Installation of the InnoWEE panels in demo sites

The panels developed in the InnoWEE project have been installed for demonstration activities in the following demo buildings:

- **Don Orione residential care center** in Bucharest (Romania) – ETICS-like panels;
- **Pilot House** in Padua (Italy) – ETICS-like panels;
- **Residential Eco-house** in Putte-Mechelen (Belgium) – radiant panels;
- **Old city hall of Voula** in Athens (Greece) – ETICS-like panels, ventilated façade panels, fire resistant indoor wood panels.

Don Orione, Bucharest (Romania)

Eco-house, Putte-Mechelen (Belgium)

Pilot House, Padua (Italy)

All the works are performed according to the **specific rehabilitation design** developed for each demo building, considering **the most performing solutions**, **requirements of the demo site**, but also architects', engineers' and our Advisors' **experience**.

Vouliagmeni, Athens (Greece)

Demo sites and their **thermal parameters are monitored** to assess **performance** and **efficiency** of the installed panels in **real conditions**.

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Work Programme topic addressed:

EeB-04-2016 New technologies and strategies for the development of pre-fabricated elements through the reuse and recycling of construction materials and structures

Project numer		Project cost
723916		**3.36 million €**
Project's start		**Project duration**
October 2016	**PARTNERS**	**4 years**
	COORDINATOR CNR-ISAC, Italy CNR-ITC, Italy CNR-ICMATE, Italy	
	Advanced Management Solutions, Greece	
	R.E.D SRL., Italy	
	Tecnalia Research & Innovation, Spain	
	Guidolin Giuseppe – Eco. G. srl, Italy	
	S.C Pietre Edil S.R.L, Romania	
	IZNAB Spolka z Ograniczona Odpowiedzialnoscia, Poland	
	Slovenian National Building and Civil Engineering Institute, Slovenia	
	Magnetti Building SpA, Italy	
	Municipality Varis-Voulas-Vouliagmenis, Greece	

„This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 723916"

Innovative pre-fabricated components including different **W**aste construction materials reducing building **E**nergy and minimising **E**nvironmental impacts

InnoWEE project focuses on the development, production and field tests of **new high performance eco-friendly prefabricated geopolymeric panels** including different recycled Construction and Demolition Waste (CDW) for **insulating facades** (ETICS, ventilated façade panels) and for **indoor radiating system** (monolithic panel, assembled panel) with **low environmental impact**, **low embodied energy**, **low CO_2 emissions** and **high thermal performance**.

The EU Framework Programme for Research and Innovation

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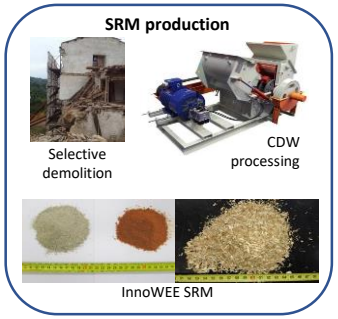
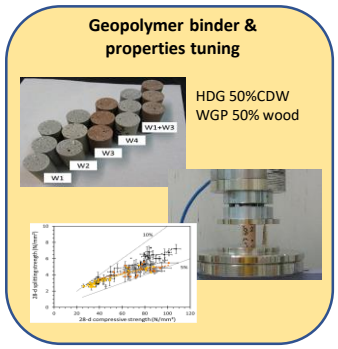
Binder development and prototype panels

Recycling of Construction & Demolition Waste (CDW) to make **new eco-friendly secondary raw materials (SRM).**

At ECO a **new CDW processing plant** has been set up to achieve a fully characterized **fine fraction SRM** consisting of **concrete** and **fired clay brick aggregates < 2mm in size** for inclusion in geopolymer binders. **Wood chips** were obtained by shredding wood from construction waste.



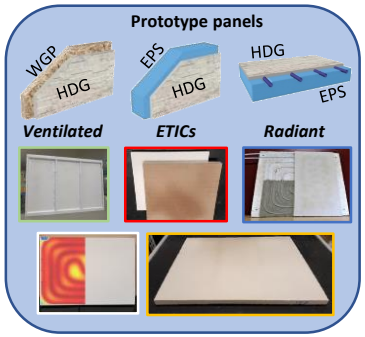
Use of the SRM with **geopolymeric technology** to **produce new insulating** and **radiating panels** with **high content of CDW** for **higher performace of buildings**.



At CNR-ICMATE a large set of **binder formulations** was tested including **up to 50% weight of inorganic CDW** and **50% of wood waste**. **Mechanical, physical** and **chemical properties** as well as **workability** and **open time** were assessed to achieve the best **binder formulation for upscaled panel production**.

