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Competitive landscape of the EU's insulation materials industry for energy-efficient buildings

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Contents

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Abstract

In the context of meeting the EU energy savings targets and improving the energy efficiency of buildings, this report looks at the competitiveness of the European industry of thermal insulation materials. Insulation materials contribute significantly to improving the overall energy efficiency and sustainability of Europe's building stock, especially by reducing the energy losses through the building envelope (walls, roofs, floors, etc.).

Driven by governmental measures to reduce greenhouse gas emissions, improve cost efficiency and adopt regulations on energy efficient buildings, the global demand for thermal insulation materials in building applications is projected to increase at a CAGR of 4.5 % between 2016 and 2027. In the EU the demand for thermal insulation materials is estimated at 3.48 % (2015-2027). Wool minerals (glass and stone wool) and plastic foams (EPS, XPS, PUR) are the most required materials for building insulation.

By analysing the competitive intensity of the global building insulation market and making a SWOT study of the major European companies operating in the insulation materials industrial sector, it is shown that the competitiveness of the European industry of thermal insulation materials in relation to other international competitors is moderate to strong. Six out of the top 10 manufacturers are European companies and some of them are world leaders in production of insulation materials. Overall, the EU is a net exporter of insulation materials. With many other European companies acting at different steps of the value chain of insulation products, the current supply of insulation materials in the EU could be considered as sustainable. Following the adoption of the EU legislation on energy-efficient buildings and in order to meet the increasing insulation requirements needed in buildings, the European industry should strengthen its innovation capability and look further to the development of advanced insulation materials (e.g. super insulating materials (SIM), phase change materials, etc.) for both renovation of the EU building stock and construction of 'near-zero-energy buildings' as well as IT integration (BIM).

1 Introduction

Buildings consume 40 % of the EU's primary energy demand and produce about 35 % of all greenhouse emissions. Buildings have a large energy-savings potential through renovation and upgrading. Under the existing Energy Performance of Buildings Directive, the EU countries must set minimum energy performance requirements for new buildings and for the major renovation of buildings. In this direction, action 5 in the Communication 'Towards an integrated strategic energy technology (SET) plan: Accelerating the European energy system transformation' (European Commission, 2015) refers to the 'Development of new materials and technologies, for the market uptake of energy efficiency solutions for buildings'.

The potential for cost-effective energy savings in buildings can be classified in two main categories:

- Reducing the heat transfer through the building envelopes by improving insulation levels of walls, roofs, floors, windows, etc.;
- Adoption of efficient installations for heating, cooling, ventilation, water heating, lighting and electricity.

Several legislative initiatives stimulate the acceleration of building renovation rates in parallel with construction of new near-zero-energy buildings as measures to increase energy efficiency in buildings.

The EU is a leader in innovation systems and R&D for buildings and this field must remain a priority in order to keep this leadership in the future. Adopting the inspirational targets of annually renovating 2 % of the whole building stock and 3 % of central government buildings (which is doubling of the current renovation rates) as well as the transition to 'near-zero-energy buildings' will bring important structural changes in the construction and materials sectors. These sectors will need to anticipate the needs, adapt and develop in order to become more competitive, resource efficient and sustainable.

The successful implementation of the revised Energy Performance of Buildings Directive would also depend on the effective functioning and competitiveness of construction and material sectors in the EU. It is therefore necessary that high-quality materials are produced and delivered timeously at an appropriate price.

2 Buildings stock in Europe and opportunities for energy savings

Some 160 million buildings were in Europe in 2010 with an overall floor space of about 24 billion m^2 (Bax et al., 2016). Although the floor space is dominated by residential buildings (75 % of the total floor space), their average energy consumption per square metre is much lower compared to non-residential buildings.

