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Thermal insulation products and applications - Future road maps

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Abstract

The European energy efficiency and greenhouse gas reduction policy sets challenging targets both for new buildings and retrofitting actions. Nearly zero energy buildings cannot be realized without highly insulated building envelopes. New thermal insulation solutions are needed to fulfil the performance and buildability requirements. There is on-going strong development of new insulation materials and applications and also the performance properties of conventional insulations are continuously improved.

A project was created to form road-maps for thermal insulation materials, products and solutions applicable in northern conditions. These road maps answer the needs of the building industry, applied research and authorities for the mid- to long-term periods. The main objective was to identify the R&D topics, product development priorities and the emerging and promising technologies and materials that can support technology leaps towards energy and resource efficient targets.

The study included state-of-the-art report, analysis of key performance indicators of thermal insulation products, a sophisticated patent search and several interviews of professionals in the building sector. The interviews followed by workshops revealed the visions, expectations, barriers, trends and hypes that are related to the energy efficient building envelope applications.

This study that was focused on Finnish perspective, but the formed road-maps cover the Northern climate conditions, European regulations and the international material and product development aspects. The challenges discovered in cold climate conditions give perspective also for the development needs and potentials in other climates.

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1. Introduction

The driving forces behind the set energy efficiency targets are the climate change impacts and the limited natural resources. The European Commission estimates that the energy efficiency improvement with 20% by 2020 is not sufficient and new measures have to be implemented to reach the needed reduction of the greenhouse gas emissions.

While residential and commercial buildings are responsible for about 40% of the EU's total final energy consumption and 33% of CO₂ emissions, the energy efficiency actions in the building sector are crucial. A well-insulated building envelope is recognized as key for high energy-efficient performance of buildings (IEA 2013). Also the life time of the structures is significantly higher than that of the other systems, which emphasizes the importance of the highly insulated building envelope to meet with the performance level of the other systems in the future.

In cold climates the low U-values of energy efficient structures require significant thicknesses of thermal insulation. This can cause architectural and technical challenges, like the placement of windows, and also valuable building space is lost. Improved conventional and new thermal insulation products and integrated envelope solutions are now emerging in the market. Developments in materials science, for different fields and industries, bring suitable solutions also for the use in the constructions.

The objectives of this work were to form roadmaps for the thermal insulation materials, products and systems that can be used in northern cold climate conditions in Finland to fulfill the future energy efficiency requirements and also the other performance requirements set for construction products and systems [1]. To achieve these targets required an integrated approach including the deployment of energy-efficient technologies and engagement of influential stakeholders on the market supply, demand and regulation sectors.

The roadmaps were created to answer the needs on how building envelope insulation materials and products, at different development stages, are positioned in this framework and how changes in the built environment affect existing products and create new emerging ones.

There are many technical and socio-economic barriers to overcome before market upscale and mass production of the emerging materials and products solutions is possible. The main drivers are the building directives and regulations, and the main barriers come often from non-technological issues. The combination of energy efficiency regulations and the challenge of the renovation of the old Finnish building stock raises demands for adaptable and integrated pre-fabricated products.

2. Roadmap methodology

The road mapping process included state of the art –survey, a patent survey of the recent trends in thermal insulation R&D field and interviews and workshops for the main stakeholders in the field.

2.1. State of the art

The state of the art study of thermal insulation solutions study was done gathering qualitative information through literature surveys, product information and statistics and regulatory publications. Also a patents database study was carried out to find out the areas where the research has been focused. In addition previous relevant roadmaps were reviewed [2-5]. These formed the baseline for the development of roadmap and future recommendations.

2.2. Interviews and workshop

The drivers, barriers and trends were studied through focused interviews and stakeholders feedback in active workshop discussions. The analysis and road-mapping process had the following identification and action steps:

- Categorization of the thermal insulation materials, products and systems
- Solutions at different stages
- Performance indicators and evaluation criteria
- Demand and potential usage analysis

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