



INDTECH2018

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PILLAR 1

Session 1.2

Energy-enabling materials for Energy Efficiency in Buildings

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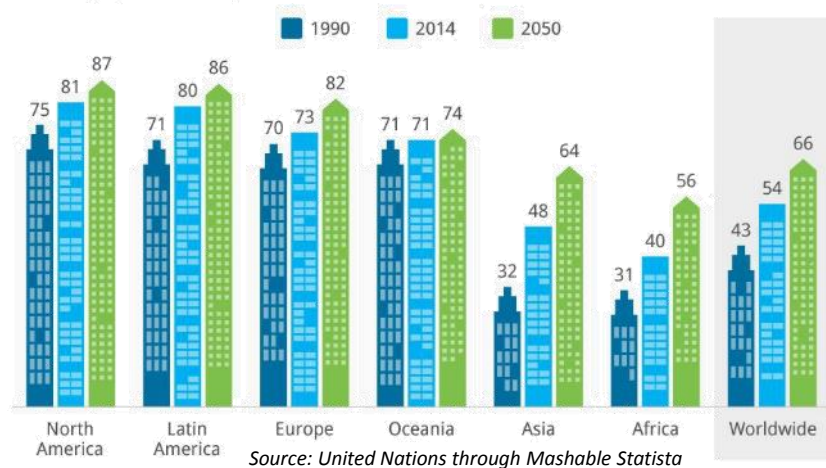
ADVANCED MATERIALS AND NANOTECHNOLOGY
FOR CONSTRUCTION CLUSTER

30 October 2018

The built environment context

54% of the World's Population Now Lives in Cities

% of the population living in urban areas



Energy efficient buildings

- Reduce energy consumption and lower energy bills
- Improve indoor comfort
- Cut greenhouse gases

ECONOMIC, SOCIAL & ENVIRONMENTAL BENEFITS

The European construction context

Largest EU single activity



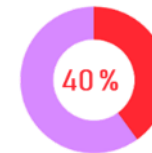
Yearly > €1,2 trillion (2011)
largest single activity - 9.6% of GDP

Biggest industrial employer

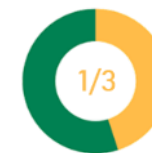


~14,6 million direct jobs

Buildings accounts



Total energy



Greenhouse
Gases in Europe

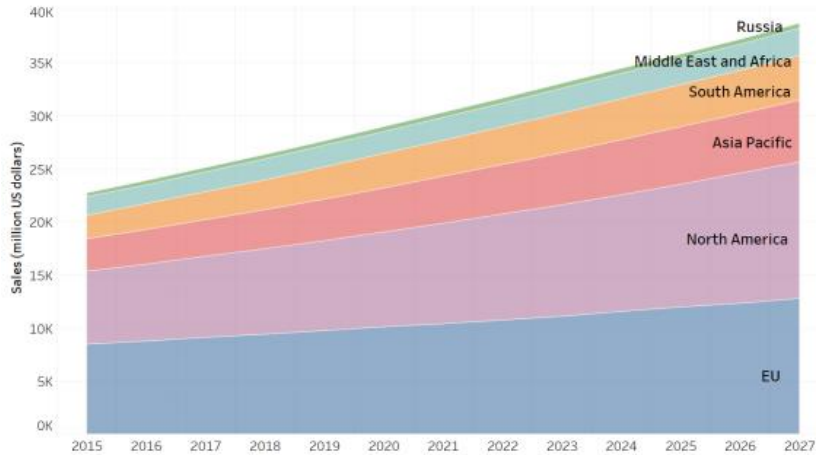
Current path



Increasing **renovation** rate
(1- 2% per year)

Buildings as a critical path to help decarbonise the European economy by 2050

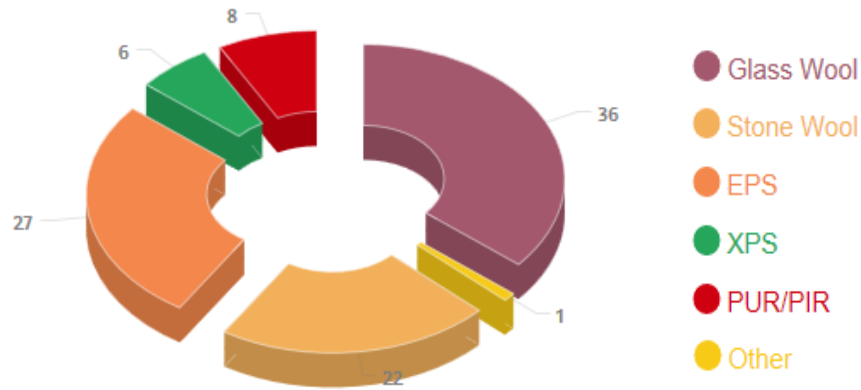
Thermal insulation global market



Source: adapted from Joint Research Centre (JRC) 2018 report doi:10.2760/251981

EU thermal insulation market

Thermal insulation market in Europe in 2014, by volume



Source: adapted from Joint Research Centre (JRC) 2018 report doi:10.2760/251981

Traditional thermal insulation

Materials & Products	Thermal conductivity $\text{mW m}^{-1} \text{K}^{-1}$
Cellulose and Cork	40-50
Mineral fibers (Glass wool mineral wool)	30-40
Extruded and Expanded Polystyrene (XPS, EPS)	30-40
Polyurethane (PUR)	20-30

Europe's relying on R&I to demonstrate and bring to the market innovative technologies

Demands for energy efficiency required by the European directives can only be attained either by:

- Increasing the thickness of conventional thermal insulations (loss of living space)
- **High-performance Super Insulation Materials (SIM)**

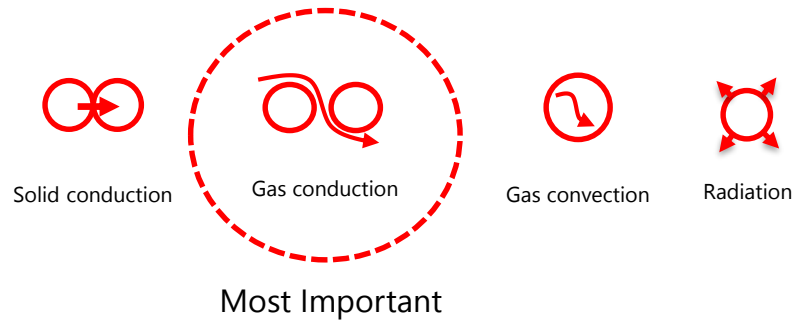


How Nano-insulation works?

Nano-insulating materials are based on the laws of energy transfer and while suppressing/eliminating gas conduction given by intermolecular gas collisions - pore size reduction (e.g. 200 nm) - **Knudsen effect**

Overall thermal conductivity

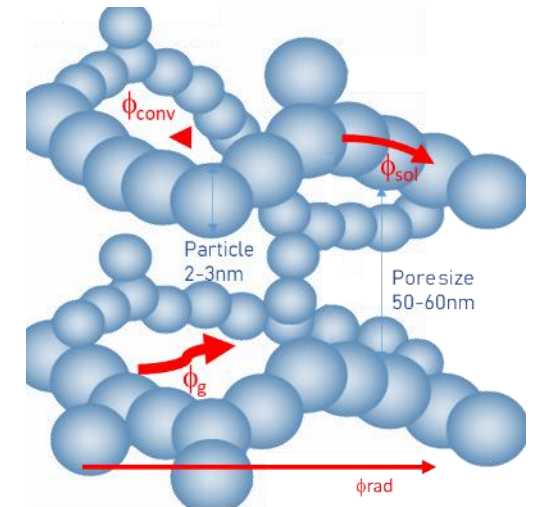
$$\lambda_{total} = \lambda_{sol} + \lambda_g + \lambda_{rad} + \lambda_{conv} + (\lambda_{coupling})$$



$$\lambda_g = \frac{\lambda_{g;0}}{1 + C \frac{T}{\delta p_g}}$$

Still air = 25 mW m⁻¹ K⁻¹

Pore size Pressure



High-performance Super Insulation Materials (SIM) <20 mW m⁻¹ K⁻¹ ?

The answer is **ADVANCED MATERIALS** and **NANOTECHNOLOGY (KETs)**

State-of-the-art Super Insulation Materials (SIM): Nano-insulation



Advanced Porous Materials - Aerogels

Synthetic mesoporous ultralight material derived from a gel in which the liquid component of the gel has been replaced with a gas - made of more than 90% of air