The vast majority of the buildings stock dates from before 1990 and about half of the buildings are pre-1960. Today, about 1 % of the existing building stock is built new annually, which means it will take 100 years to replace the entire stock. Therefore, the existing older buildings have more potential to contribute to achieving the energy efficiency targets through renovation than the new buildings' stock. It is estimated that **deep renovation of buildings could cut up to 36 % of their energy consumption by 2030**, while reducing EU energy import dependency, creating growth, innovation and employment, reducing fuel poverty and resulting in more comfortable and healthier buildings (BPIE, 2017).

The competitiveness of the construction companies is an important factor to ensure the sustainability of the sector, as well as associated growth and employment. This sector could contribute significantly to job creation especially in some promising areas such as deep renovation of buildings. It is estimated that **approximatively 17-19 jobs are created per 1 million EUR invested in improving energy efficiency in buildings** (CEU, 2010; Euroace, 2012). The public sector renovation policy at the target rate of 3 % per year would result in an average annual employment rate of some 29 000 additional jobs, or some 200 000 person-years of employment by 2020 (Euroace, 2012). Overall, 2 million jobs could be created by 2020 by investing in energy efficiency (European Commission, 2011).

Costs of deep renovation of buildings with substantial energy efficiency benefits range from a few hundred euros/m^2 up to close to EUR 1 000/m^2. The latter cost level (EUR 1 000/m^2) is close (or beyond) the costs of construction from scratch of a new building in some parts of Europe.

Materials could contribute significantly to reducing energy consumption in buildings and sustain the competitiveness of the construction sector by improving the energy and cost performance in the building envelope (walls, roofs, floors, etc.), windows, mechanical systems as well as on-site renewable generation and thermal systems.

The key focus of this report has been set on the competitive landscape of insulation materials manufacturing in the EU for reducing energy consumption in buildings in connection with the construction sector (Figure 1).

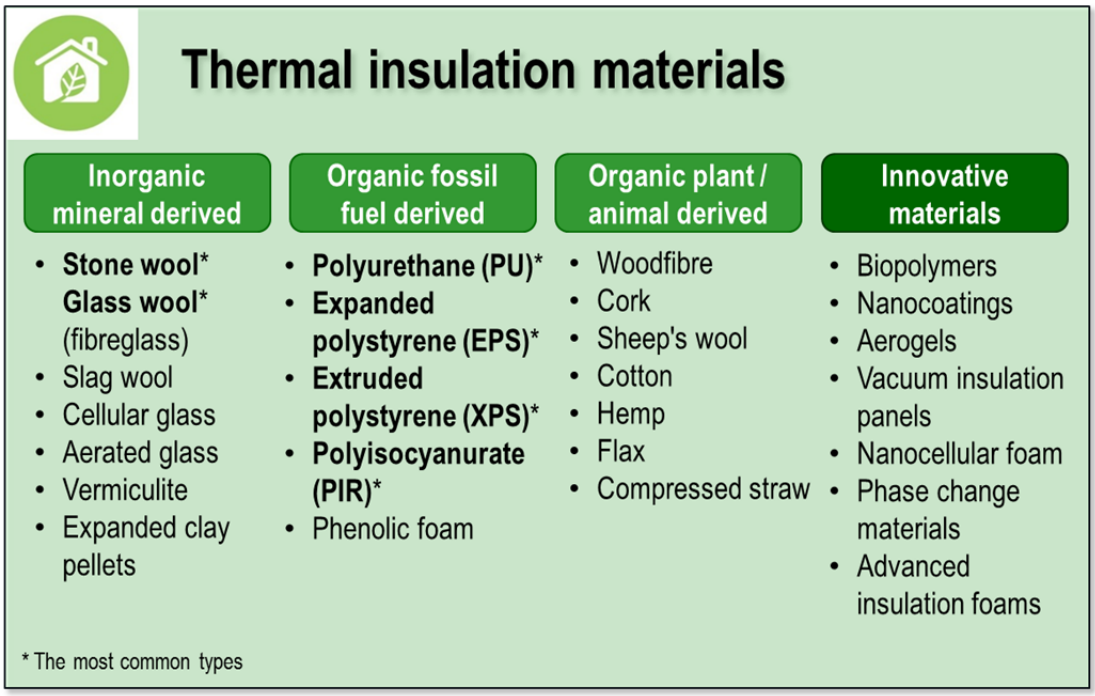
Figure 1. Role of insulation materials to increasing the energy efficiency in buildings

Source: JRC representation.

3 Insulation materials for increasing energy efficiency of the building

Insulation materials could highly impact the overall energy efficiency and sustainability of buildings especially by improving the insulation of the building envelope, appliances or other equipment. There is no one material (or technology) that can solve alone the building energy issue. Several insulation materials can be used to reduce energy use in new buildings (near-zero-energy buildings) as well as in retrofitting/refurbishment (renovation) projects. The most common types of materials used for insulation of buildings include mineral (e.g. stone or glass) wool and plastic foams (e.g. polyurethane, polystyrene, etc.) (Figure 2).

Figure 2. Types of materials used in thermal insulation of buildings



Source: JRC representation.

Although the thermal properties and performance of the traditional building insulation materials have significantly improved over the years, new emerging insulation solutions with similar or higher performances based on biotic renewable or biopolymers are expected to be adopted by the market to a larger extent in the future. Moreover, additional innovative materials (e.g. high reflective nanocoatings, vacuum insulation panels, nanocellular foam, aerogels, phase change materials, advanced insulation foams, etc.) with superior insulation properties, but having higher prices than the conventional solutions, are currently under development, and the EU represents a potential market for them.

Today, the largest market potential for insulation materials in building applications is dominated by those materials which offer the best performance per unit cost, such as mineral (stone and glass) wool and plastic (polymeric) foams such as polystyrene and polyurethane.

Inorganic mineral wool has good insulation properties, which are described by the so-called lambda-values. The lambda-value determines the effectiveness of an insulating material; the lower the lambda-value, the better the insulating effectiveness.

Plastic foams, like all organic materials, show excellent insulation properties.

The cost of an insulation material increases in general with the thermal resistance of a material given by the so-called R-values. Since the insulation properties (R-value) of some materials degrade over time, a cost–benefit analysis of an insulation product has to consider the overall lifetime performance along with its safety aspects.

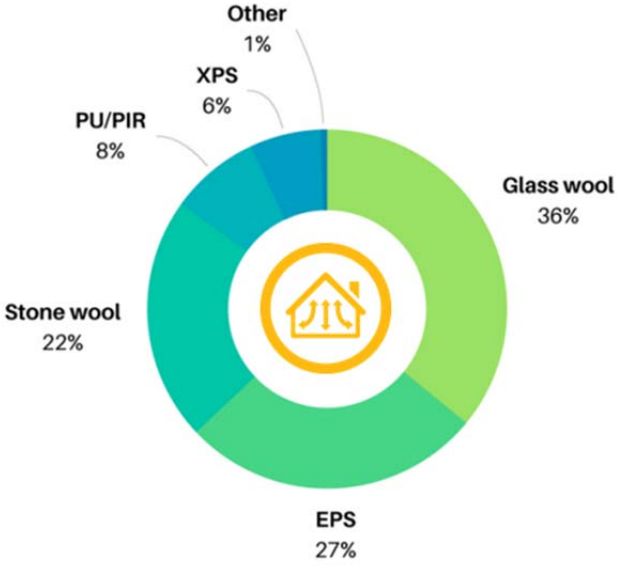
The insulation materials are used in three major parts of a building that are subject to heat losses, i.e. internal and external walls, floors and roofs. Selection of an insulation material depends on weather conditions and the level of insulation to be included in the building. Wall insulation is the largest application in the building thermal insulation market (by value) with about 47 %, followed by roof (37 %) and floor (15 %) (Visiongain, 2017).

