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Sustainable Bio&Waste Resources for Construction New insulating construction material from prototypes from biobased and waste resources

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► To cite this version:

Feriel Bacoup. Sustainable Bio&Waste Resources for Construction New insulating construction material from prototypes from biobased and waste resources. 12th conference of biobased materials, May 2019, Cologne, Germany. hal-04255088

HAL Id: hal-04255088

<https://hal.science/hal-04255088>

Submitted on 23 Oct 2023

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Goals of the project

- Study a range of bio-based and waste-based materials poorly valued and locally available in the France (Channel) England area : (i) **Corn-pith**, (ii) **Waste polyester** and (iii) **Wheat straw**.
- Development **low carbon thermal insulation prototypes**: carbon footprint 25% lower than standards insulation materials for the building.
- Testing these prototypes in laboratories and on pilot sites & Evaluate the economical cost and environmental impact of these new materials.
- Elaborate a future **industrialization strategy** and raise awareness among **construction professionals** into using these prototypes

European funding of 1.26M€

→ for a total budget of 1.8M€

- **European Regional Development Fund (ERDF)**: the SB&WRC project is part of the "Climate Change and Sustainable Energy" theme of the European Strategy 2020.
- **Interreg France (Channel) England**: the program supports the development economic and environmental management of the France-England cross-border area. The SB&WRC project is part of the "Low Carbon Technologies" theme.

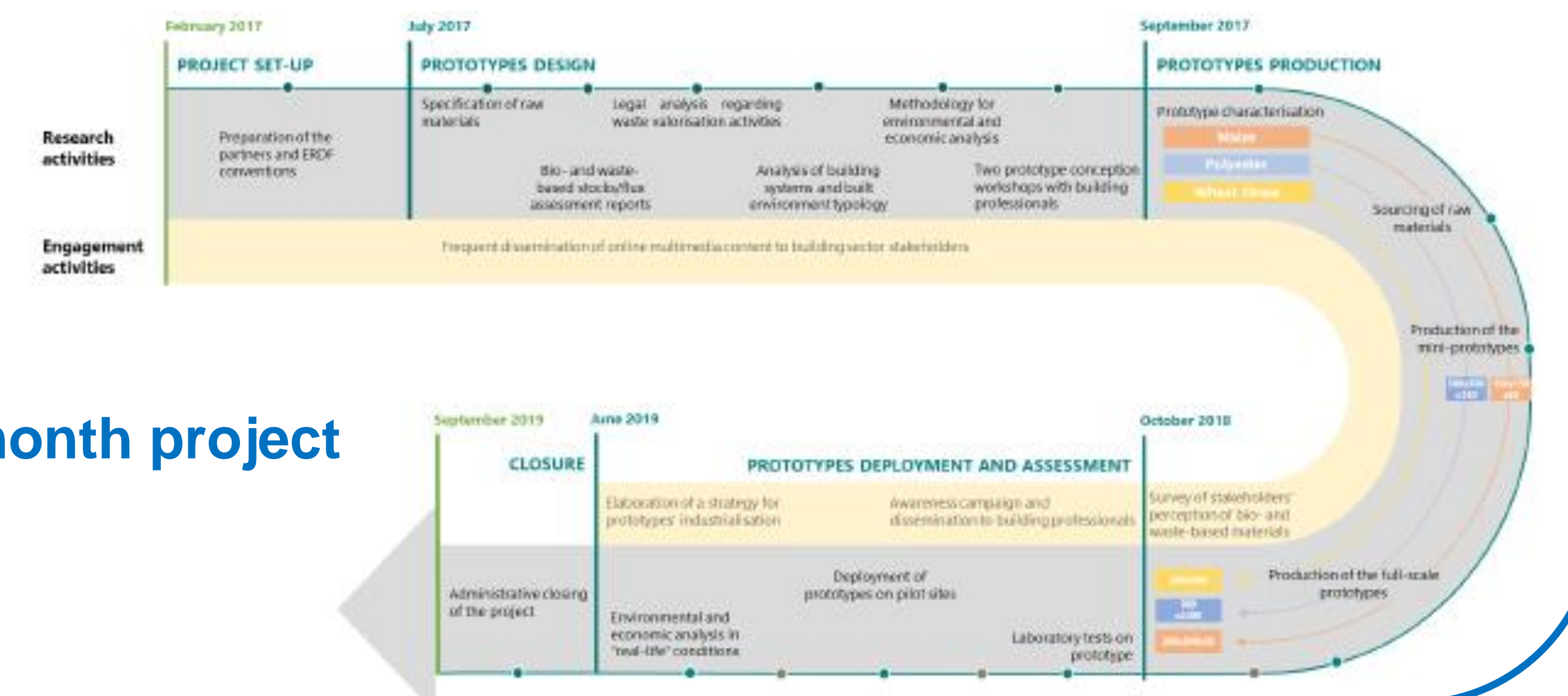


Partners and perimeter of the project

A French-British cooperation



A 32 month project



UniLaSalle Prototype 1: Valorization of Corn-pith in insulating material

- Evaluation and deployment of Prototype 1, **thermal insulation based on corn-pith**, an agricultural byproduct.
- **Thermocompression** is used to elaborate particleboard.
- The challenge for the development of this prototype is to **preserve the intrinsic properties of the material** by adding the least natural binder possible while having a **correct mechanical strength** for it to be manipulated.

Thermocompression process



Performances of prototype

Thermal conductivity
 $\lambda = 0,042 \text{ w}\cdot\text{m}^{-1}\cdot\text{k}^{-1}$

3-point bending :

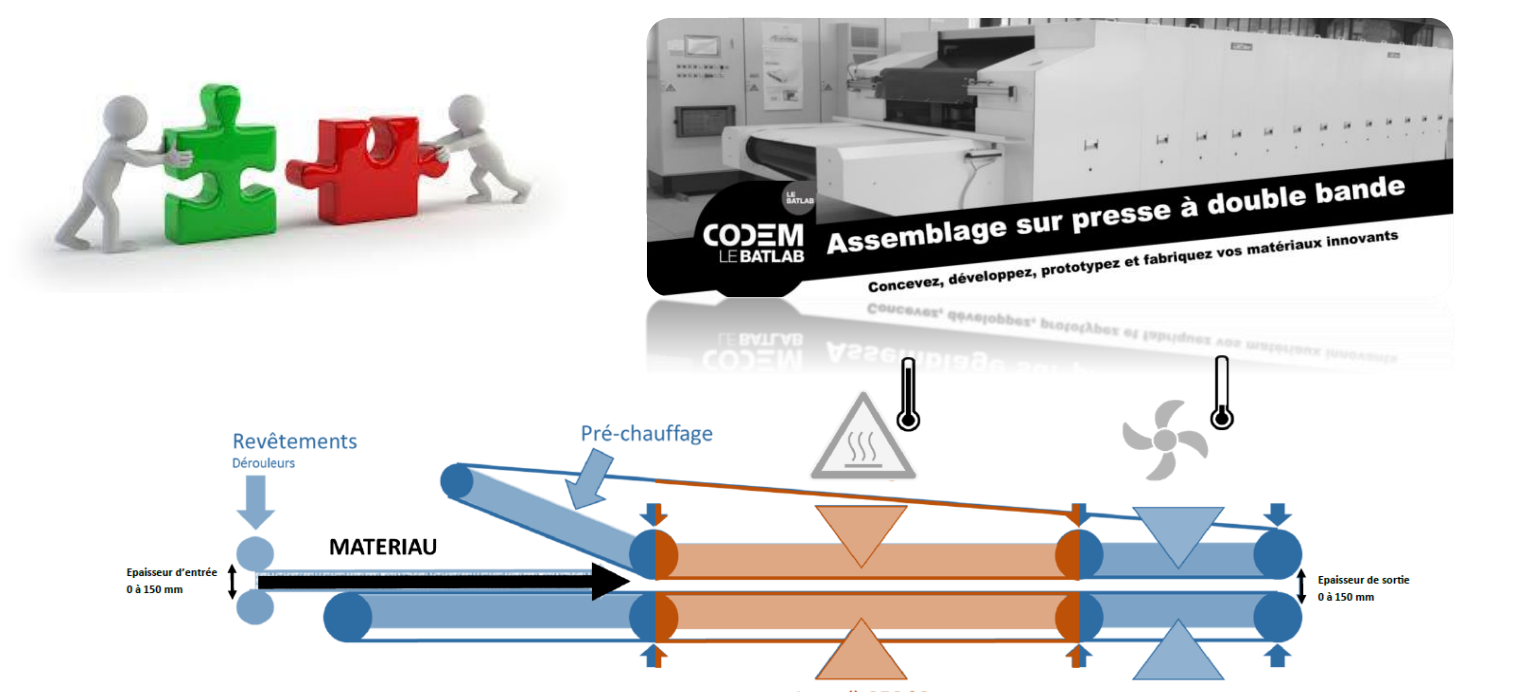
Handle panel and easy to cut
Maximal bending strength = 0,03 MPa

fire testing

Burning time of panel from corn-pith (30min) is higher than the control (15 seconds)

Tests pilots and deployments

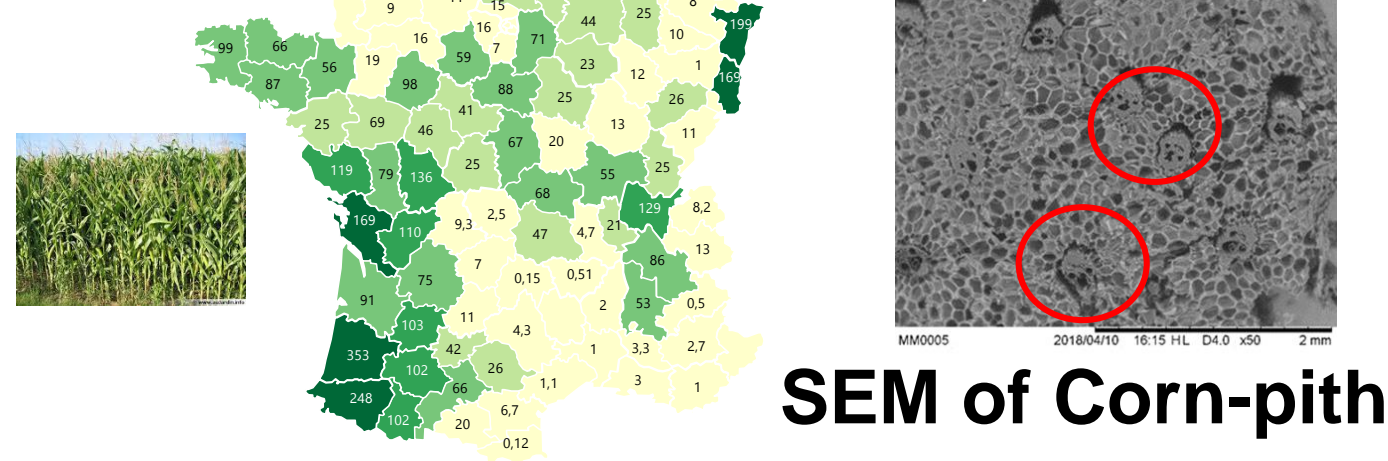
Partnership between CoDEM and Unilasalle



Results : 3 panels 1100*1100*25mm³
Technical deployment at Bath University



Maize



SEM of Corn-pith

- 400 000 ton of Maize is available in area of project

Departement for Environment, Food and Rural Affairs, 2016 ; Agreste, 2017
EP 3149085, S. Grass, Method for the production of superabsorbent pellets and/or of a fibrous material from crop residues, patent, (2014)

Prototype 2 : Insulation panel based on bedding waste polyester

- Reuse of textile waste from beddings as thermal insulants in buildings.
- ESITC Caen is in charge of characterizing raw materials, studying the thermal properties of the mini-prototypes designed by the University of Brighton, deploying and characterizing the real-sized prototype 2.
- Prototype 2 is built out of bedding waste polyester associated with wooden panels.

