ReSBE 2026
ReShaping the Built Environment through Sustainability and Circularity
20-23 of October, 2026
Thessaloniki, Greece

SNUG

Innovative and Sustainable Insulation Solutions for Zero-Emission Buildings

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Energy and Buildings in the EU

SNUG

Buildings are the single largest energy consumer

→ **40%** of final energy consumption in the Union

→ **36%** of its energy-related greenhouse gas emissions



Energy consumption used for space heating in the residential sector

39%	**11%**	**3%**
Natural Gas	Oil	Coal





Energy and Buildings in the EU



85% of existing buildings were built before 2000



85% to 95% of the current building stock will still be standing in 2050



75% of buildings are energy-inefficient

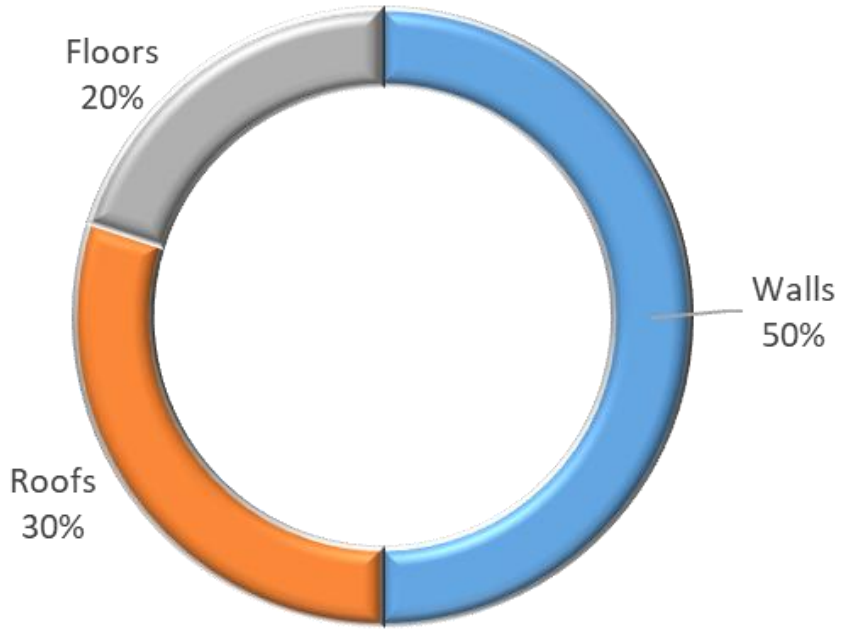


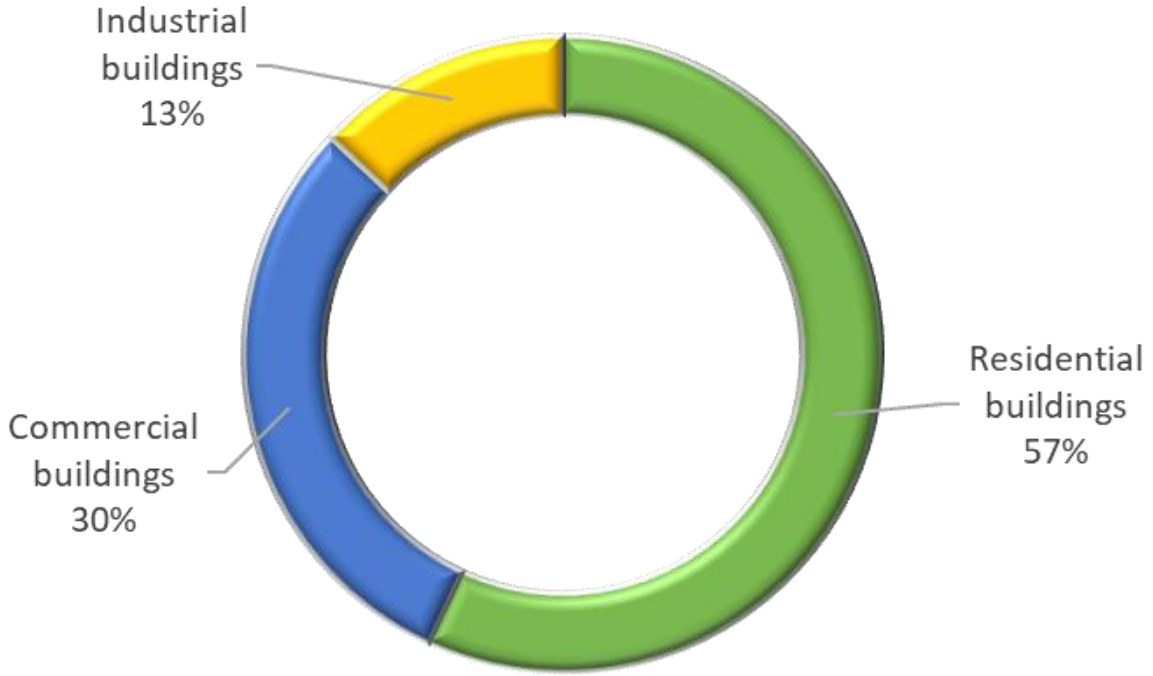
1% is the weighted annual energy renovation rate.