According to IAL Consultants, in 2014 the total European market for thermal insulation products was 234.6 million m^3 (IAL, 2015). Commercial and domestic buildings represent the majority of the demand for thermal insulation materials, accounting for 87 %, the remaining 13 % being used in industrial applications.

Glass and stone wool represents 58 % of the European thermal insulation market (Figure 3). This share of mineral wool is due particularly to the good insulation properties, fire safety and its compatibility with common structural products developed for thermal insulation.

Expanded polystyrene (EPS) foam is the most popular material used for external wall insulation, because of the low price and the better performance characteristics. Polyurethanes (PU and PIR) offer advantages in the context of higher requirements for thermal insulation being thinner than other insulation materials for the same insulation efficiency.

Figure 3. Thermal insulation market in Europe in 2014, by volume

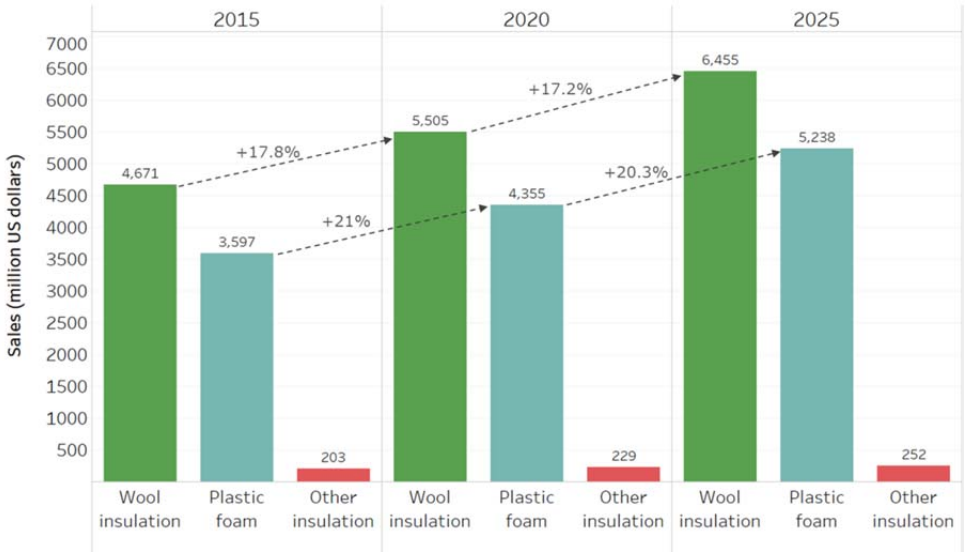


Source: JRC representation with data from IAL, 2015.

The European thermal insulation market is expected to grow on average at a rate of 2.8 % per year until 2019 with higher rates in central and eastern European countries. This will bring the total demand for thermal insulation products in Europe to a total of 269.3 million m^3 by 2019 (IAL, 2015).

Mineral wool insulation (glass and stone wool) are the most widely used categories for building insulation in the EU and the market is expected to increase by 38 % in the period 2015-2025 (Figure 4) (Visiongain, 2017).

Figure 4. Thermal insulation market in EU in 2015 and forecast for 2020 and 2025, by value



Source: JRC representation with data from Visiongain, 2017.

Plastic foam materials (EPS, PU/PIR and XPS) accounting for 42 % in 2015 is estimated to register an even higher growth of 46 % by 2025.

Germany, France and Poland are the leading countries in the EU market for thermal insulation materials (Figure 5). Countries from western Europe represented an important market of insulation materials in buildings, accounting for 30 % of the global market in 2015. However, the market in this region is projected to register a slower growth by 2025 as it is quite mature. A higher economic growth of the EU countries and increasing the investments spending will raise the demand for thermal insulation materials.