Manufacturing and assessment of **prototype panels** in laboratory to obtain a **basis for scaling-up** the production process.

Designed respecting **wind** and **seismic safety** guidelines and allowing **installation with commercial anchoring** solutions. A set of **real scale prototype panels** were produced to **verify the feasibility of the fabrication process** and to **assess their properties**.

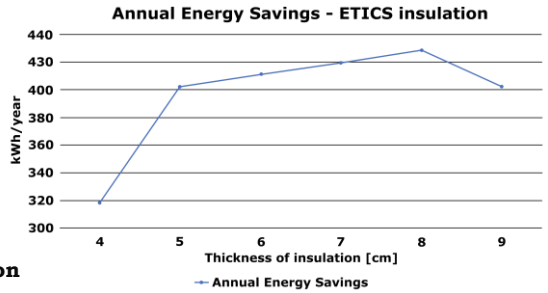


Energy performance simulation and thermal design of InnoWEE products

Simulation models are being developed by TECNALIA and RED to evaluate the **energy performance of InnoWEE solutions** under different parameters. Thus, optimized solutions are suggested based on **economic feasibility studies**. Calibrated simulation models allow:

- to **evaluate the performance and quantify the savings** according to the International Performance Measurement and Verification Protocol (IPMVP);
- to **select and optimize the best technical solutions** and project designs based on a **cost-effective analysis**;
- thermo-hygrometric, energy and economic assessment of the solutions;
- to analyse the **replication potential** under different climates.

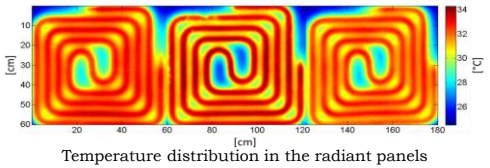
The results indicate that the solutions proposed by InnoWEE consortium **perform as competitive applications in construction sector.**



Moreover, they would be **suitable to achieve the EU goals** in terms of **energy efficiency** and **integration of renewable energy in buildings**.

CNR-ITC performed the **thermal design of InnoWEE radiant panels** to obtain **the best thermal performance** while respecting the constraints on **material thickness** and **piping geometry**. The design process was divided in three steps:

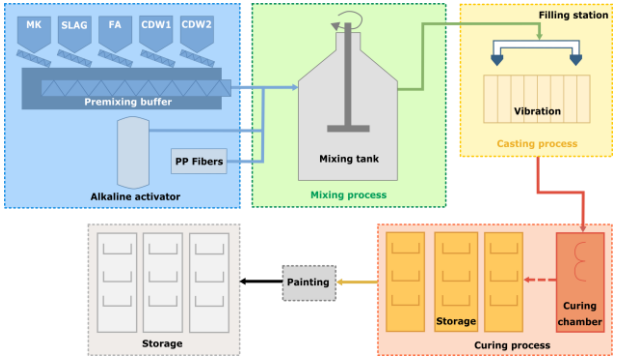
1. Thermal characterization of materials – the **thermal conductivity** as the key parameter;
2. Numerical simulations of the alternative solutions – **More than 60 design alternatives have been investigated** to define the **best configuration of geopolymeric thickness, mixture,** and **piping geometry**;
3. Thermal testing on specimen in laboratory – Thermal testing in a climatic chamber, both in steady state and in transient regime.



Temperature distribution in the radiant panels

Pilot production of InnoWEE panels and LCA

Following the most strict and advanced **industrial standards**, under a **fully automated monitoring processes**, the **"Technology Upscaling Pilot Plant" (TUPP)** has been designed by AMS in such technical flexibility that is **capable to upscale a wide range of technologies**. The **TUPP** was modified to meet all the **specific requirements of the High Density Geopolymer (HDG) panels**. The modified pilot line involves many steps like 1) preparation of raw materials, 2) pre-mixing, 3) mixing, 4) casting, 5) post curing, 6) curing, 7) painting and 8) logistics.



Scheme of the „Technology Upscaling Pilot Plant"

Life cycle assessment (LCA) is the study of the **environmental impacts** related to different life cycle stages of the product. In the InnoWEE project ZAG performs **life cycle inventory** and **impact assessment** for four types of panels where **secondary raw materials (SRM)** are used. The processing and the preparation of SRM must be taken into account when calculating the **environmental footprints**. Due to the substitution of virgin materials with SRM considered "waste", the **environmental footprints tend to be lower** as when using virgin materials.