SUSTAINABLE PLACES 2025

SNUG

"Advancing Sustainable and Energy-Efficient Buildings Through Circular Material Innovation at Optimal Cost"

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Presentation order:

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- SNUG project. Overview.
- Development of sustainable and energy-efficient solutions for buildings.

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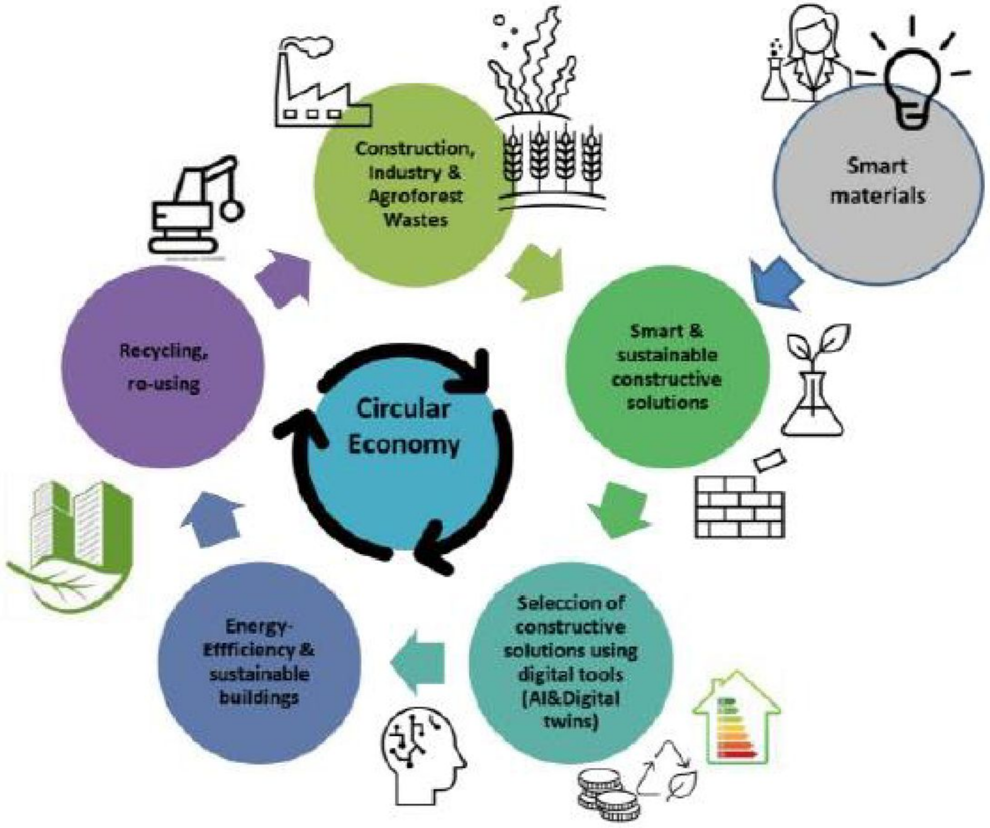
Our mission is clear: maximize building energy efficiency and minimize greenhouse gas emissions, enabling a greener future for communities.

Objectives:

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



Specific objectives:
SO1. Optimize advanced and durable sustainable-by-design thermal insulation materials and multifunctional prefabs.

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MATERIAL SOLUTIONS

Design, formulation and characterization of sustainable & smart thermal insulation materials

AERATE SUSTAINABLE CONCRETE (CTC)

Raw Materials	Products	Applications
• Biomass ash (rice husk) • Recycled diatomite (Natural diatomite, recycled diatomites from beer and wine).	• Blended Portland cement • Blended cement with diatomites • Geopolymer • Self leveling mortars	• Self leveling mortars • Rendering mortars • Autoclaved aerated concrete blocks

SUSTAINABLE MORTARS WITH SMART ADDITIONS FOR HEATED FLOORS (HIOF)