Figure 5. Market forecast of thermal insulation materials for representative EU countries. Values represent US million dollars

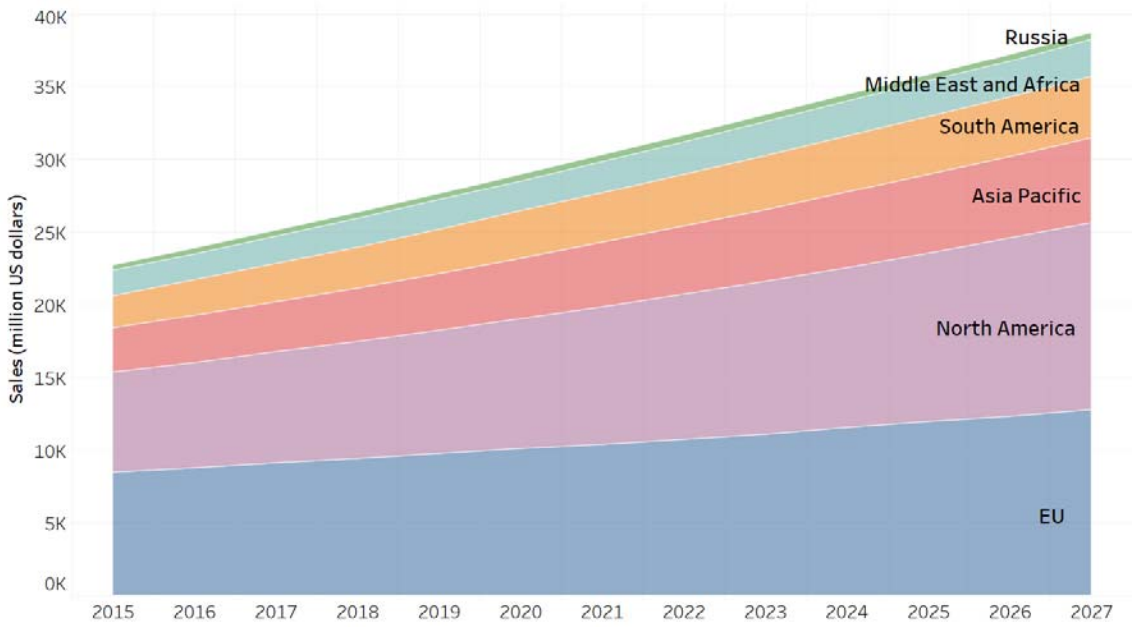
Source: JRC representation with data from Visiongain, 2017.

4 The global market of thermal insulation materials

The global market size of thermal insulation materials for buildings applications was estimated at about USD 22.73 billion in 2015 and is projected to increase at a CAGR of 4.5 % between 2016 and 2027, reaching USD 38.69 billion by 2027 (Visiongain, 2017). The increase of demand for thermal insulation materials in building applications will be driven by measures for greenhouse gas emissions reduction, cost efficiency and government regulations on energy efficient buildings.

The EU is the largest market for thermal insulation materials, in terms of value, closely followed by North America (Figure 6).

