nZEM

Design of zero-energy modular and prefabricated housing structures.

The research project nZEM aims to create a prototype of a prefabricated housing module that combines high energy performance, low environmental impact, and process innovation to offer a quality product inspired by principles of the Circular Economy.

The main objective of nZEM is to encourage cooperation between companies and research organizations, promoting the development and prototyping of modular and flexible construction elements characterized by the integration of **innovative envelope and plant technological solutions**, which are created to respond to various functional and technical-regulatory needs (energy saving and efficiency, indoor comfort, accessibility, structural safety) respecting environmental compatibility, in order to guarantee participating companies access to new production tools and new markets in the construction sector, increasing its competitiveness.

The nZEM research stimulates the companies involved to start **Open Innovation processes**, favoring new investment opportunities at regional, national, and European levels, with a view to process optimization promoted by the concept of **industry 4.0** and development policies connected to the **Circular Economy**.

The goal of the nZEM project is to define new innovative envelope systems that can be assembled into a modular unit made with a wooden construction system that can adapt to different uses, functional needs, and spatial locations. For these reasons, the Nearly Zero Emission Module housing is designed to meet the requirements of prefabrication, transportability, and adaptability, as well as those necessary to ensure high energy efficiency and low environmental impact.

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Partnership
LAM ambiente (Project Coordinator)
UNIFI | Department of Architecture DIDA
Vigiani s.r.l
Verdiani & Linari s.r.l
Vetreria Vitrum s.r.l
B.R.T. Consulting

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VIGIANI S.r.l

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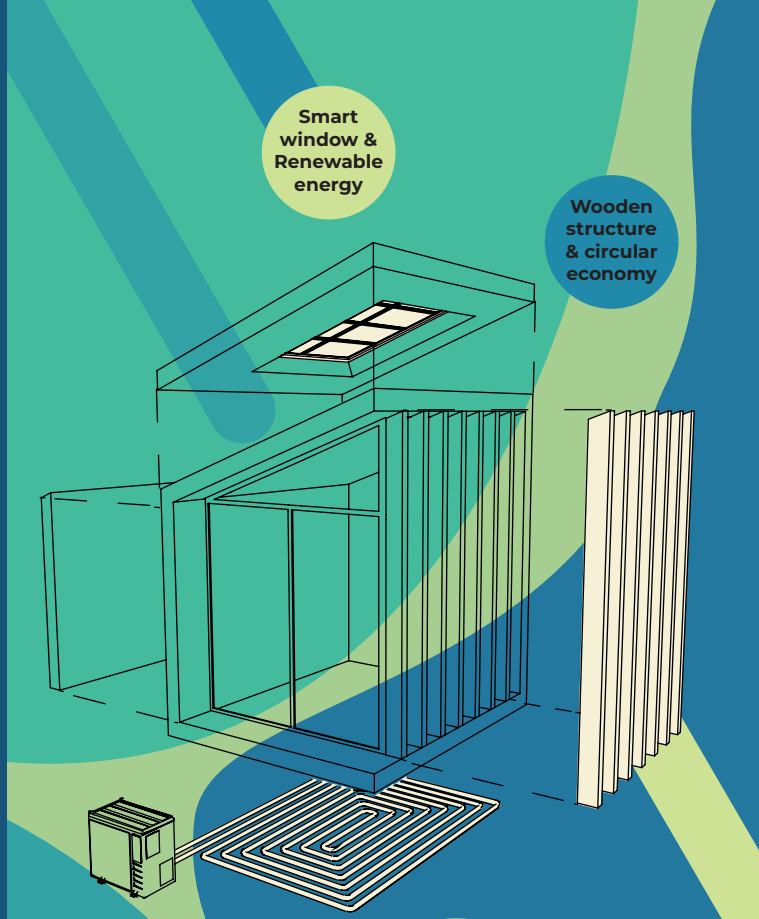

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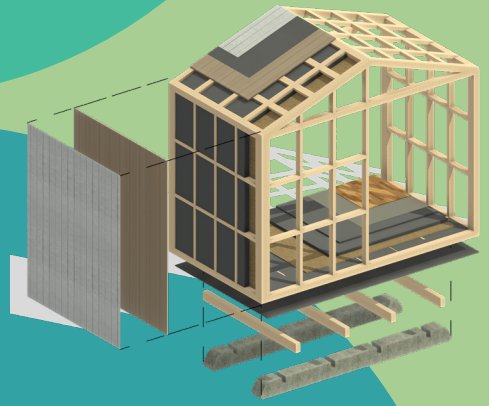
Opaque wooden walls

The modular system is **designed with a structure capable of assuming different stratigraphic configurations easily adaptable to various climatic conditions**, in terms of thermo-hygrometric performance and aesthetic-functional characteristics.

The module structure follows a solid wood **platform frame** construction method, with uprights and crosspieces positioned approximately 50 cm apart. This system has been preferred over the XLAM system for reasons of cost-effectiveness, ease of assembly, and low environmental impact. Moreover, it accommodates the **integration of customizable insulating cladding within the cavity, adaptable to specific climatic requirements**.

The platform system stands out for its exceptional structural resilience in wooden construction, a crucial factor considering that nZEM modules must not only meet static and seismic resistance standards but also endure the stresses from transportation between production and installation sites.



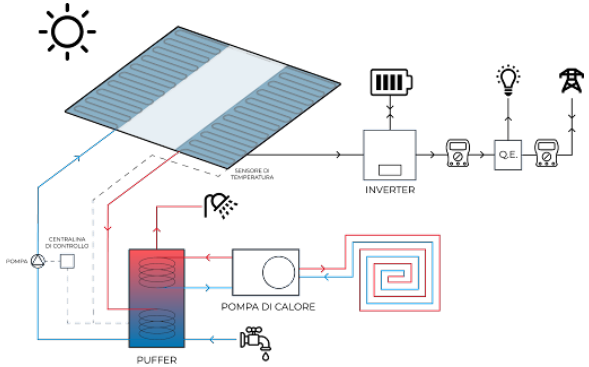
Partners:

Smart window

The **smart window** has been designed as a dynamic transparent sealing system capable of utilizing natural resources to **generate electrical energy, produce hot water, and allow sunlight to enter the living space**. Fundamentally, the smart window comprises two opaque components and one transparent component.

The opaque elements include transparent glass, thermoplastic film (EVA), photovoltaic cells, polycarbonate panel, copper sheet, and copper water coils for hot water circulation, all integrated with a thermal insulation panel. Conversely, the **transparent part consists of transparent glass, low-emissivity treatment, argon-filled cavities, and additional layers of glass treated for low emissivity**. The opaque section of the smart window serves a dual role: generating electrical energy through the photovoltaic cells and producing hot water via the coils beneath the copper sheet.

The electricity generated is stored in battery units for later use, while the hot water is channeled into a storage boiler for future domestic applications.



Partners:

Living module

The **nZEM housing unit** produced is **zero energy, totally prefabricated, easily transportable, assemblable, and reversible**, which, thanks to the possibility of customising the external closing elements, also lends itself to being used in geographical areas with different climatic characteristics and in contexts with different needs (tourism, emergency, permanent housing, etc.).

The basic module, consisting of a studio apartment with a bathroom, was tested in different geographical locations to verify performance in different contexts. The result is that in all the contexts analysed, the module guaranteed low energy consumption and excellent indoor comfort.

Partners: