The supply chain for Off-Site building envelope insulation solutions: analysis of the Italian landscape and a proposed methodology to investigate opportunities

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Dubrovnik, 26th september 2023

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Introduction

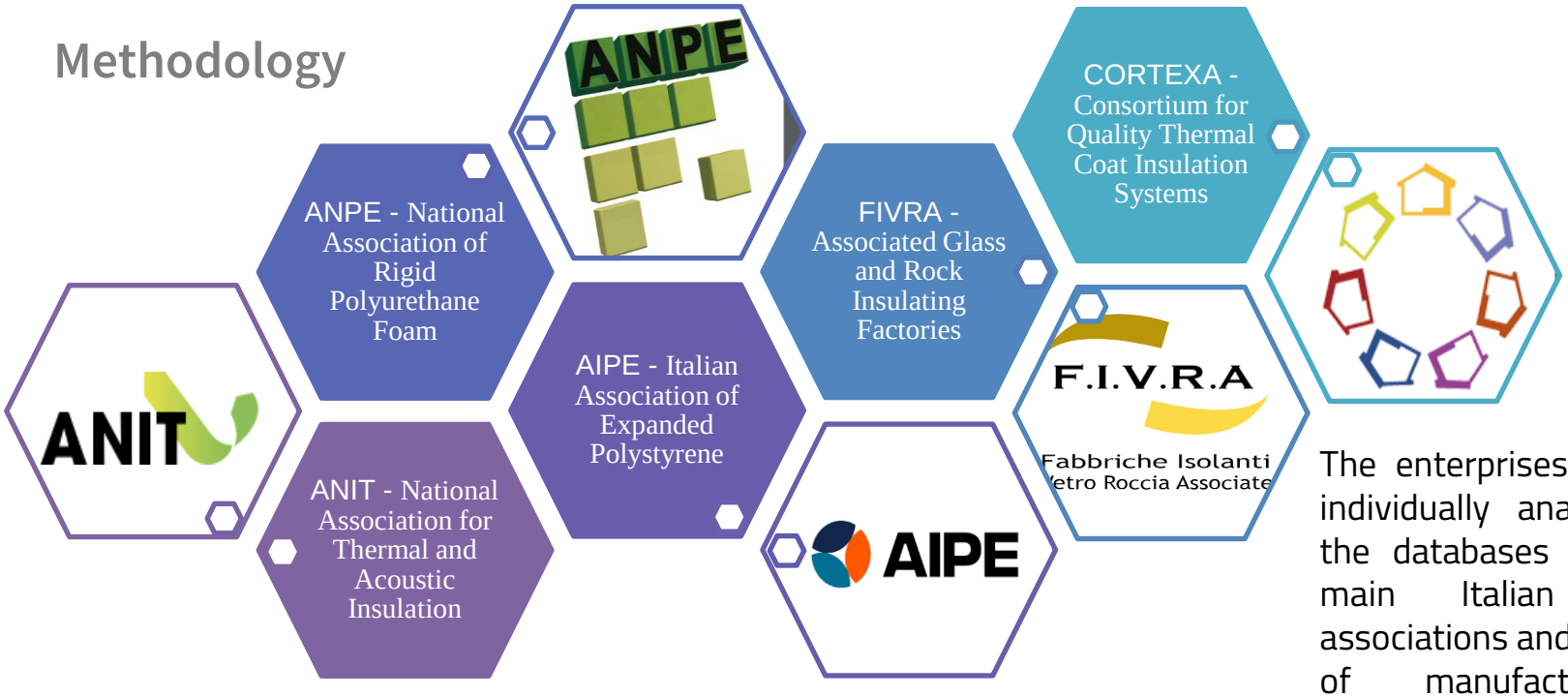
In order to achieve high standards of efficacy and efficiency of OSC supply chains an **integrated planning and optimization strategy of the production and supply chain** are required, as well as an increased **interaction of the actors** involved, from the factory to the construction site. This is particularly true in Italy where the **current supply chain is considerably fragmented**.

Off-Site Construction (OSC) solutions seem to be the most effective answer, using construction processes characterized by an **industrial phase that replaces on-site activities**. They allow **optimization of resources** (including energy), time and costs, not to mention operation in the presence of inhabitants and **excellent performance** in terms of thermal insulation.

The **renovation of the building stock** has become an issue in Europe (recently highlighted by the debate triggered by the proposed European "EPBD" directive). In Italy it is a **particularly critical issue** due to the high medium age of residential buildings and a much more fragmented ownership. Renovations, as envisaged by the directive, would entail major interventions on the building stock, involving about two thirds of the buildings. There is currently **not enough production capacity** of insulation solutions.

Preliminary analysis of the Italian market of manufacturers of building envelope solutions

Methodology



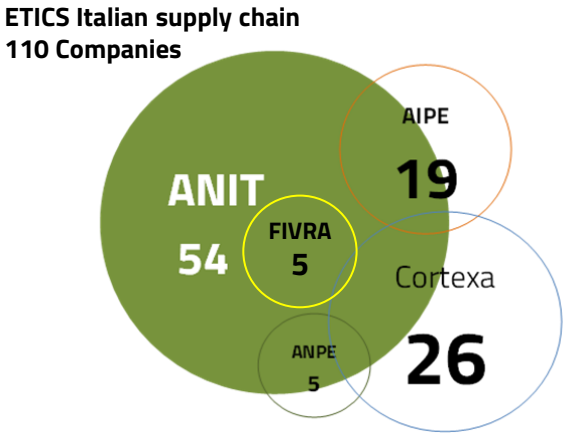
The enterprises have been individually analysed from the databases of the five main Italian business associations and consortium of manufacturers of insulation materials

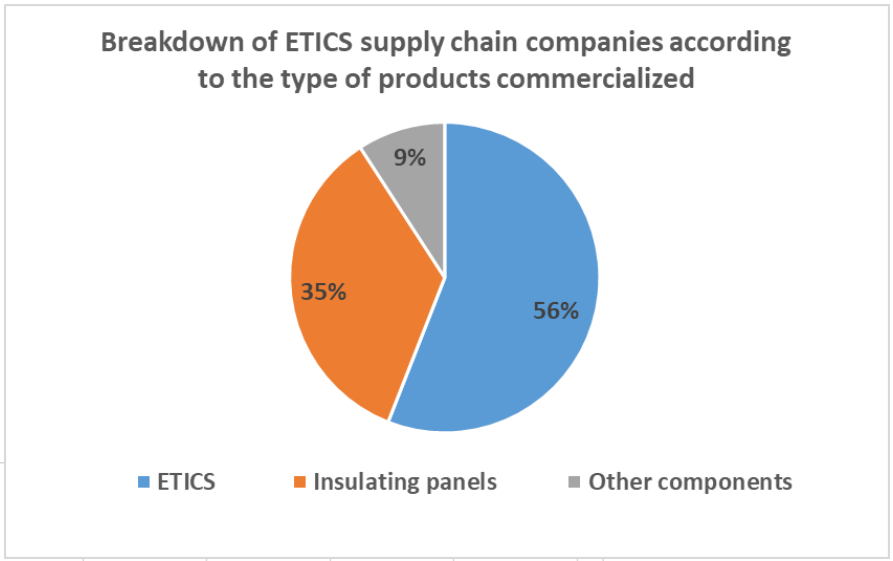
The mapping has been carried out at enterprise level, analysing four different aspects:

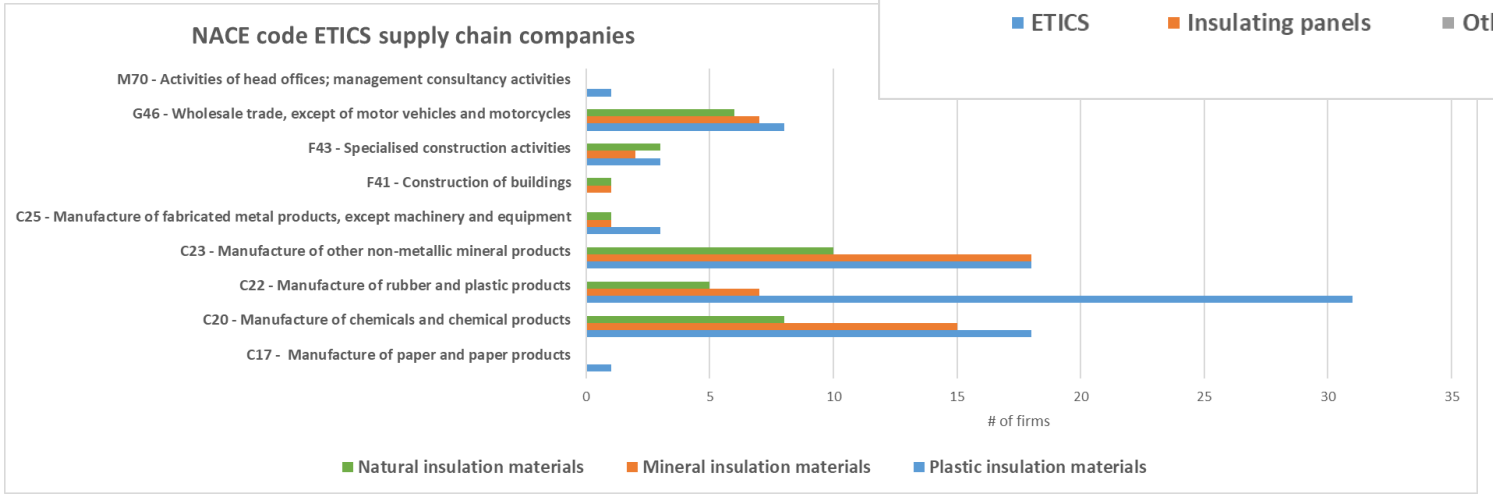
- Economic and management information
- Insulation materials commercialized/manufactured
- ETICS solutions: integration and certification
- Energy information

Preliminary analysis of the Italian market of manufacturers of building envelope solutions

Preliminary results

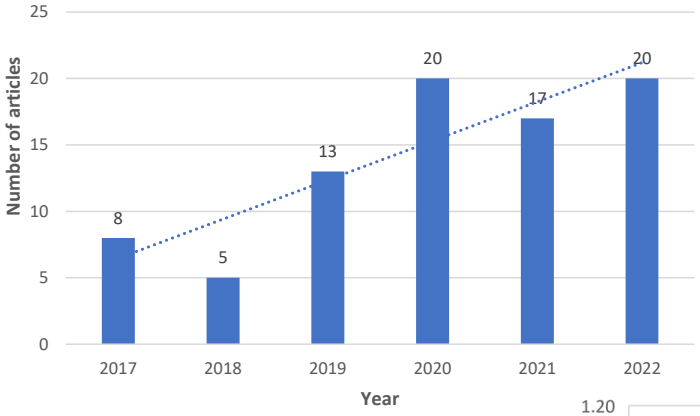






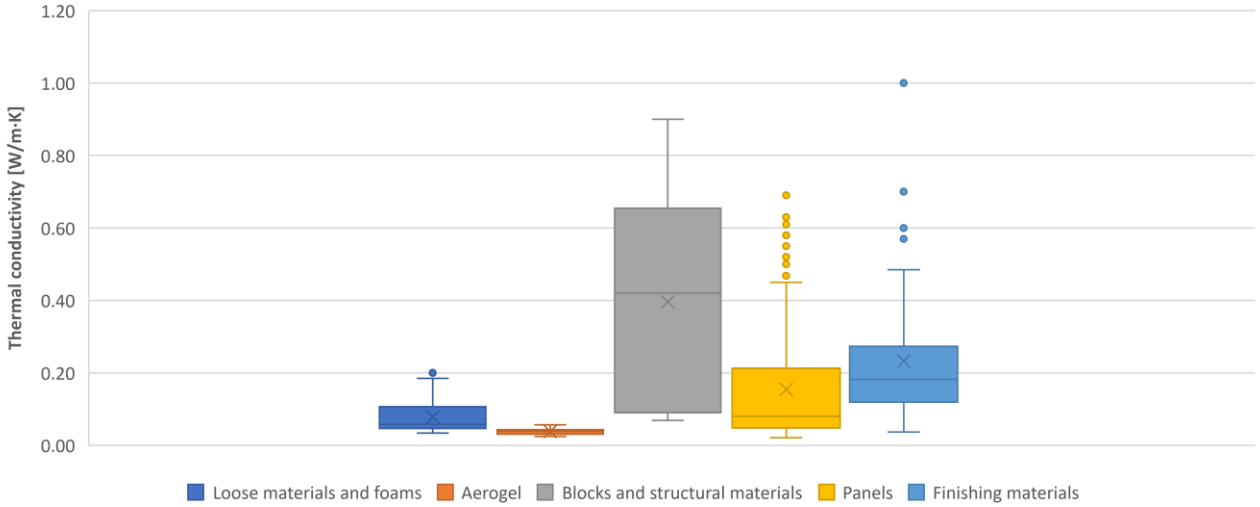
Preliminary analysis of the Italian market of manufacturers of building envelope solutions

