SNUG

“Circular economy-based materials development to foster the transition to sustainable and high energy performance buildings at optimal costs”

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SUSTAINABLE PLACES 2024

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Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
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Transforming the buildings of tomorrow

SNUG is a European project that aspires to contribute to a world where buildings seamlessly integrate with the environment by reshaping the construction industry and fostering the transition to Zero-Energy Buildings (ZEBs).

Project ID

Project Name	Innovative methodology based in circular economy and artificial intelligence to foster the transition to Sustainable and very high eNergy performance bUildinGs at a cost optimal level
Acronym	SNUG
Project Number	101123150
Call	HORIZON-CL5-2022-D4-02
Topic	HORIZON-CL5-2022-D4-02-05
Type of Action	HORIZON Innovation Actions
Project starting date	1 November 2023
Project end date	30 April 2027
Project Duration	42 months

Partners

SNUG

AIDIMME INSTITUTO TECNOLÓGICO

Becsa Simetría

ctcon Centro Tecnológico de la Construcción

University of Stuttgart Germany

CHIMAR.

CRH

F6S

KAΠE CRES

BRIMATECH

keey AEROGEL

AUSTRIAN STANDARDS

Høgskolen i Østfold

KASTAMONU

TAKKENKAMP GROEP

AGITEC green efficiency

LURTIS AI Solving Your Tech Challenges

Globalcyclus Simetría

Presentation order

→ SNUG project. Objectives, Ambition and Methodology.

→ Analysis and design optimization of the Biomass-based materials (AIDIMME).

→ Industrialization and validation of the innovative solutions (Next Steps).