At the current pace, the decarbonisation of the building sector would require centuries

Building insulation market

- Globally → €21.3 billion → annual growth rate 5.7%
- EU → €7.5 billion → growth expected to increase to 6.3% per year





EU Built Environment

- 50% of all extracted materials are used in the built environment
- 35% of total waste generates from construction sector
- 5%–12% of total GHGs are delivered from:
  - ➔ material extraction
  - ➔ construction product manufacturing
  - ➔ building construction
  - ➔ renovation

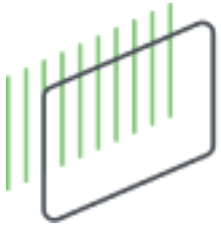
Material efficiency could reduce these emissions by up to 80%

Building performance simulation

SNUG "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".



DIGITAL TOOL ASSISTANT



SUSTAINABLE-BY-DESIGN THERMAL INSULATION MATERIALS



THERMAL INSULATION MATERIALS DATABASE



DIGITAL BUILDING LOGBOOK

Building performance simulation

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DIGITAL TOOL ASSISTANT

Offers tailor-made options of thermal insulation materials and layouts, taking into account technical, environmental, and economic inputs

SUSTAINABLE-BY-DESIGN THERMAL INSULATION MATERIALS

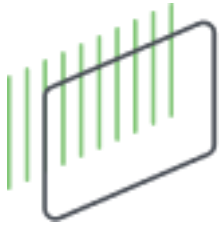
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DIGITAL TOOL ASSISTANT



SUSTAINABLE-BY-DESIGN THERMAL INSULATION MATERIALS

Made of locally sourced renewable materials and bio-based components, with a focus on cost-effectiveness

THERMAL INSULATION MATERIALS DATABASE

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SUSTAINABLE-BY-DESIGN THERMAL INSULATION MATERIALS



THERMAL INSULATION MATERIALS DATABASE

Catalogue of both existing and new solutions, providing life cycle assessment details through an open data tool

DIGITAL BUILDING LOGBOOK

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SUSTAINABLE-BY-DESIGN THERMAL INSULATION MATERIALS

THERMAL INSULATION MATERIALS DATABASE



DIGITAL BUILDING LOGBOOK

Facilitates decision-making and information sharing, connecting building owners, occupants, financial institutions and public authorities

SNUG Thermal Insulation Materials

- **Aerated eco-concrete blocks:** Lightweight materials offering low density, improved thermal insulation, and material efficiency.
- **Sustainable self-leveling mortars (SLMs):** Consist of low-carbon-emission cement-based binders incorporating inorganic or organic phase-change materials (PCMs). They are designed for radiant floor systems.
- **Aerogel-based solutions:** Provide exceptional thermal insulation and fire resistance while reducing energy demand. New solutions with lime-based renders and plasters (from CDW) and blow-in insulation (from thermal insulation waste) are being developed with lower embodied energy and cost.
- **Biopanels:** Bio-based panels made from renewable resources such as agro-waste, Posidonia, rice husk, and industrial hemp. They offer high thermal resistance, low carbon footprint, and contribute to the circular economy.



Purpose of the work

Assessment of the thermal and energy performance of a thermal insulation material.

Three scenarios are tested:

- ➔ a building without thermal protection on the external walls (Base Case)
- ➔ a building insulated with the aerogel-based material (Scenario 1)
- ➔ a building with thermal insulation of polyurethane (PU) (Scenario 2)

DesignBuilder 2025.1 Build 2025.1.0.088 EnergyPlus 23.1

The assessment carried out with the use of the simulation tool, DesignBuilder v2025.1.

A virtual building modeling environment used for building performance analysis that integrates the EnergyPlus simulation engine.