Characteristics of polyester

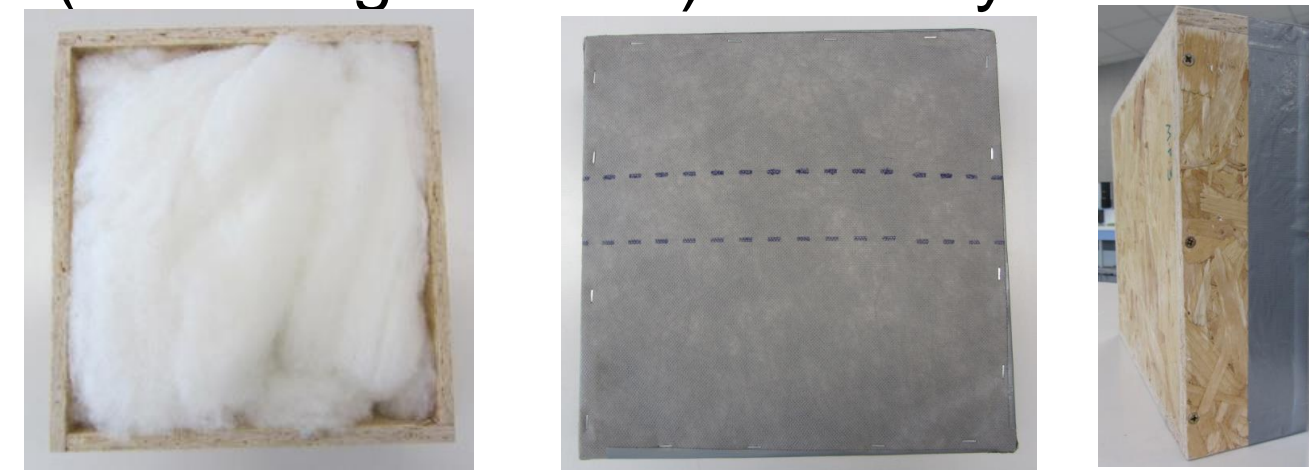


Waste polyester

Characteristics	Content in water (%)	Absolute bulk density(Kg/m ³)	Glass transition temperature (°C)	Fusion temperature(°C)
Valeur	0,14	1474	96	246

Thermal characteristics of mini-prototype 2

- The mini-prototype 2 is 200 x 300 x 100 mm sized. It consists of a wood frame, polyester (insulating material) and a Tyvek coating.



Mini-prototype 2

Temperature (°C)	Thermal Conductivity (W/(m·K))
-10	0,042
0	0,045
10	0,050
20	0,056
30	0,064