Focus on sustainable and recycled materials



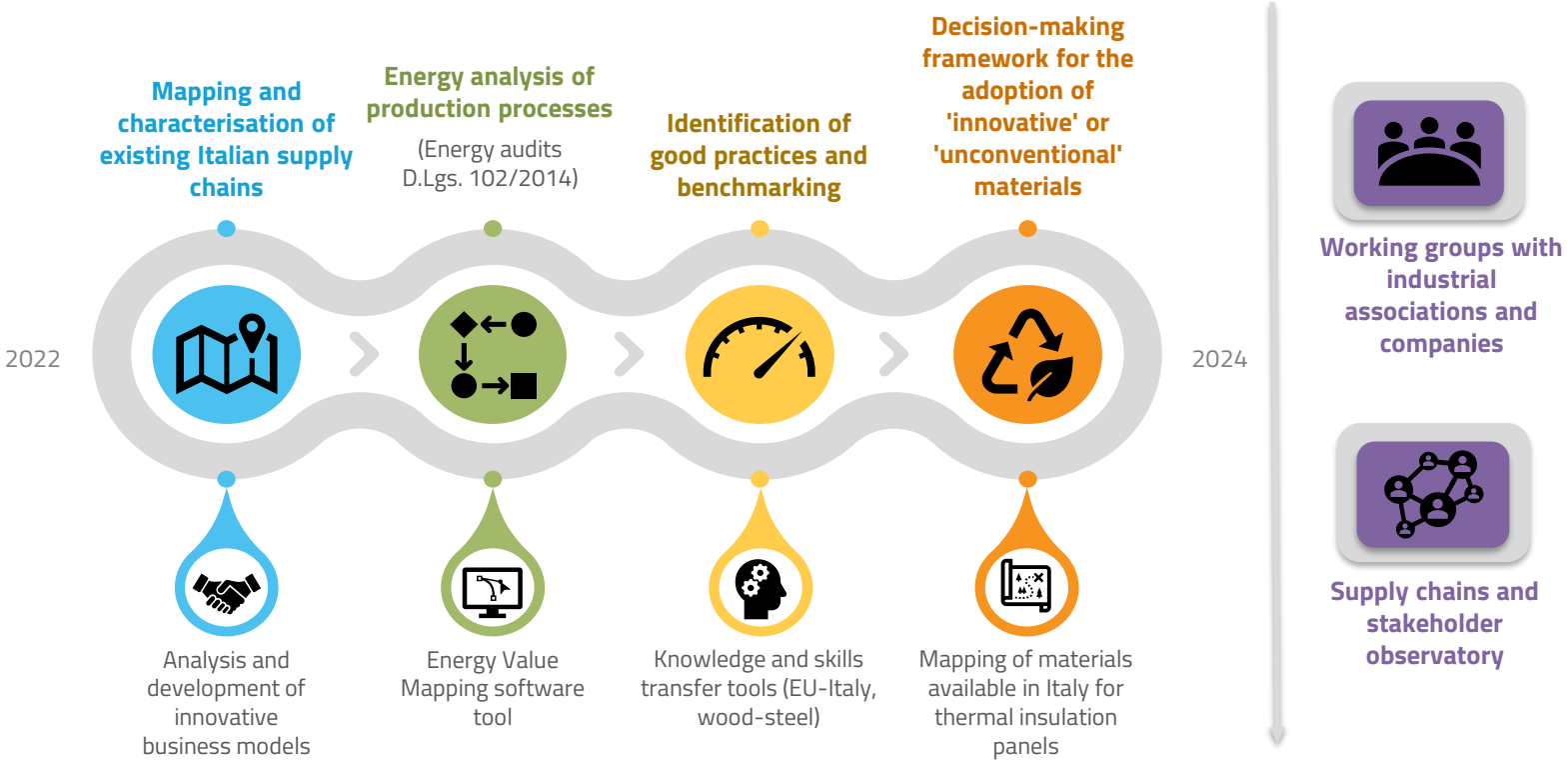
Although the building use phase has the highest environmental impacts, the use of carbon intense materials may shift the impacts to the construction or refurbishment phase. The increasing trend in the number of published articles about "sustainable thermal materials" will likely have an echo on the market in the coming years.

