

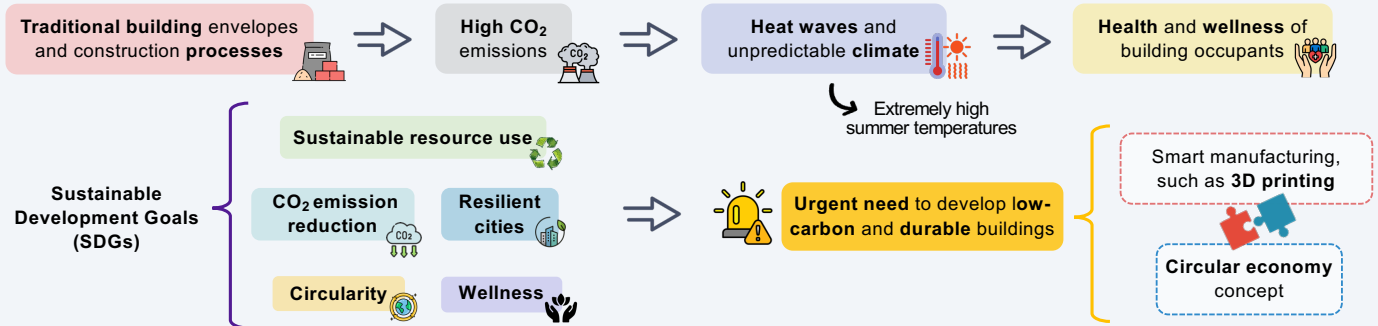
3D printed building envelopes with functionally graded materials for better insulation and engineering properties

PhD student: (1st year): Madson L. de SOUZA¹

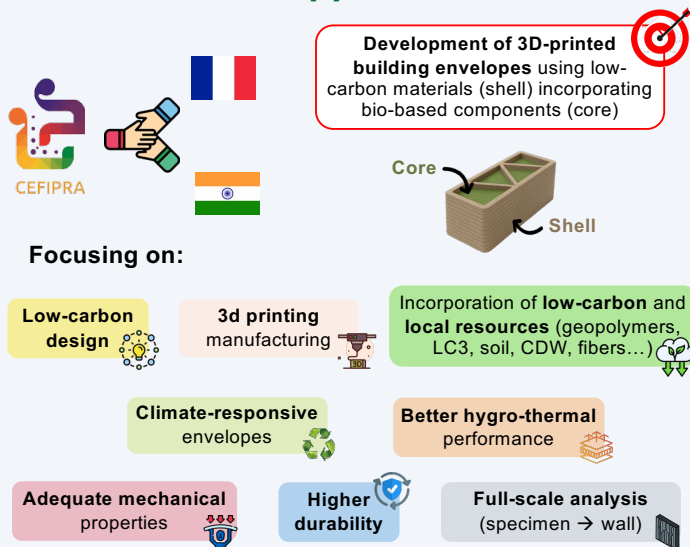
Supervisors: Yacine FERROUKHI¹ and Amir SIR LARBI¹

¹Ecole Centrale de Lyon, ENISE, LTDS UMR CNRS 5513, 53 Jean Parot, 42100, Saint-Etienne, France

Contextualization



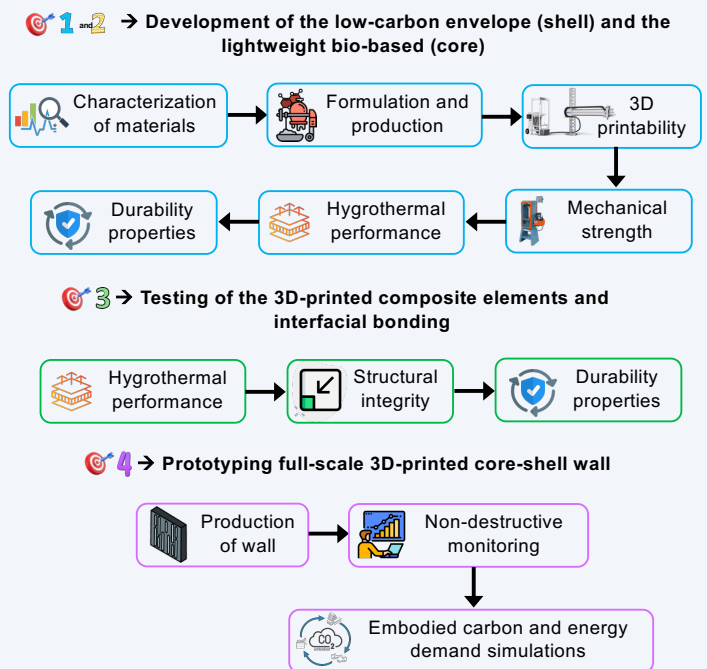
Innovation and approach



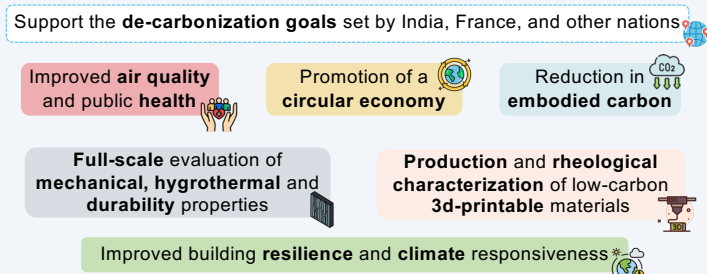
Scientific objectives

- 1 To investigate the influence of **low-carbon materials** on the **rheological properties**, **green strength**, and **hydration kinetics** of 3D-printable envelopes
- 2 To analyze the **mechanical** and **hygrothermal** performance of **lightweight infills** using **bio-based materials**
- 3 To assess the properties of the **3D printed composite elements** such as **strength**, **shrinkage** and **hygrothermal** properties at **material** and **structural** scales
- 4 To evaluate the **embodied carbon**, **hygrothermal** properties and **operational energy** in 3D printed **full-scale wall** elements

Methodology



Expected impacts



Acknowledgements



References

Scan me!



GdR MBS
MATÉRIAUX de CONSTRUCTION BIOSOURCÉS

GdR2025

Ecole d'automne du GdR 2025, 12-16 October 2025