Building performance simulation

Building

Urdorf, Switzerland



Characteristics	
Type of building	Sigle Family House
Construction year	1960s
Total area [m^2]	280



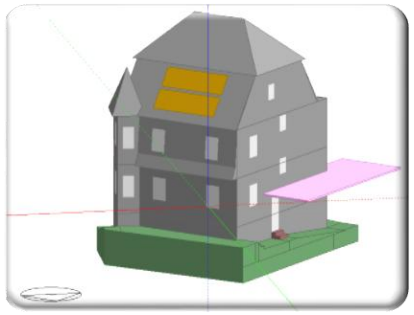


Building performance simulation

Building

Urdorf, Switzerland







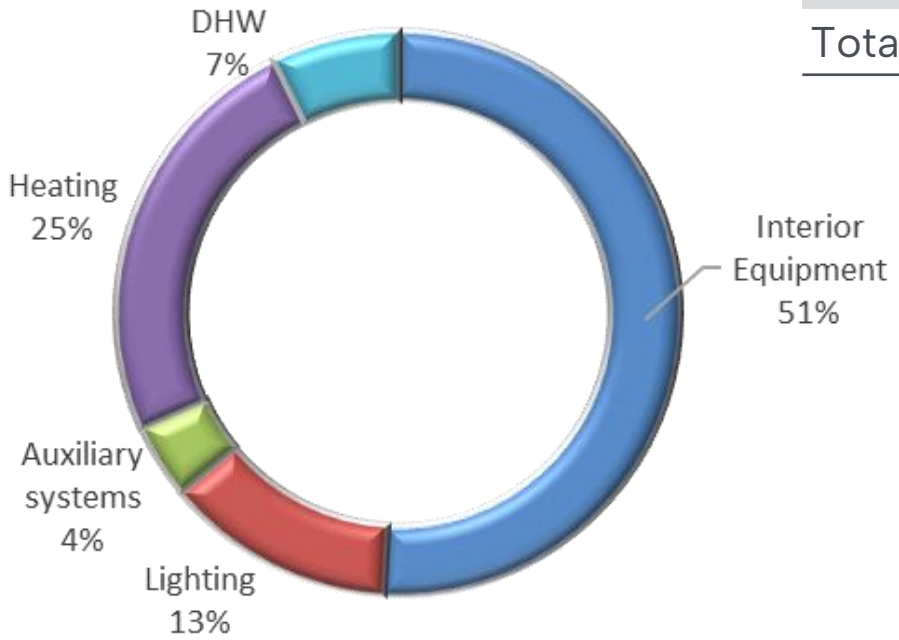
Building components		
External wall	Double-brick masonry without thermal insulation	265.6m^2
Pitched roof	Ceramic tiles with thermal insulation	84.4m^2
Windows	Aluminum frame, Double glazing with low-e	
Operational profile		
Occupancy (users)	4	
Schedule	Residential use	
Technical Systems		
Heating	Heat pump	COP:4.2
DHW	Heat pump & solar collector	9.6m^2
Ventilation	Heat recovery 85%	
Lighting	LED with manual operation	285W