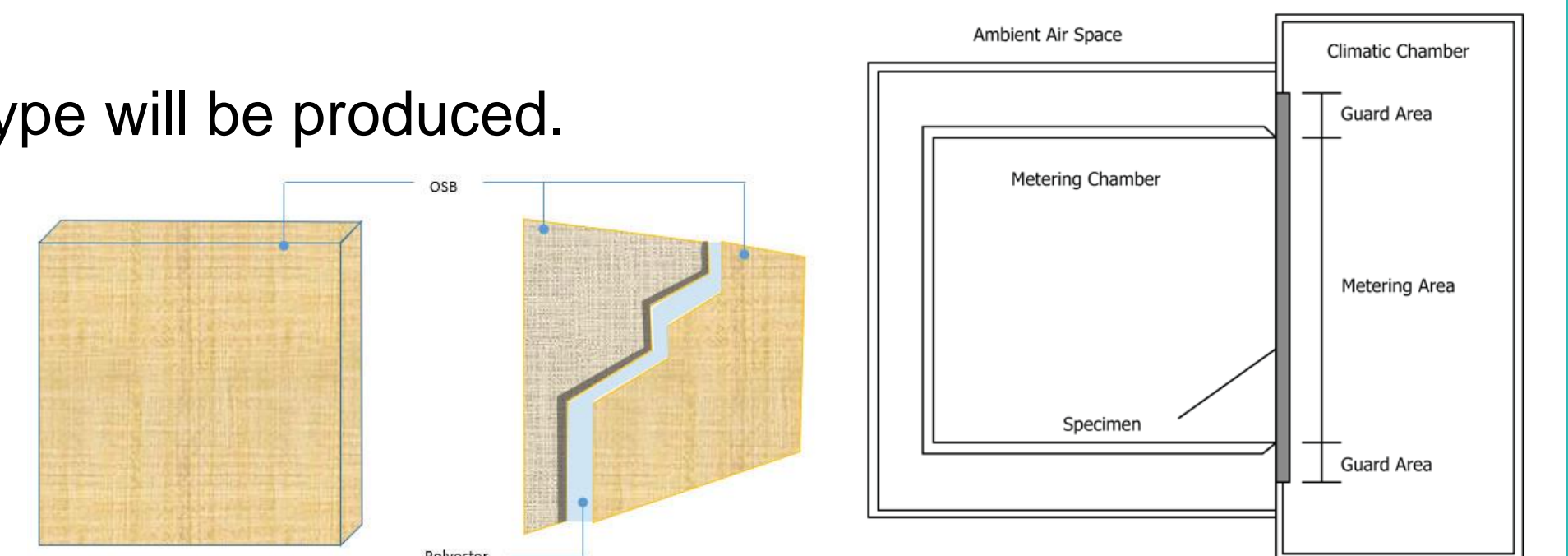
Thermal conductivity results measured at different T (°C)

The results of the thermal conductivity of the mini-prototype 2 show the insulation potential of this material.

Tests pilots

A real scale reproduction of this mini-prototype will be produced.

The prototype 2 tested in the rooms climate of the ESITC Caen so to evaluate its thermal performance.



Real size prototype (200x200x40cm) Hot Box system [ASTM C1363]

Prototype 3: Valorization of wheat straw insulation material



strawbales

- Prototype 3 is **wheat straw-based insulation material**. In order to obtain the lowest environmental impact of this material, the project selected strawbales as a model as it requires very few transformations or energy.
- Wall application, insulation only (self-bearing, non-load-bearing), associated with a timber structure for example.
- Dimensions used : 600 x 600 x 100 mm.

Targeted mechanical properties

- No minimal requirement as the prototype is non load-bearing.
- According to EN 826: compressive resistance corresponding to a strain of 10% (high deformation).
- Consider a "not to exceed strain value" for a determined load > value to determine.
- Mechanical performances will be improved with a coating.

Targeted carbon footprint

- A reduction of carbon emissions by 25% in comparison to mineral and glass wool products is targeted.