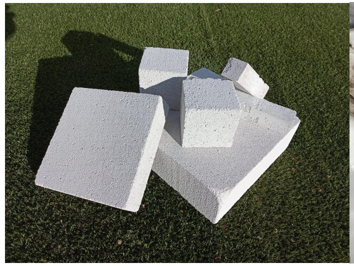
Phase change materials	Characterization	Applications
• Laurtem • Microtek • Fraunhofer	• Workability • Rheology • Hydration kinetcs	• Self leveling mortars

AEROGEL PROCESSED FROM WASTES (UST)

Raw Materials	Products
• C&D waste • Stucco mortar	• Pureflex board waste based aerogel AGI) • C & D waste-based aerogel (KEEY) • Cavity wall filling containing aerogel from KEEY • Lime based plasters containing aerogel from KEEY

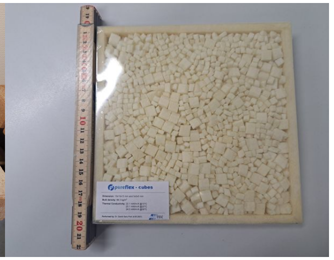
BIOMASS-BASED BOARDS AGGLOMERATED WITH BIOADHESIVES (AIDIMME)

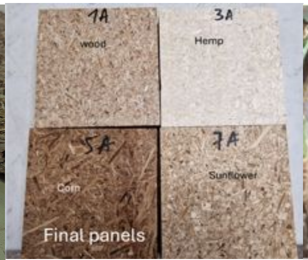
Raw Materials	Products	Applications
• Biomass (rice husk, hemp, posidonia oceanica, sunflower) • Bioadhesives (Tannins, Lignin and starch)	• Particle board made of hemp and tannin based bioadhesive. • ETICS sandwich panel	• ETICS System • Interior insulation elements









Specific objectives:

SO2. Industrialization of advanced thermal insulation materials and multifunctional products developed at a pilot scale.

KPI´s:

1. Environmental KPI’s
2. Thermal Performance KPI’s
3. S&S Performance KPI’s
4. Economical KPI’s

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.


Scandinavian climate


Continental climate

Mediterranean climate





Aerated eco-concrete blocks based on blended OPC and geopolymers (CTCON)

Analysis and Design Optimization

Leaders and participants: CTCON, BECSA, CRH.

1 New cements and geopolymers with local waste.

1. Common applications

Mortars.

BECSA/CTCON/HIOF

2 New cements and geopolymers with local waste.

2. AAC Block.

CRH/CTCON

SNUG

New low carbon footprint cements for common applications

1 GGBFS geopolymers

2 Ordinary Portland cement

WITH 40% LOCAL WASTE

Biomass ash

Recycled diatomite

SAW

Cement:

	Compressive strenght 7 days	Compressive strenght 28 days	Compressive strenght 90 days	Initial Setting (min)	Final Setting (min)	Capillary water absorption test (g/mm2)	Capillary water absorption rate %	Drying Shrinkage (%)	Slump (cm)
Blended cement	41,4	53,7	66,9	201	362	0,0142	-1,7	-0,067	14,5
Geopolymer	23,6	54,8	78,3	151	270	0,015	-16.1	-0.127	14,3

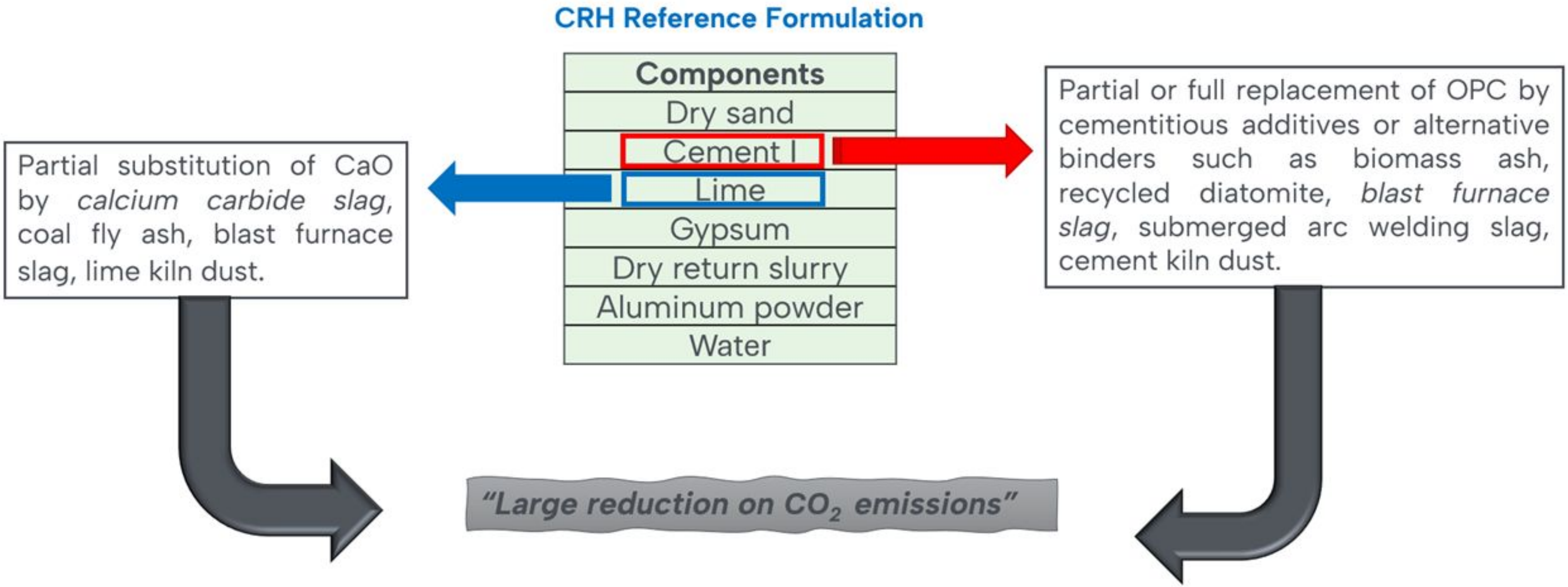
Wall cladding:

PROPERTY	STANDARD	VALUE
Compressive strength	EN 1015-11	≥ 6 MPa
Adhesion after climatic conditioning cycles	EN 1015-21	≥ 0.3 MPa
Water absorption	EN 1015-18	≤ 0.20 $kg/(m^2 \cdot min^{0.5})$
Water permeability after climatic conditioning cycles	EN 1015-21	≤ 1 ml/cm^2 after 48h
Water vapour permeability	EN 1015-19	$\mu \leq 15$
Thermal conductivity	EN 1745:2012	≤ 1 W/m·K
Reaction to fire	EN 13501-1	A1 class

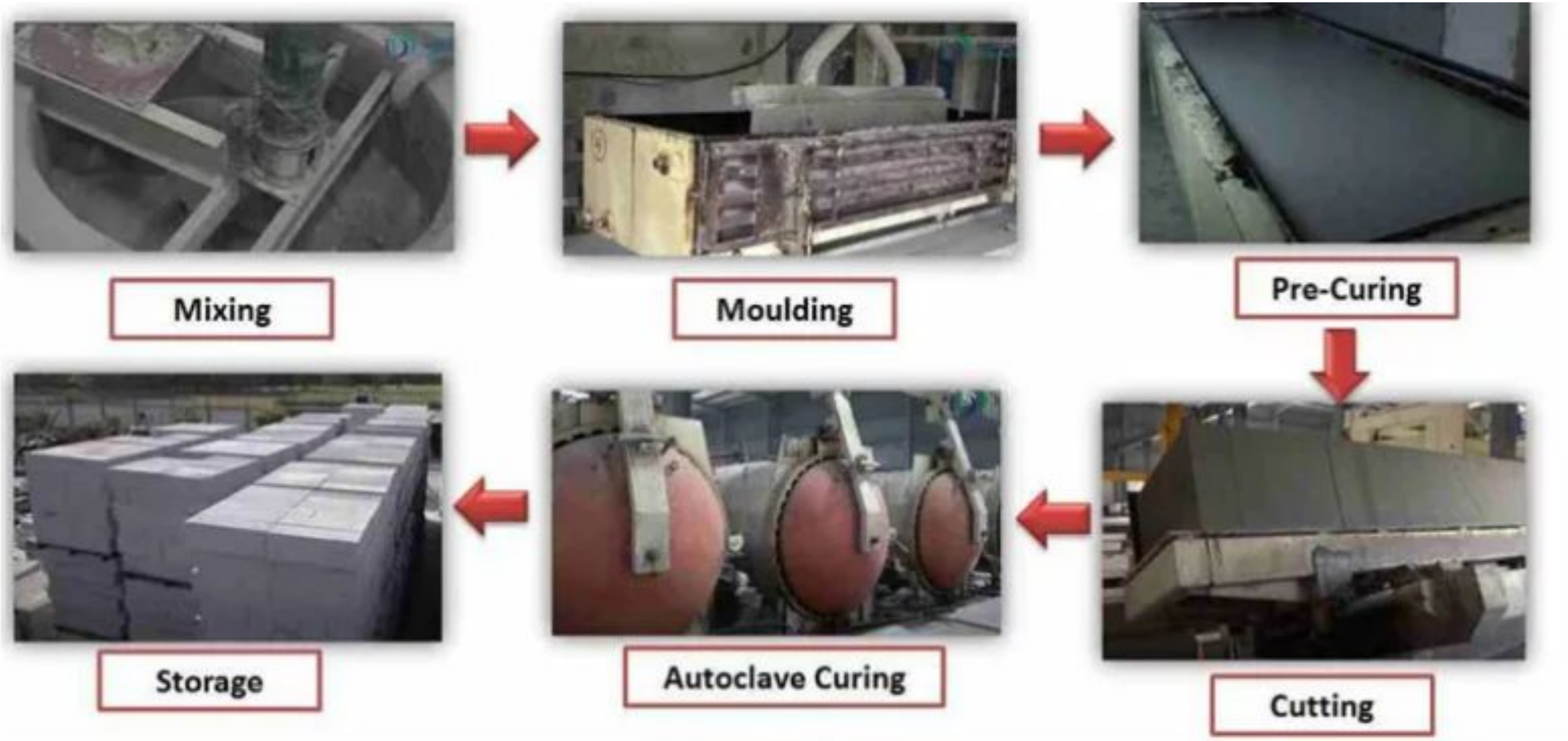
AAC BLOCKS:

AAC BLOCKS:

A novel approach on autoclaved aerated concrete production from waste sources was performed.



AAC BLOCKS:


Mixing
Moulding
Pre-Curing
Cutting
Autoclave Curing
Storage

AAC BLOCKS:

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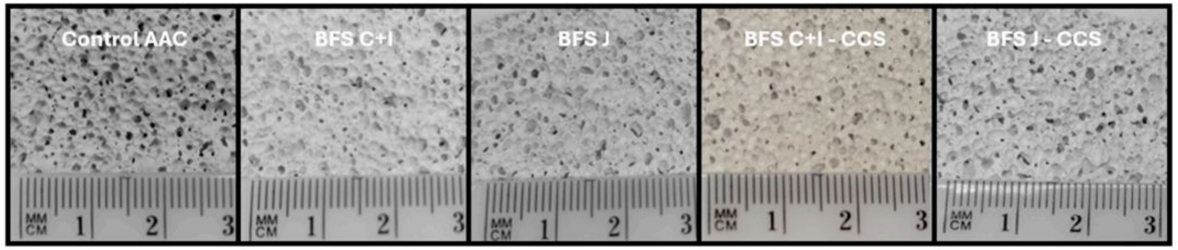
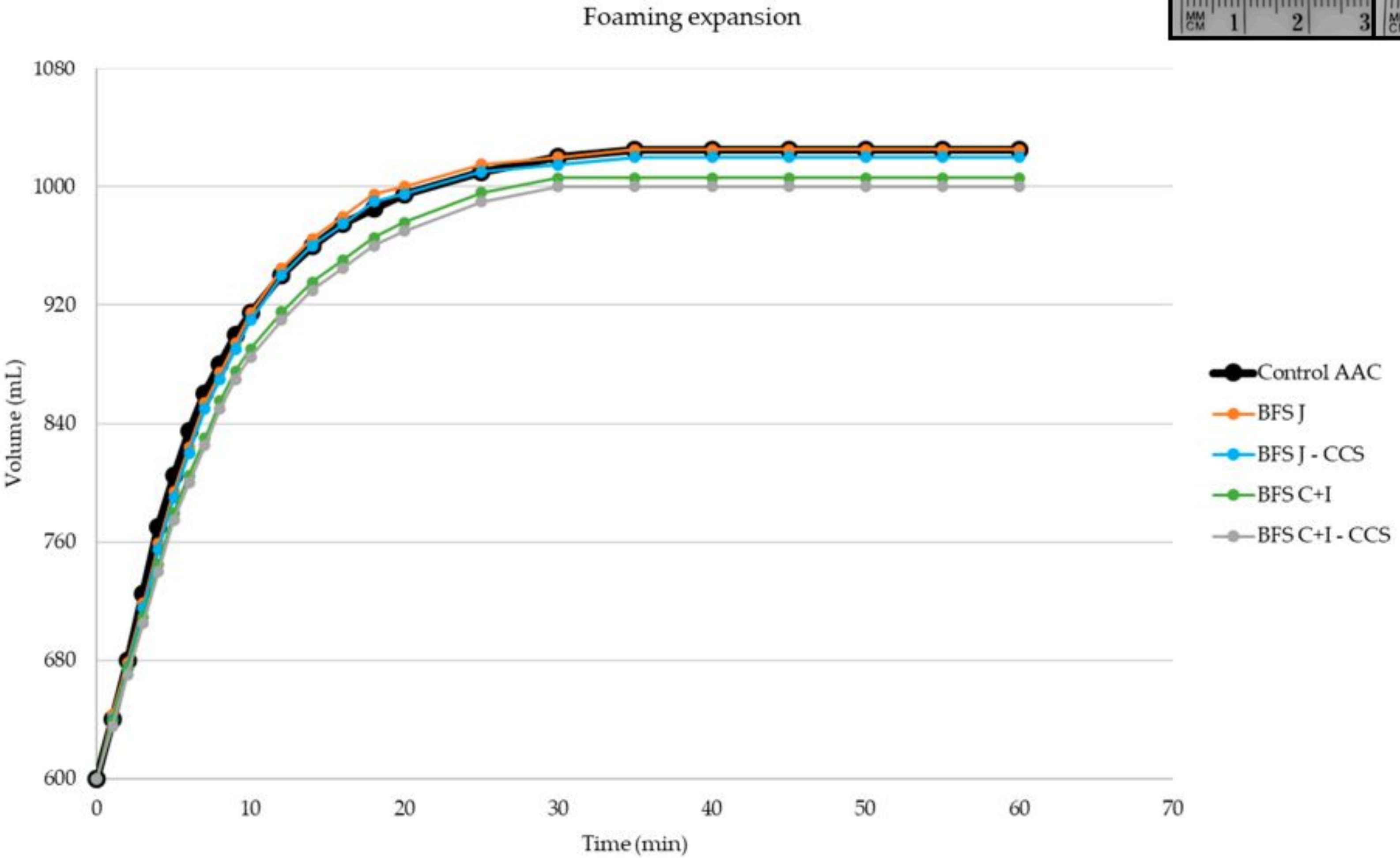
Mix	OPC (wt.%)	Lime (wt.%)	CCS (wt.%)	BFS J (wt.%)	BFS C + I (wt.%)	Sand (wt.%)	Gypsum (wt.%)	GAAC-CW (wt.%)
Control AAC	28	9	0	0	0	44	4	15
BFS J	-	9	-	28	-	44	4	15
BFS C + I	-	9	-	-	28	44	4	15
BFS C + I—CCS	0	9	9	0	23	41	4	14
BFS J—CCS	0	9	9	10	0	50	5	17






AAC BLOCKS:





Mix	Apparent Density [kg/m^3]
Control AAC	425
BFS C + I	428
BFS J	433
BFS C + I—CCS	420
BFS J—CCS	441

AAC BLOCKS:

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Mix	Compressive Strength (MPa)
Control AAC	2.51
BFS C + I	1.52
BFS J	1.33
BFS C + I—CCS	2.27
BFS J—CCS	2.49

Mix	Pre-Curing Portlandite (%)	Pre-Curing Quartz (%)	Pre-Curing Tobermorite (%)	After the Hydrothermal Treatment Portlandite (%)	After the Hydrothermal Treatment Quartz (%)	After the Hydrothermal Treatment Tobermorite (%)
Control AAC	9.0	29.2	0.0	0.2	16.7	40.6
BFS C + I	1.4	29.5	0.0	0.2	21.9	28.5
BFS J	3.6	29.2	0.0	1.3	17.3	27.8
BFS C + I—CCS	8.3	30.6	0.0	0.7	14.5	39.1
BFS J—CCS	7.9	28.5	0.0	0.8	18.2	36.8

AAC BLOCKS:

indicator/property	KPI (Control AAC)	BFS J-CCS	BFS C+I -CCS	GOALS
	technical INDICATORS			
Dimensions (mm)	600; 650 ± 1.5 75; 100; 125; 150; 250; 300; 350; 375; 400 ± 1.5 200 ± 1	600; 650 ± 1.5 75; 100; 125; 150; 250; 300; 350; 375; 400 ± 1.5 200 ± 1	600; 650 ± 1.5 75; 100; 125; 150; 250; 300; 350; 375; 400 ± 1.5 200 ± 1	YES
Compressive strength- (N/mm^2)	> 2	2,4/2,6	2,1/2,4	YES
Dimensional stability (mm/m)	max. 0.4	<0,4	<0,4	YES
Water absorption (90min) ($g/m^2\ s\ 0.5$)	Max. 120	< 120	< 120	YES
Water vapor permeability	Range 5/10	Between 5/10	Between 5/10	YES
Apparent density (kg/m^3)	400 ± 40	400 ± 40	400 ± 40	YES
Thermal conductivity (W/m K)	<0,1112	0,1125	0,1195	YES

AAC BLOCKS:

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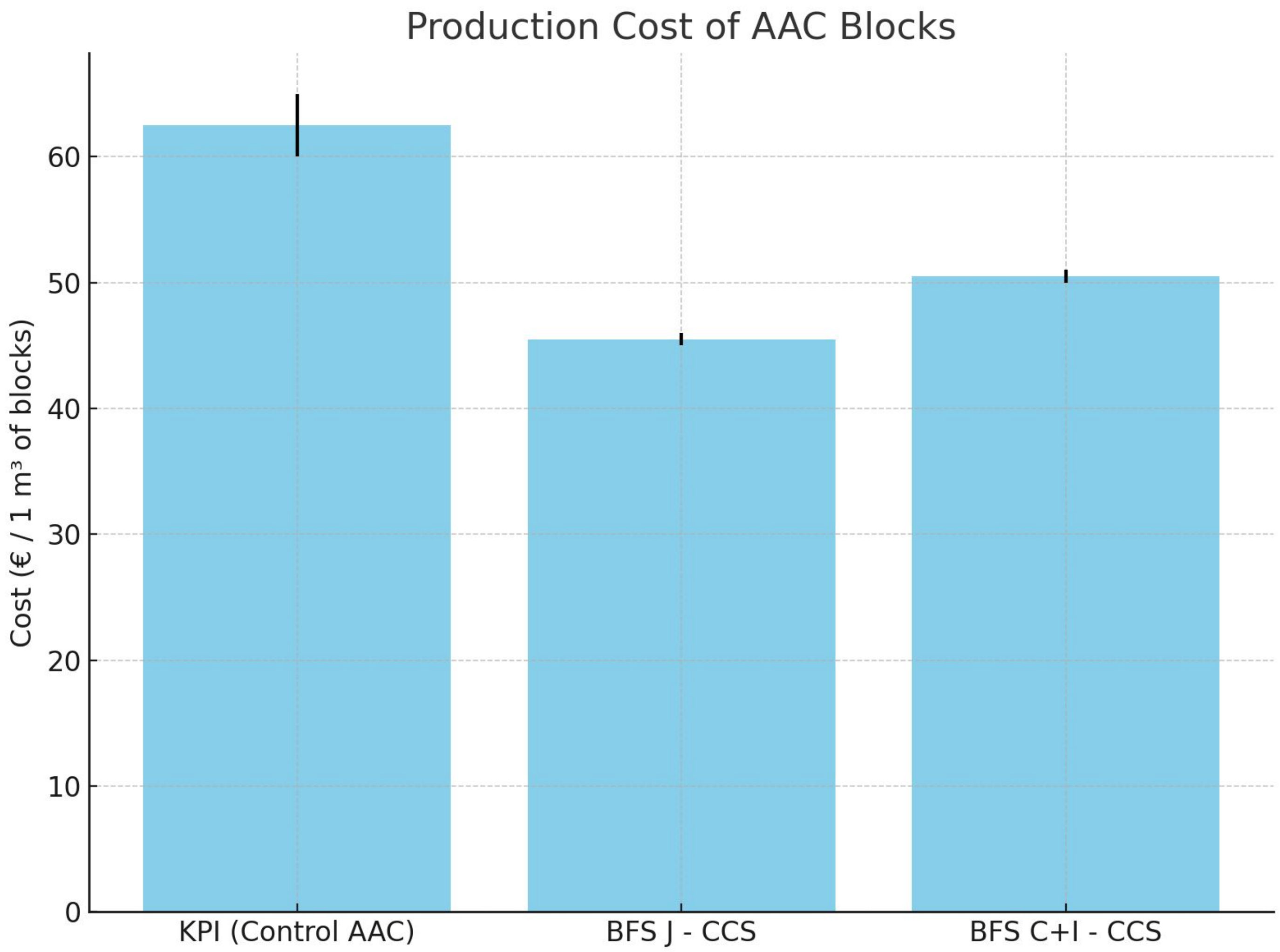
Environmental impacts of 1 m^3 of AAC blocks by mix design.