SNUG Project

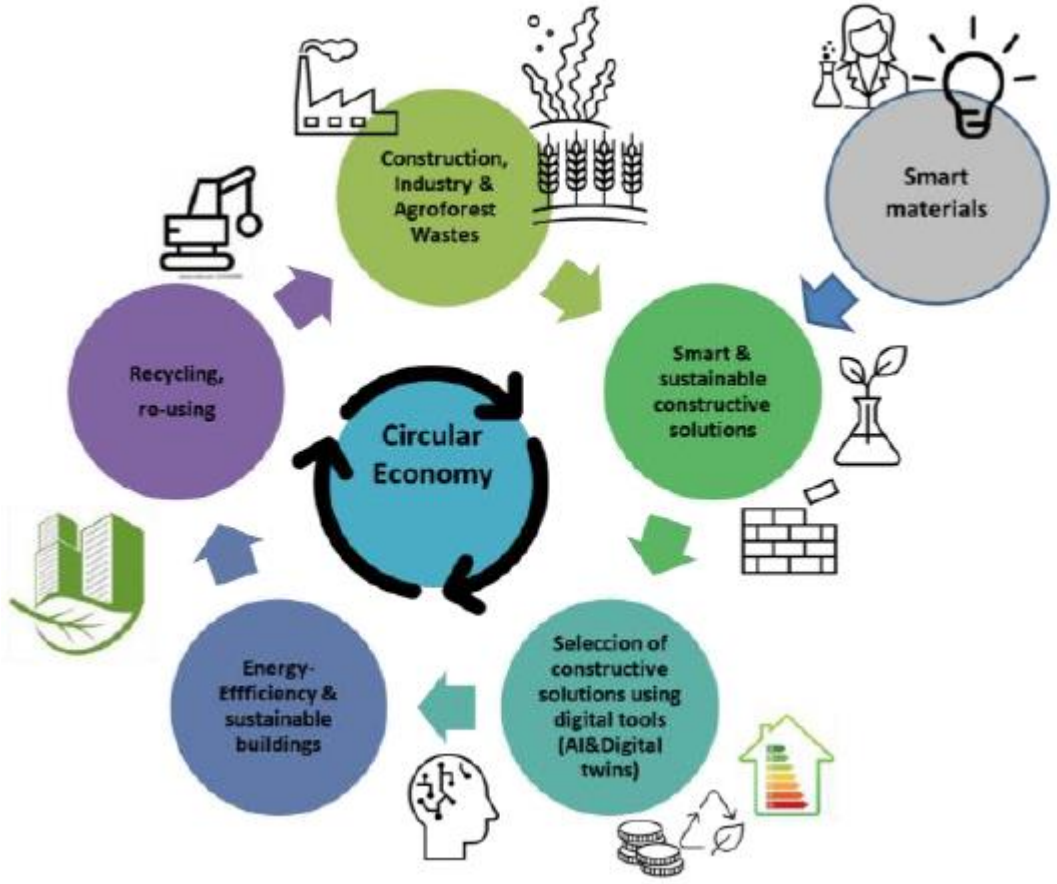
Objectives, Ambition and Methodology

Ambition

- In order to stimulate Europe building rehabilitation EU introduced ambitious new policies to encourage the improvement of energy efficiency of buildings:
  - **Zero Emissions Building (ZEB)** → all existing buildings to be transformed into ZEBs by 2050.
  - **Renovation Wave Strategy** → more energy-efficient, less carbon-intensive and more sustainable.
  - **The circular Economy Plan** which promotes designing products and infrastructure for longer lifetimes, reusing and recycling raw materials.
- **Assess buildings** energy and emissions performance from a life-cycle perspective. **Embodied + Operational.**
- **Implement energy efficiency measures during the design phase** which will minimize the operational and embodied emissions.
  - **Low carbon materials**
  - **Monitor** and test **materials** in a **real environment**.
  - **Standardization** for **new materials**.