$$\lambda \text{ 13 - 15 mW m}^{-1} \text{ K}^{-1}$$



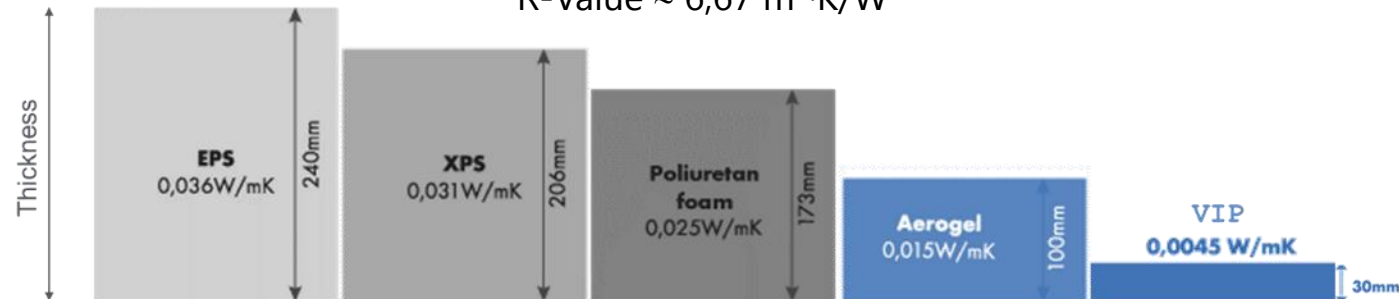
Vacuum Insulation Panels (VIP)

An evacuated foil-encapsulating an open mesoporous material core

$$\lambda \text{ 4 - 8 mW m}^{-1} \text{ K}^{-1}$$

Comparison between isolation materials thickness for the same R-Value

R-Value $\sim 6,67 \text{ m}^2 \cdot \text{K}/\text{W}$



Adapted from <http://www.turvac.eu>

Impact of Energy Efficiency in Buildings using SIM

Overall EU building stock energy consumption



200 kWh/m²

Cost savings of 40% heating/ cooling



56 kWh/m²

Typical gas heated apartment
100 m²



Savings: €336/y
5600 kWh/y

Smart Cities program



180.000 apartments/y refurbishment
20.000 new ones

Total savings
1.120 million kWh

* Source: Smart Cities Stakeholder Platform: Advanced Materials for Energy Efficient Buildings

Super Insulation Materials SWOT

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Performance | Energy and space savings | R&D innovation | Technical expertise | Durability

Cost (High production/operational costs - low economy of scale) | Small number of players and suppliers (availability) | Market awareness and acceptance (niche market)

Energy-efficiency directives compliance | Rising retrofit market | High-value urban real state as market entrance | Consumer demand preference | Prefabricated systems | Strategic growth initiative | Growing market demand on developing markets

Market (**Cheap traditional solutions** | Highly competitive market | Raw materials price volatility) | **Environmental and H&S** (High embodied energy | Toxicity) | **Technical** (Skilled installation) | **Financial** (High R&D investments and high capital required for scale-up facilities | Available technologies often protected)

AMANAC CLUSTER

Advanced Materials and Nanotechnology for Construction Cluster

AMANAC is the cluster of all the Advanced Material and nanotechnology PPP-EeB and NMBP projects whose activities address development of (nano)materials, components and systems for improving the built environment.

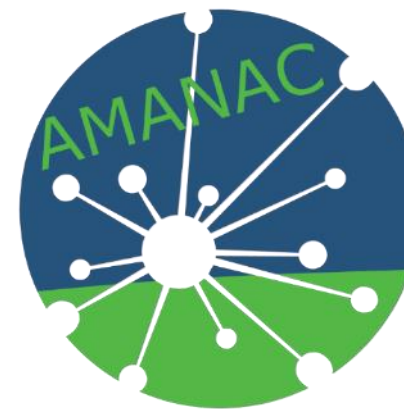
Main Objectives

- Collaboration/promotion of synergies and mutual strategies among projects to tackle common challenges
- Strength further networking and maximizing projects' contribution for present/future policy.

Currently involves studies on:

- **Energy Efficient Building Materials**
- Sustainable Life Cycle Assessment of construction materials
- Construction materials durability, including buildings, on-shore and off-shore infrastructures
- Advanced materials-based products industrial upscaling
- Standardisation and building products certification

9 Ongoing projects



The Cluster in numbers



37 clustered projects
9 ongoing ones



56M€ overall
projects budget



106 Participants



21 Countries



30% of SMEs
members



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Presenting AMANAC projects



www.amanac-cluster.eu

Bringing together EU funded R&I projects focused on nanotechnologies and advanced materials for the construction industry



Federal Ministry
Republic of Austria
Transport, Innovation
and Technology

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Thank you



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Advanced Materials and Nanotechnology Cluster

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