Impact Category [EF 3.1]	Unit	AAC control	AAC BFS J-CCS (Percentage reduction)	AAC BFS C+I - CCS (Percentage reduction)
Acidification	mol H^+ eq	0.4321	47%	49%
Water resource depletion	m^3 world eq. deprived	48.33	17%	21%
Ozone depletion	kg CFC-11 eq	2.67E-06	14%	15%
Fossil resource depletion	MJ	1628.24	26%	26%
Mineral and metal resource depletion	kg Sb eq	2.00E-04	50%	50%
Climate change (total)	kg CO_2 eq	206.13	48%	48%
Freshwater ecotoxicity (total)	CTUe	163.59	36%	34%
Eutrophication, freshwater	kg P eq	2.83E-02	36%	36%
Eutrophication, marine	kg N eq	1.14E-01	55%	57%
Eutrophication, terrestrial	mol N eq	1.1963	57%	59%
Photochemical ozone formation, human health	kg NMVOC eq	0.4183	47%	48%
Particulate matter	Disease incidence	3.42E-06	33%	39%
Ionizing radiation, human health	kBq U235 eq	10.97	28%	28%
Human toxicity, cancer effects (total)	CTUh	1.22E-07	56%	55%
Human toxicity, non-cancer effects (total)	CTUh	9.88E-07	63%	64%
Land use	pt (points)	377.65	20%	29%

AAC BLOCKS:


Production Cost of AAC Blocks
Cost (€ / 1 m³ of blocks)
0
10
20
30
40
50
60
KPI (Control AAC)
BFS J - CCS
BFS C+I - CCS

AAC BLOCKS:

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More information:

- https://snugproject.eu/aerated-eco-concrete-blocks/

- Development of Low-Carbon Autoclaved Aerated Concrete Using an Alkali-Activated Ground Granulated Blast Furnace Slag and Calcium Carbide Slag. Appl. Sci. 2025, 15, 9946. https://doi.org/10.3390/app15189946

- Properties of Cement-Based Materials Incorporating Ground-Recycled Diatom. Crystals 2024, 14, 1030. https://doi.org/10.3390/cryst14121030

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