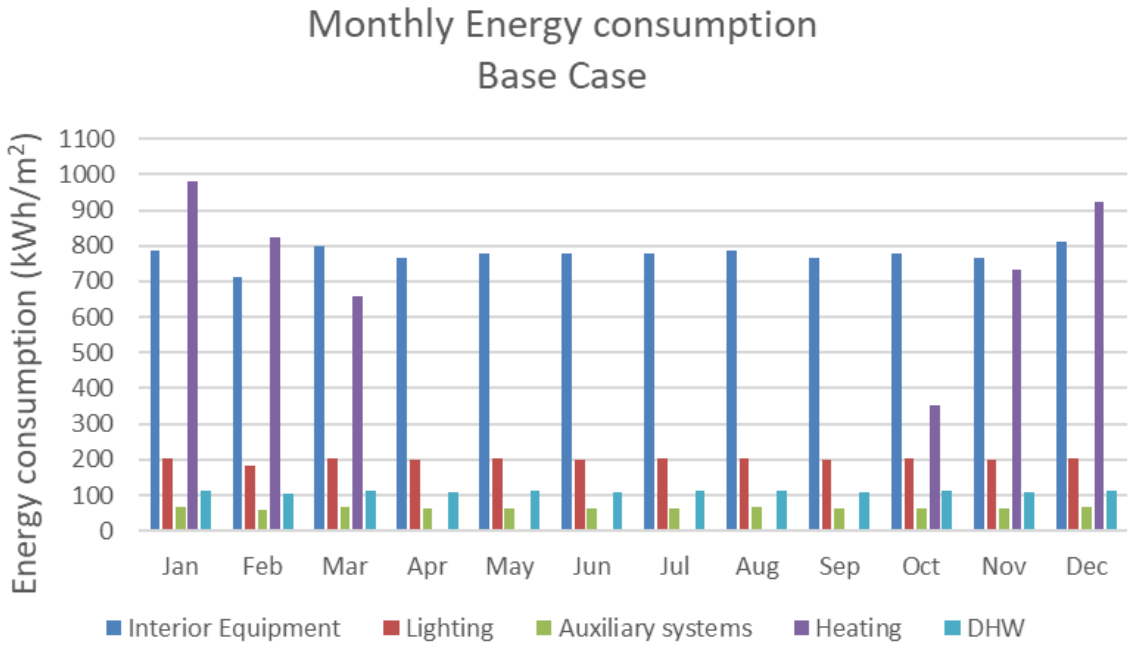
Building performance simulation

Building –Base Case

Simulation Results

End Uses	Electricity [kWh]	Electricity [kWh/m²]
Heating	4468.5	19.3
Interior Lighting	2405.7	10.4
Interior Equipment	9302.4	40.2
Auxiliary systems	775.2	3.3
DHW	1333.6	5.7
Total End Uses	**18285.4**	**78.9**