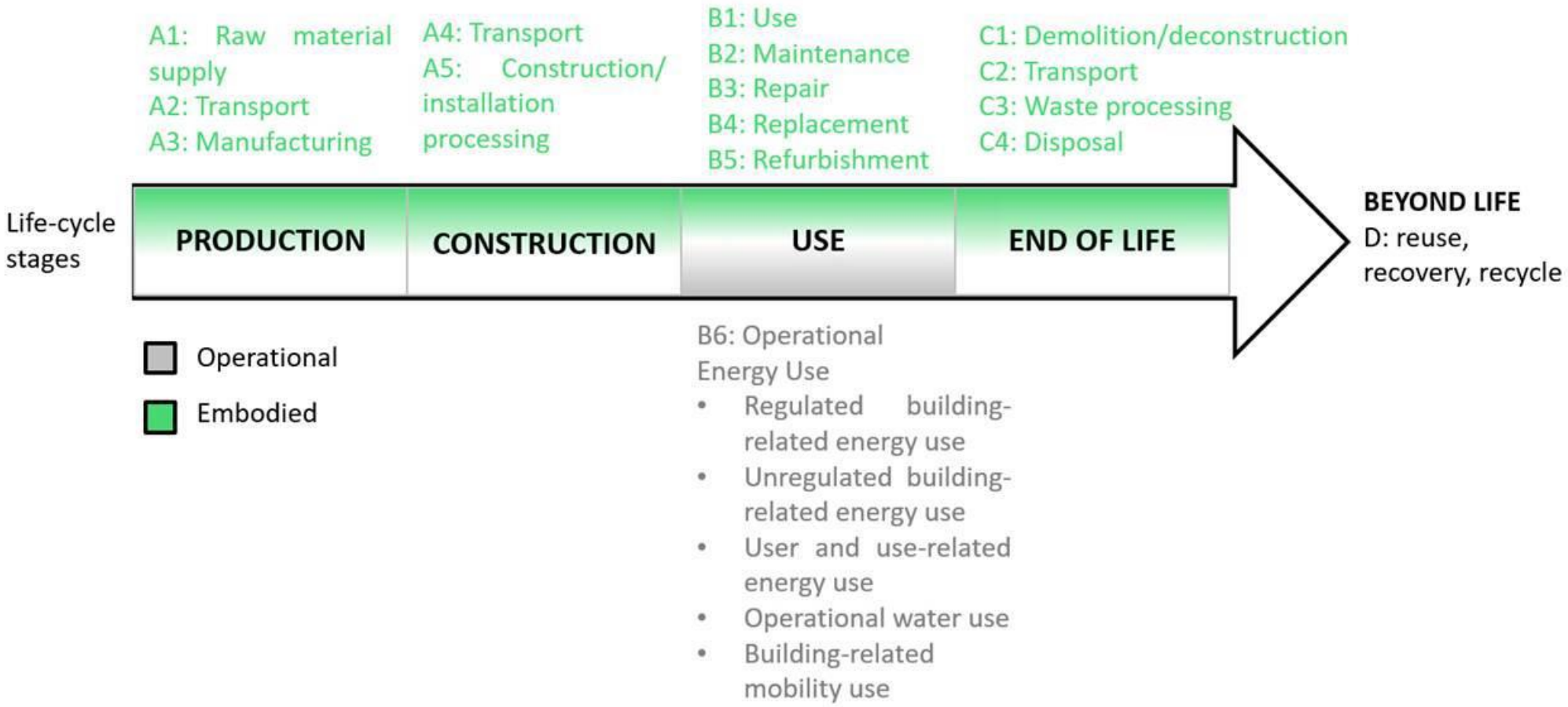
Objectives

- The best strategy in the design of **ZEBs** is **to act on the envelope or retrofit.**
- The installation of **insulation materials** proved to be **very effective** in the r**eduction of energy consumption.**
- **SNUG** aims to **develop and demonstrate a methodology to help** builders, architects, engineers, etc., **in the selection** of the most appropriate set of **thermal insulation materials or constructive solutions** by the development of:
  - **Digital Tool Assistant (DTA) based on AI and virtual simulation.**
  - **A set of sustainable-by-design thermal insulation materials and lightweight prefab solutions.**
  - **A database of thermal insulation materials, including metrics and LCA information.**
  - **A Digital Building Logbook**
- **Maximize** the **energy efficiency** and **minimize GHG emissions** of the building envelope **throughout its life cycle…**