Authors reviewed 83 scientific international articles corresponding to 466 case studies. The literature review showcased that most of the sustainable thermal materials incorporate locally available wastes; specifically, both agricultural and forest wastes and animal wastes are used



Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Characterization of the supply chain of Off-Site Construction solutions for buildings' renovation, implementation of ad hoc tools for its development, integration and optimization.



Optimization of Off-Site supply chains for the renovation of the built environment (OFFICIO)

Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Supply chains and stakeholder observatory

What

The observatory is a network of experts, represented by the main stakeholders in the supply chain, as well as researchers, academics and practitioners, who are interested in deepening the topic and supporting companies.

Why

The observatory will act as a link between the needs of companies and professionals and the information and tools made available by ENEA and the Universities participating in the project, enabling more effective dissemination of results and the identification of in-depth technical and non-technical criticalities.

How

The observatory will combine regular meetings (general and for specific task forces) and workshops with a forum for information sharing.

Get involved!

To participate and stay up-to-date on the observatory's activities, please send an e-mail with an expression of interest to osservatorio.officio@enea.it

Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Structure of the questionnaire and first validation

- Personal and professional information of the respondent
- Economic activity of the company
- Energy efficiency status and practices within the company
- OSC general knowledge and perception
- OSC perceived benefits
- OSC perceived barriers to implementation and diffusion

Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Structure of the questionnaire and first validation

Energy efficiency status and practices	Presence of an energy manager	Closed-ended question (yes/no)
	Presence of an energy management system	Closed-ended question (yes/no)
	Energy audit carried out within the last 4 years	Closed-ended question (yes/no)
	Energy efficiency measures implemented within the last 4 years	Closed-ended question (yes/no)
	Energy efficiency incentives used within the last 4 years	Closed-ended question (yes/no)
	Presence of an energy consumption monitoring system	Closed-ended question (multiple choice with one possible answer: no, yes with manual meters, yes with automated meters)
	Weight of energy costs on overall business costs	Closed-ended question (multiple choice with one possible answer: low, average, high)
	Weight of energy costs on overall operations costs	Closed-ended question (multiple choice with one possible answer: less than 5%, from 5 to 10%, from 10 to 20 %, from 20 to 30%, over 30%)
	Main energy vectors	Closed-ended question (multiple choice with more than one possible answer: electricity, natural gas, automotive fuels, other)
	Presence of on-site energy production facilities (renewables)	Closed-ended question (yes/no)
	Presence of on-site energy production facilities (cogeneration/trigeneration)	Closed-ended question (yes/no)

Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Structure of the questionnaire and first validation

Off-Site construction general knowledge (Off-Site Construction, OSC, refers to the production, planning, design, manufacture and assembly of building elements at a location other than that of the final installation, thus moving activities from the construction site to the factory)	Keywords used to describe off-site construction	Put the following keyword in order of relevance: modular construction, prefabrication, digitalization, industrialized construction, automation, drywall systems
	Basing on the given definition of OSC, current involvement of the company in the OSC sector	Closed-ended question (yes/no)
	Role of the company within the OSC sector	Closed-ended question (multiple choice with more than one possible answer: new buildings, energy renovations, other)
	Main activity of the company within the OSC sector	Closed-ended question (multiple choice with more than one possible answer: component manufacturer, insulation solutions assembly, distributor, supplier of structural prefabricated building solutions, supplied of thermal insulation prefabricated solutions)

Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Structure of the questionnaire and first validation

OSC benefits	Time – Reduced construction time	Rate on the following scale: not relevant, quite relevant, relevant, highly relevant
	Time – Reduced overall project time	
	Costs – Improved control of project costs	
	Costs – Reduced materials costs	
	Costs – Reduced overall project costs	
	Costs – Reduced labour costs	
	Quality – Improved product and process quality	
	Productivity – Higher process efficiency	
	Productivity – Higher level of automation and digitalization	
	Productivity – Additional competencies acquired and more skilled workforce	
	Productivity – Market expansion and additional revenues	
	Productivity – Simplification and reduction of maintenance activities	
	Productivity – Avoid congestion on the construction site	
	Productivity – Reduced damage during installation and reduced waste	
	Safety and environment - Reduction of health and safety risks on the construction site	
	Safety and environment - Reduction of environmental impacts of renovation projects	
	Other benefits	Open-ended question

Proposed methodology for the investigation on the current use and opportunities for industrialisation of the building construction market and bottlenecks

Structure of the questionnaire and first validation

Barriers to OSC adoption and diffusion	Time – Additional logistics issues	Rate on the following scale: not relevant, quite relevant, relevant, highly relevant
	Time – Additional uncertainties	
	Costs – Higher initial costs	
	Costs – Higher design/panning costs	
	Costs – Limited choice of suppliers and need for "turnkey" solutions	
	Quality – Additional coordination effort required among designers and suppliers	
	Quality – Lower customization	
	Productivity – Low availability and/or higher costs of specialized workforce	
	Productivity - Organisational issues between design and implementation	
	Productivity - Limited production capacity of suppliers	
	Productivity – Smaller range of usable technical solutions due to prefabrication	
	Productivity – Limited divisibility of project phases entailing limited possibility of project progress intermediate checks	
	Productivity – Need for new professional figures	
	Productivity – Limited possibility to transfer lessons learned and competencies from one project to another (higher projects specificity)	
	Productivity – Less know-how available within companies	
	Productivity – Less jobs created/available in the construction site	
	Safety and environment – Additional coordination issues within the construction site	
	Safety and environment – Need for new procedures	
	Safety and environment – Lack of specific protocols and/or legislation	
	Customers – Perception of a low-quality product	
	Other barriers	Open-ended question

Conclusion

- OSC has proved to improve construction process efficiency and is therefore a promising means to rapidly increase production capacity where needed to meet buildings renovation requirements.

- Its implementation and diffusion are nonetheless yet to be completed, as it requires a deep shift in production management and practices. In addition, in order to allow developing effective and efficient OSC supply chains, it is fundamental to gain knowledge and keep control over energy efficiency and sustainability practices along the different steps of the supply chain.

- To this end, a stakeholders-oriented methodology has been developed within the project OFFICIO that will allow to map and characterize existing supply chains in Italy, to study and innovate business models, to perform energy analyses of the most energy intensive production processes, and to create guidelines and tools to support companies in gaining and sharing knowledge and competences on this topic.

- A first analysis of the Italian ETICS market has allowed to identify, characterize, and categorize companies already or potentially part of OSC supply chains according to economic and management information, insulation materials commercialized/manufactured, integration and certification of marketed solutions. The integration level of the proposed solutions and the supply chain structure highly depends on the main insulation material used and therefore on the NACE sector of the insulation manufacturer. Certified kits are currently the most common form in which ETICS are commercialized, while fully OSC solutions are still very far from being largely diffused, although there seem to be interest towards their applications from both designers (and final customers) and producers.

- As concerns sustainable insulation materials with organic or inorganic wastes, they are spurring interest within the scientific community and have already proved to be able to offer thermal performances similar to those of the most widely used thermal insulation materials.

- A preliminary structure of a questionnaire aimed at investigating OSC perception, in terms of general understanding, benefits and barriers to implementation, as well as energy efficiency status and practices, has been developed and a preliminary validation has been carried on with good results.

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