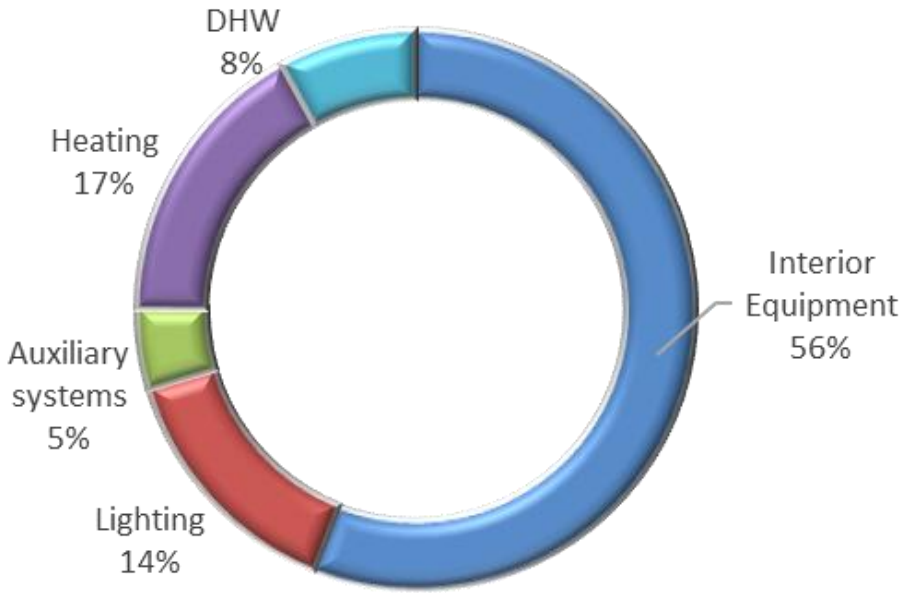




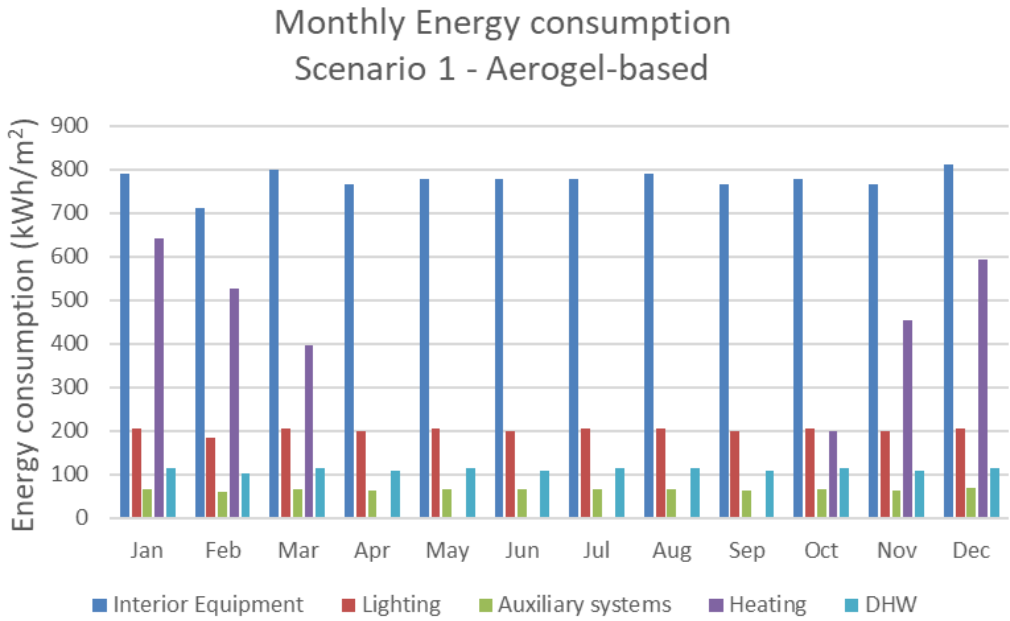
Building performance simulation

Scenario 1 –Aerogel-based

Simulation Results



End Uses	Electricity [kWh]	Electricity [kWh/m^2]
Heating	2805.5	12.1
Interior Lighting	2405.7	10.4
Interior Equipment	9302.4	40.2
Auxiliary systems	775.2	3.3
DHW	1333.6	5.7
Total End Uses	**16622.4**	**71.7**

