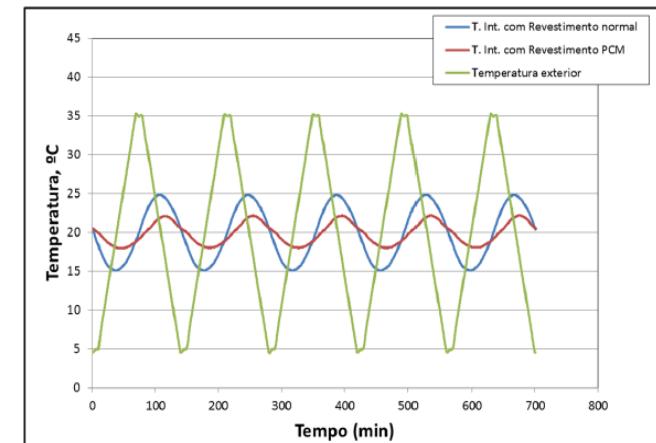
Revestimento PCM



Grés ThermoCer PCM



Grés ThermoCer



Self-cleaning ceramic coatings



Out/11 a Set/2013.

http://www.ctcv.pt/projdi_sensetiles.html



Objective:

Development of ceramic coatings with self-cleaning and purifying functions.

Tecnology and benefits

By modifying its surface with nanostructured photocatalytic materials, it is intended that these new features help to reduce the maintenance costs of buildings and reducing the impact of human activity on the environment (reduction of nitrogen oxides NOx)

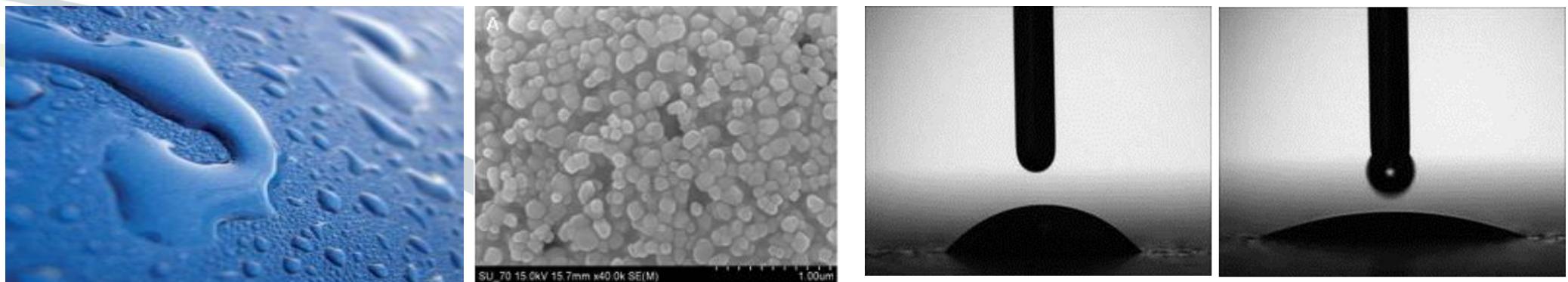


Figure 7. Hydrophilicity evaluation by performing water contact angle measured before (left) and after 1 hour UV-A irradiation.

NEW CHALLENGES ???

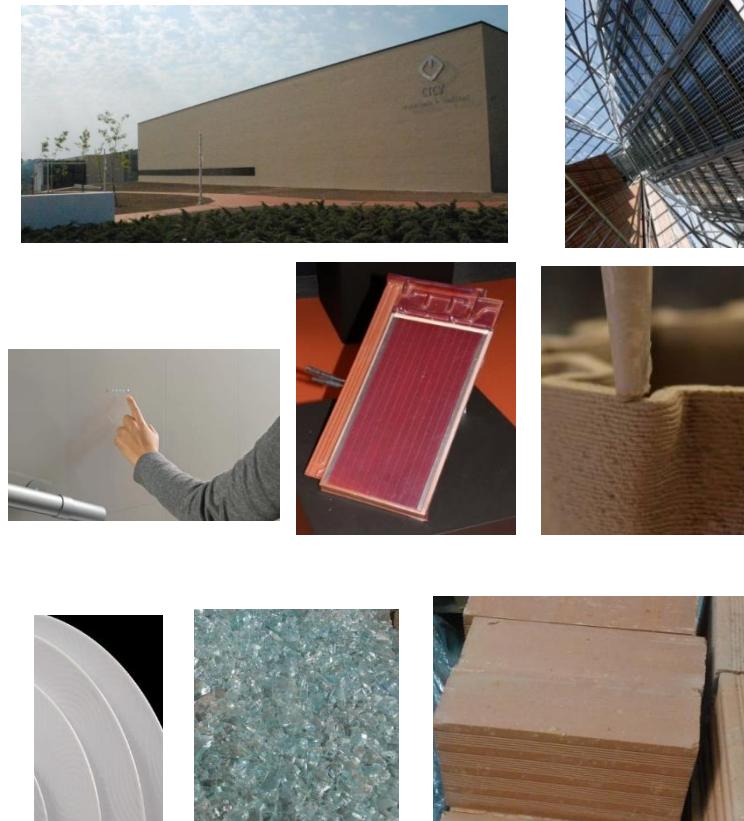
New tools:

- Driving the change through **Green procurement**,
- Study the life cycle - detailed rules for the definition of **functional unit**, define the existing rules for **system boundary** at the **end-of-life** (Modules C and D) - to be part of the assessment
- OERCO2 project - site
- SIAC CTCV2020 - on-line platform for **circular economy** strategies and case-studies;
- **Degren** - Centro transfronterizo de ecodiseño de la EUROACE

CTCV 2020 - Valorização e Transferência de Conhecimento Tecnológico e I&D para a Indústria do Habitat

Transferência de conhecimento

- Promoção da Economia circular
- Promoção da digitalização da Indústria (Indústria 4.0)
- Promoção da Inovação responsável nas indústrias de materiais e nanotecnologia
- Promoção de produção de materiais seguros para o Habitat em ambientes Interiores



Demonstração de desenvolvimento tecnológico

- Processos de conformação avançada de componentes (metálicos e cerâmicos)
- Fabricação aditiva em cerâmica (modelação, fabricação)
- Produtos multifuncionais para o Habitat
- Promoção de eficiência energética na indústria
- Novos produtos solares

Cofinanciado por:



Fabrico rápido de produtos em porcelana por R3D

RoboCer3D project aims the development of an additive manufacturing technology for porcelain tableware products by “Robocasting 3D” (R3D).

Shaping freedom capacity with additive manufacturing technologies, in this case R3D, makes possible the production of parts with shapes and functionalities that are not possible by the conventional production techniques.



Cofinanciado por:





Thank you!

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