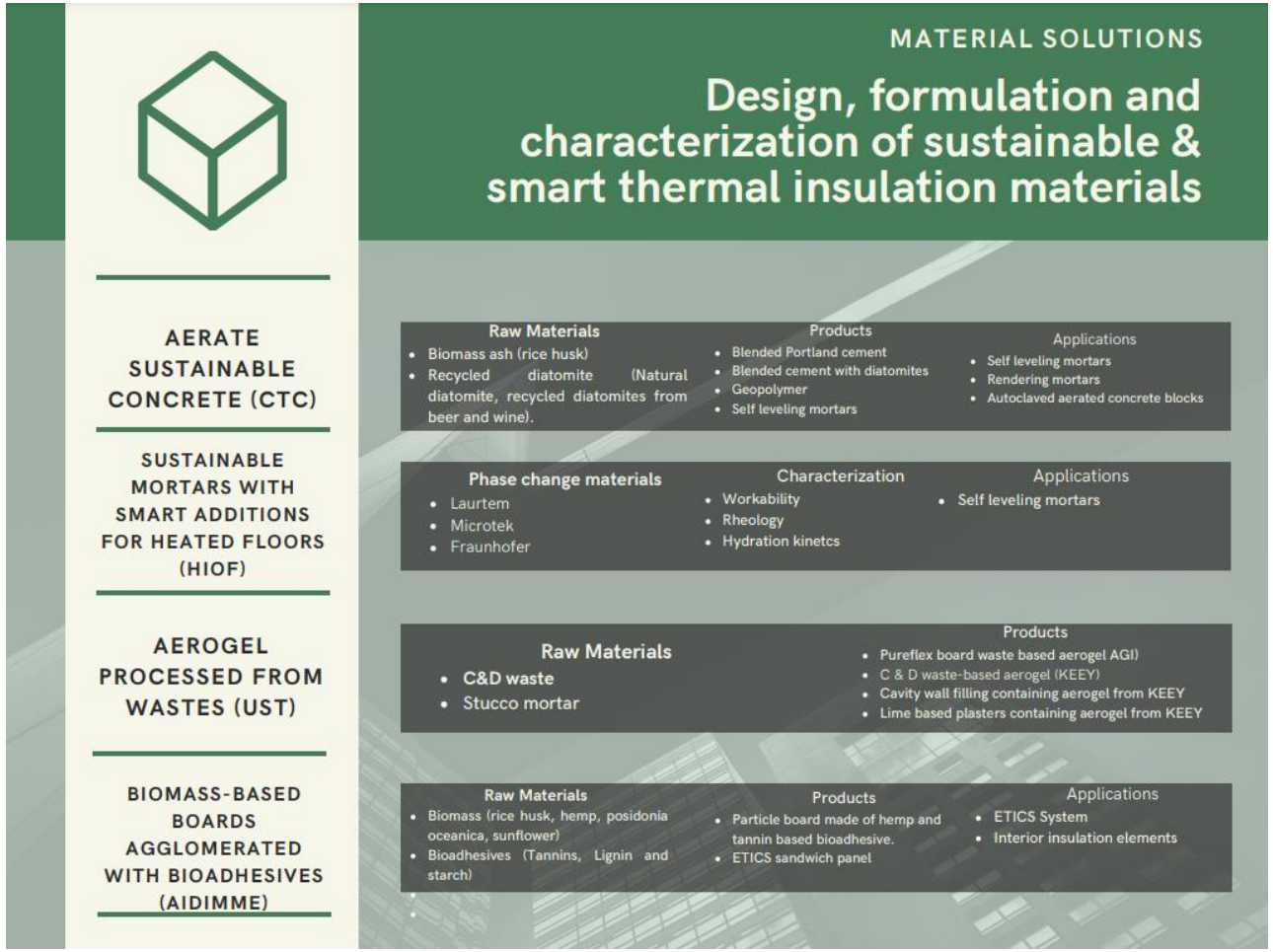
Methodology

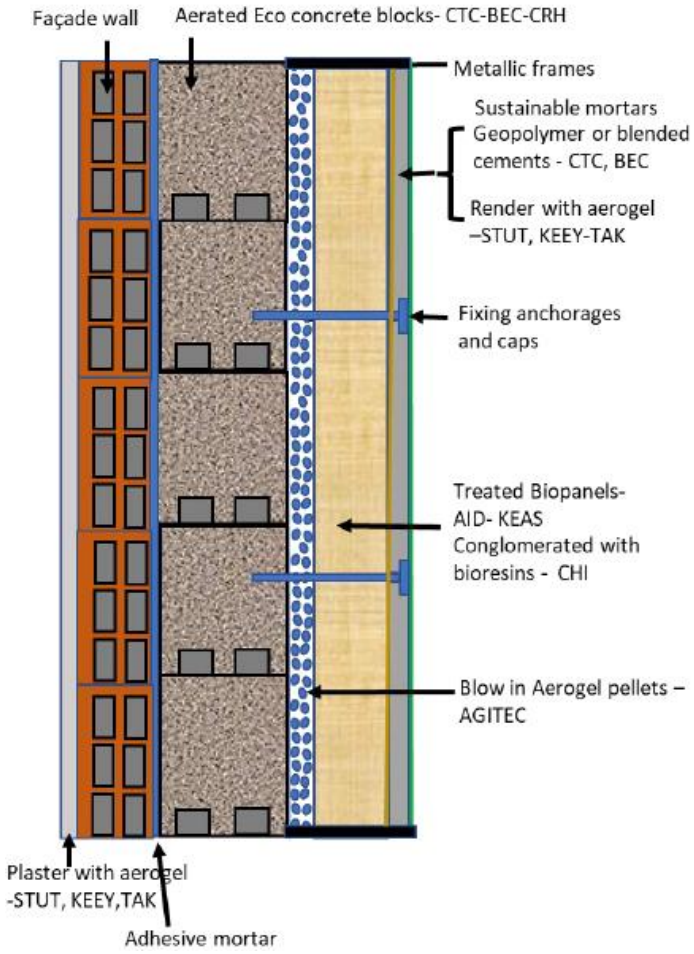
Life-Cycle stages and modules with details on the operational and embodied impacts.



Specific Objectives

- **SO1.** Optimize advanced and durable sustainable-by-design thermal insulation materials and multifunctional prefabs based on circular economy:





Specific Objectives

- **SO2. Industrialization** of advanced **thermal insulation materials and multifunctional products** developed at a pilot scale .
  - **Scale up** the developed materials to a preindustrial step **(TRL 6-7)**
  - **Reproduce features and performance** of products developed at pilot scale
  - **Minimizing the energy demand** of the industrial process.
  - **Achieve cost effective and sustainable** thermal insulation materials.
  - **Deploy advanced, market ready prefabs** and multifunctional materials with **recycling a reducing potential**.

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Specific Objectives

- **SO3.** Development of **Digital Tool Assistant (DTA)** able to **select the best thermal insulation solutions and installation.**
- **SO4. Demonstrate in three real buildings of different features, use and climatology**, methodology proposed for the selection of **best solutions adapted.**
- **SO5. Clustering and cooperation with other relevant projects** and HE Partnerships with related topics.