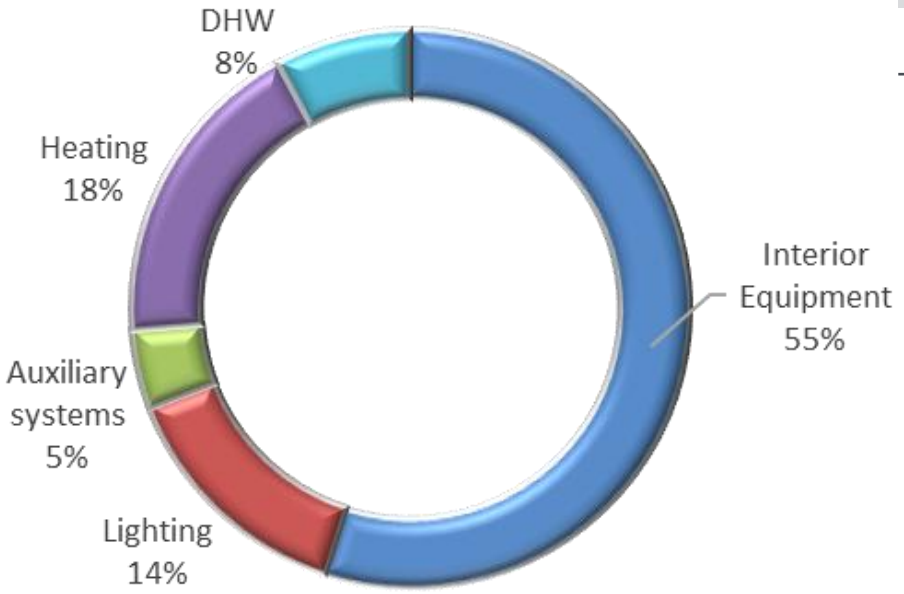


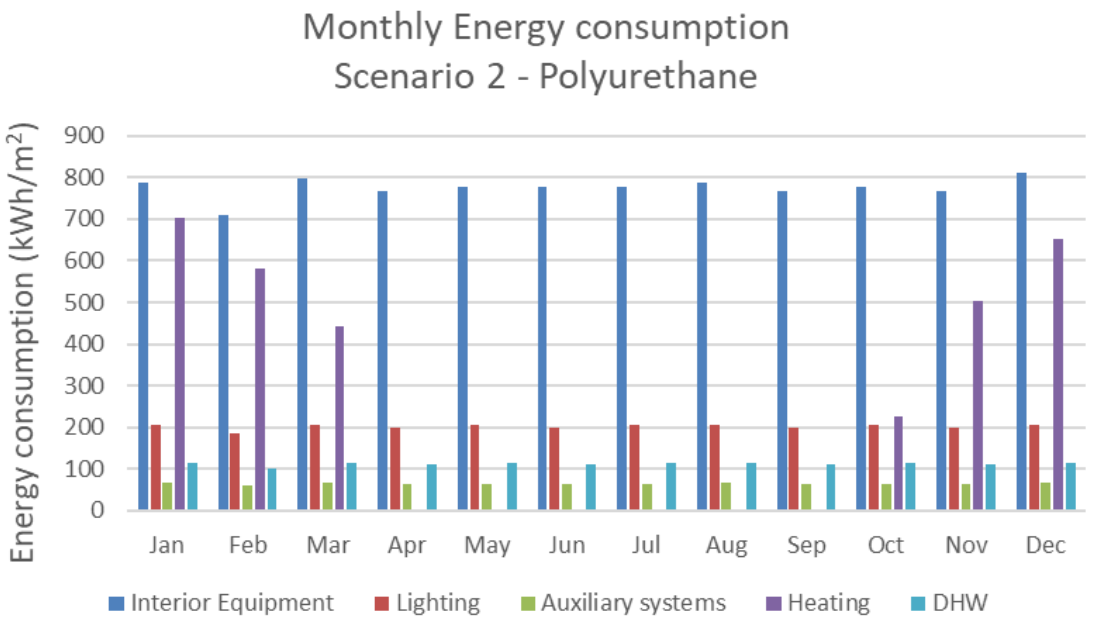
Building performance simulation

Scenario 2 –Polyurethane

Simulation Results

End Uses	Electricity [kWh]	Electricity [kWh/m²]
Heating	3104.0	13.4
Interior Lighting	2405.7	10.4
Interior Equipment	9302.4	40.2
Auxiliary systems	775.2	3.3
DHW	1333.6	5.7
Total End Uses	**16920.9**	**73.0**