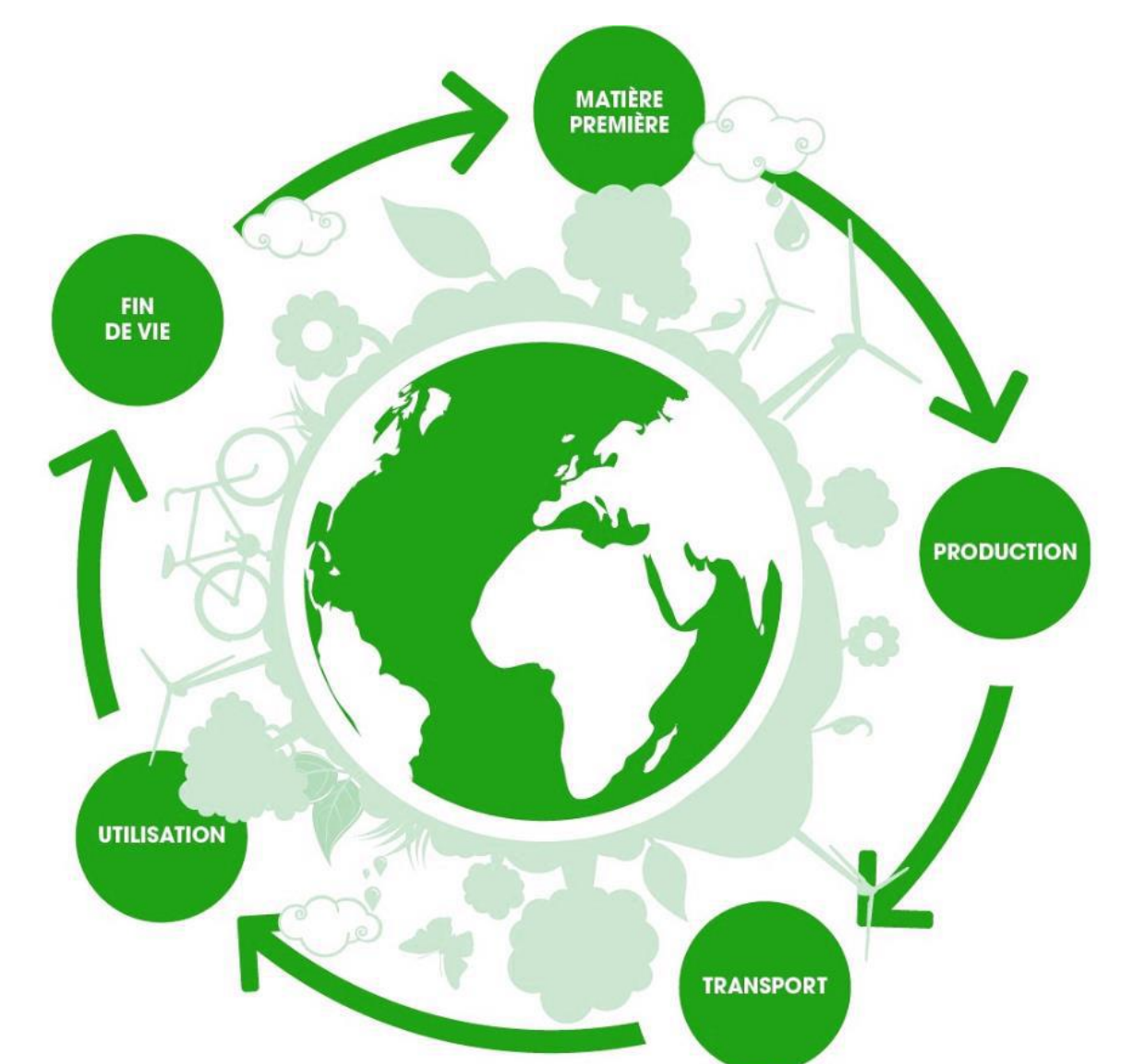
Targeted thermal performance

- Thermal conductivity: the objective is to reach the value of FASBAa, close to 0.04 W.m⁻¹.K⁻¹, to be competitive with other insulation materials.
- This value can be obtained by changing the orientation of the straw in comparison to its initial orientation (from the baler).

Targeted fire resistance

- UK Building Regulations: 30 minutes (it has been measured 90 minutes in the literatureb).
- Fire resistance will be highly influenced by the coating.

An environmental study of 3 prototypes is in progress



PERSPECTIVES

The 3 prototypes have a very good potential of valorization as thermal insulants materials in buildings. For a possible commercialization of these 3 prototypes, an economic and environmental analysis are in progress by Nomadeis and BATH University respectively.