Switzerland

Spain

Norway

Biomass-based materials (AIDIMME)

Analysis and Design Optimization

Background

- AIDIMME investigated the feasibility of using sustainable prefab elements, developed by the institute itself in previous local projects.

- The construction elements for exterior (ETICS) and interior insulation were installed to study their behaviour in a real environment by a digital monitoring system.

SNUG KPI's

4 BIOPANELS AND SANDWICH PANELS

ENVIRONMENTAL BENEFITS

Table 13. Environmental KPI's

	Bio-panels			Sandwich panels		
KPI'S	**Circularity**	**Embodied energy**	**CO_2 emissions**	**Circularity**	**Embodied energy**	**CO_2 emissions**
Units	% vol	MJ/m^3	kg/m^3	% vol	MJ/m^3	kg/m^3
End project	95-100	700-1800	50-150	Ext.: 85-95 Int: 95-100	Ext: 750-900 Int: ~1800	Ext: ~ 150 Int: ~50

PERFORMANCE BENEFITS

Table 14. Thermal Performance KPI's

	Bio-panels			Sandwich panels		
KPI'S	**Thermal conductivity**	**Dimensions**	**Density**	**Thermal conductivity**	**Dimensions**	**Density**
Units	W/mK	mm	kg/m^3	W/mK	mm	kg/m^3
End project	0,045 – 0,060	Th = 50 W = 350-1000 L= 600-1000	190 – 300	<0,070	Th = 60 W = 350-1000 L = 600-1000	Ext: 510-530 Int:180-190

Table 15. S&S Performance KPI's

	Bio-panels		Sandwich panels	
KPI'S	**Reaction to fire**	**VOC's**	**Reaction to fire**	**VOC's**
Units	Classification	ppm	Classification	ppm
End project	C	0	B-s1, d0	0

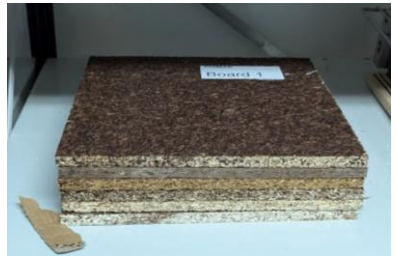
COST

Table 16. Economical KPI's

		Bio-panels	Sandwich panels
KPI'S	**TRL**	**COST**	**COST**
Units		(€/m^2)	(€/m^2)
End project	7	<170-185	<160

Analysis (Tests)

Material	Density (kg/m3)	Thermal Cond. (W/m-K)	Reaction to fire (*MAHRE)	Acoustic Insul. (dB)	Internal Bond. (Mpa)
Hemp	443	0,0757	93,0	21,0	**0,61**
Rice Husk	453	**0,0634**	-	16,5	-
Sunflower	475	0,0718	**72,2**	**21,8**	0,12
Citrus waste	487	0,0741	85,8	12,3	0,09
Posidonia	490	0,0661	-	21,3	0,03



***MAHRE HRR (kW/m2): máximum average heat reléase per unit area**

Formulation Design Optimization

Chimar Hellas SA participated in the evaluation of the **compatibility** and performance of a series of **bio-adhesives** and the different **natural fibres** used.

Those **adhesives** were **developed by Chimar Hellas SA** and had to be **bio-based**, so resins with **tannin, lignin, soy and starch** were tested in the process.

Finaly in conjunction with Chimar, AIDIMME and Kastamonu took the decision for one combination.

HEMP FIBRES

+

TANNINS BASED RESIN

Characterization: Work to do (AIDIMME)

AIDIMME will study at lab-scale the final formulation through the **identification and selection of parameters** that will **influence** the system **performance** such as bio-adhesive percentage, thickness, density, application to existing surfaces.

Then with the bio-based panels in a sandwich system the following **characteristics** will be experimentally **tested**.

Test	Standard
Moisture content	UNE-EN ISO 18134-1:2016. Part 1.
Ash content	UNE-EN 14755
Sand content	UNE 56744:1988
Fungal resistance	EN ISO 846
Specific Heat	Internal Method
Compression resistance	EN 826
Shear Strength	EN 12090
Traction	EN 1608 and EN 1607
Water Absorption	EN ISO 29767
Dimension Stability	EN 1604
Water Vapor Transmission	EN 12086

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