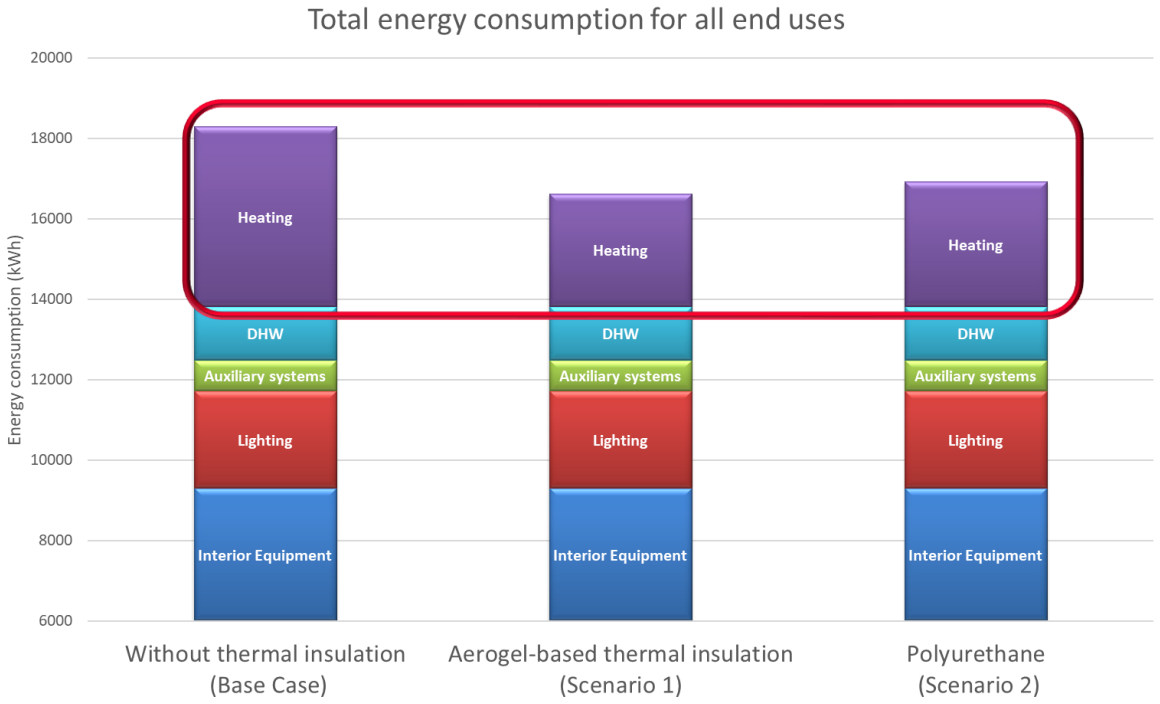


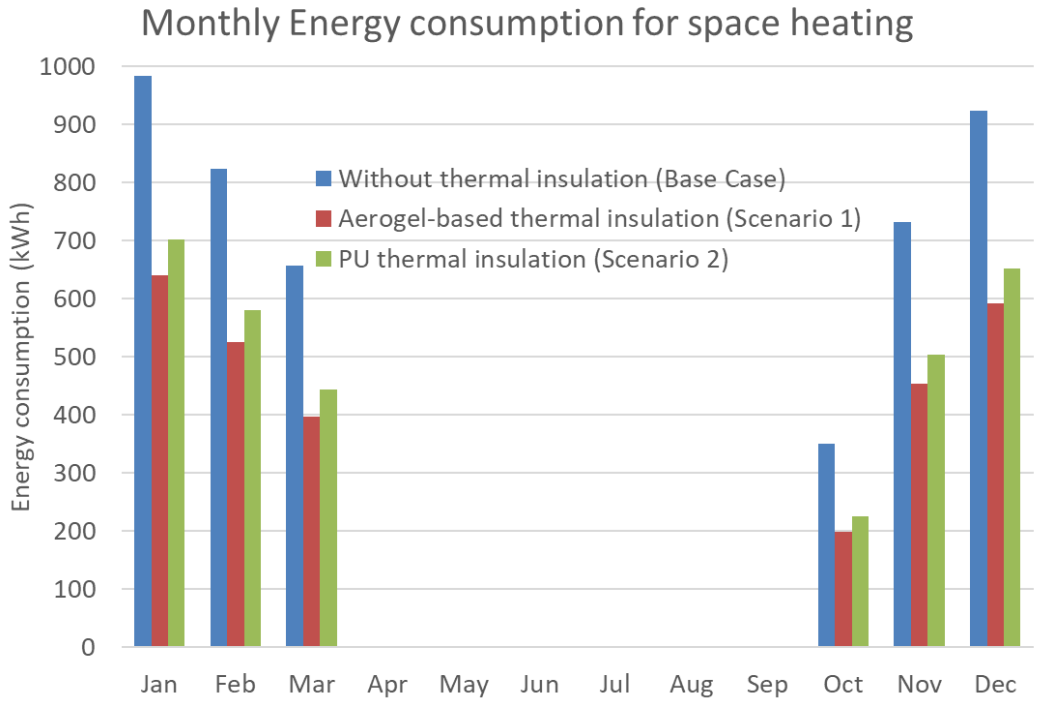


Building performance simulation

Building

Simulation Results



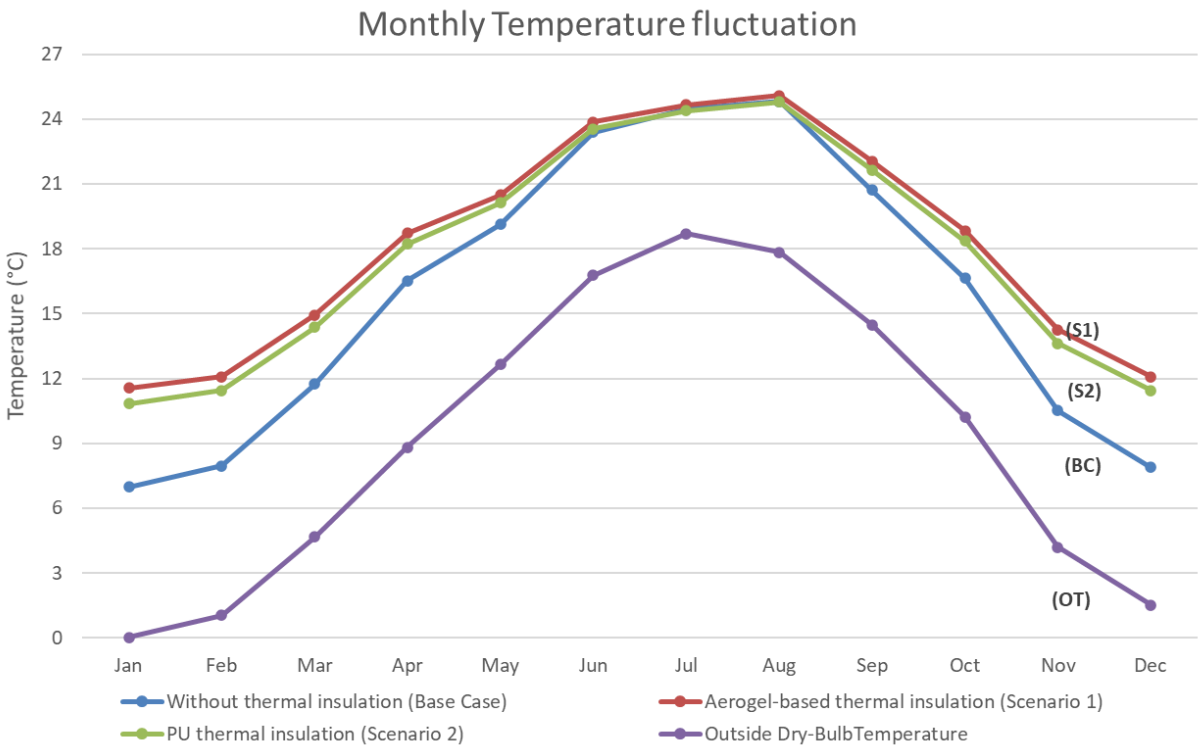


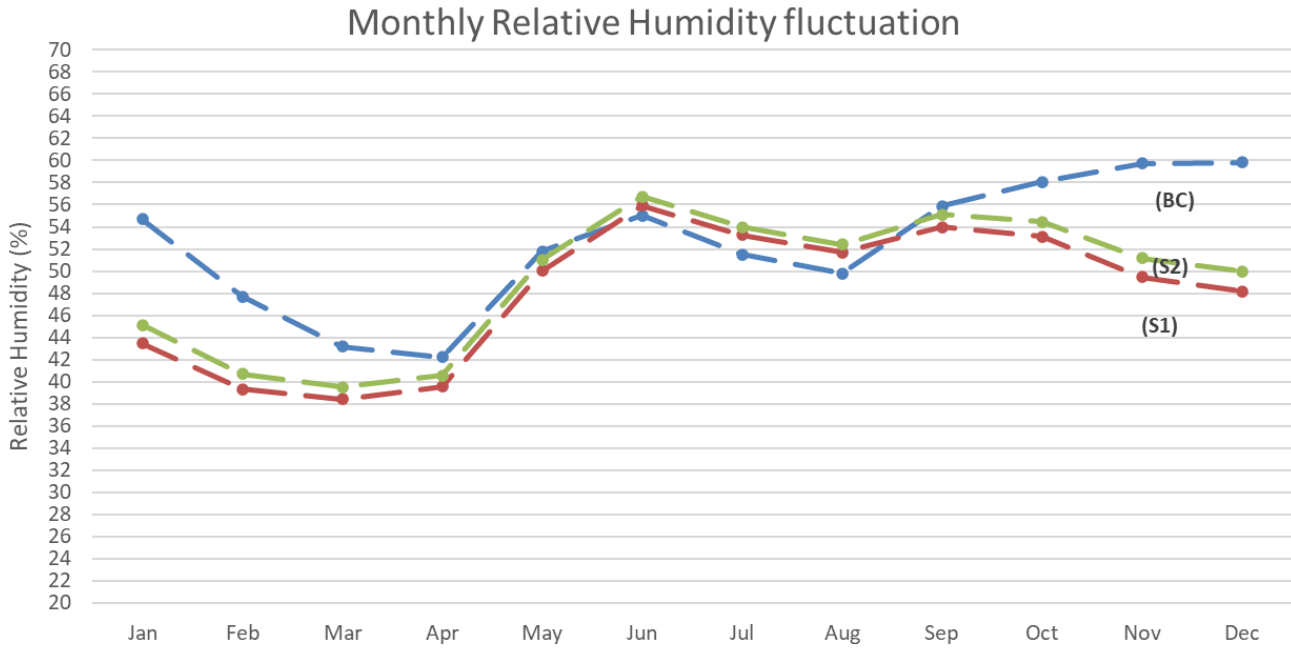
Savings	Energy consumption	CO_2 emissions
Scenario 1	37.2%	9.1%
Scenario 2	30.5%	7.5%

Building performance simulation

Building

Simulation Results





Conclusions

- The performance assessment was carried out, considering both energy and indoor environmental parameters.
- The installation of the aerogel-based thermal insulation solution improves substantially the energy performance of the building, resulting in 37.2% energy saving compared to the base case.
- The installation of the aerogel-based thermal insulation solution reduces CO_2 emissions by 9.1%.
- The aerogel-based thermal insulation solution achieves the highest indoor temperatures under free-floating room conditions during the heating period.
- The average indoor temperature in aerogel-based thermal insulation solution is approximately 0.6°C higher than PU thermal insulation.
- Both thermal insulation materials contribute to lower indoor relative humidity levels, further increasing indoor environmental quality.



Thank you

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