Figure 6. Global market forecast for building thermal insulation, by region



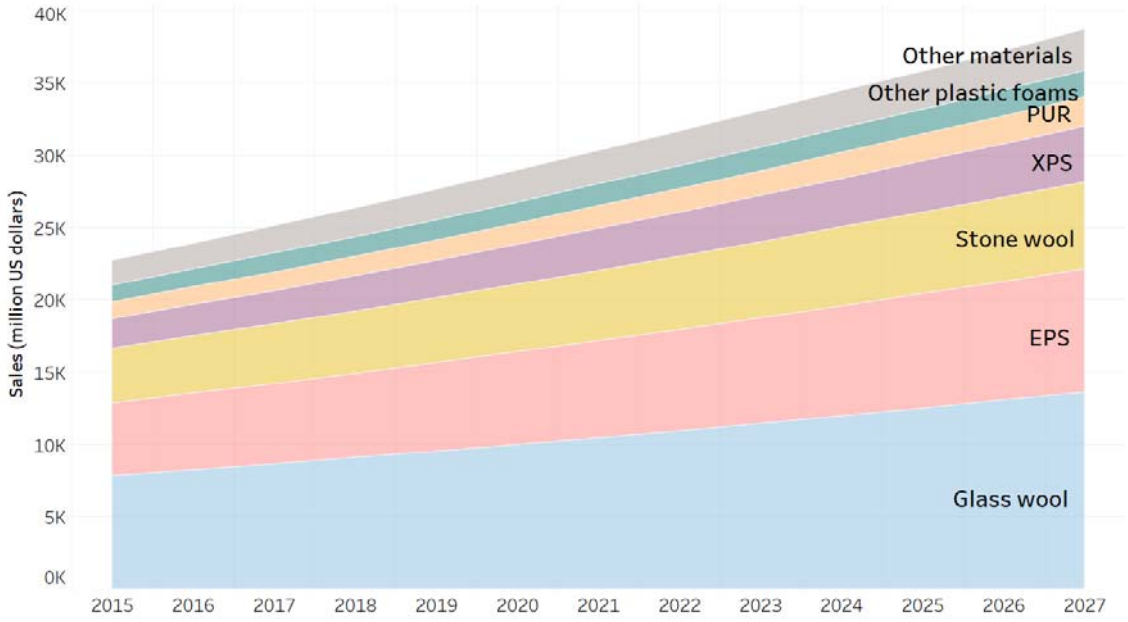
Source: JRC representation with data from Visiongain, 2017.

In 2015 the value demand in the EU was USD 8 471 million and is expected to reach USD 12 768 million by 2027, at a GAGR of 3.48 % (2015-2027) (Visiongain, 2017). The implementation of the revised EU legislation on energy-efficient buildings (Directive 2018/844) is expected to boost the penetration of thermal insulation in the overall building stock and also will increase the amount of insulation needed per building.

Globally, the most used insulation materials to make different kinds of insulation products are based on mineral wool (glass and stone wool) and plastic foams (EPS, XPS, PUR). These materials have different technical and insulating properties and depending on the characteristics they cover a wide range of applications. For example, EPS is mostly used for facades, floor and flat roof and PUR for pitched and flat roof applications.

The mineral wool insulation segment accounted for just above half of the overall building insulation global market in 2015 (Figure 7). The plastic foams such as EPS, XPS, PUR, etc. accounted for a share of 41 % in 2015 and are projected to register the highest growth rate during the next 10 years due to their better insulation properties.

Figure 7. Building thermal insulation global market forecast, by material type

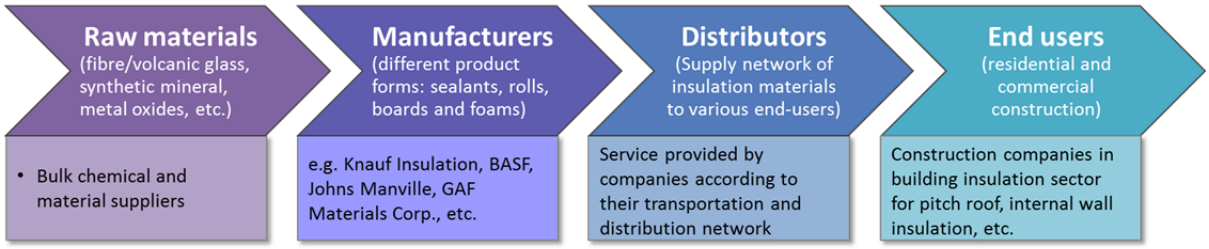


Source: JRC representation with data from Visiongain, 2017.

5 Supply chain of thermal insulation materials and key industrial players

The value chain of the building thermal insulation materials comprises a multi-level network of raw materials suppliers, manufacturers of finished insulation products and distributors to end-users, such as construction companies (Figure 8).

Figure 8. Supply chain of thermal insulation materials used in building applications

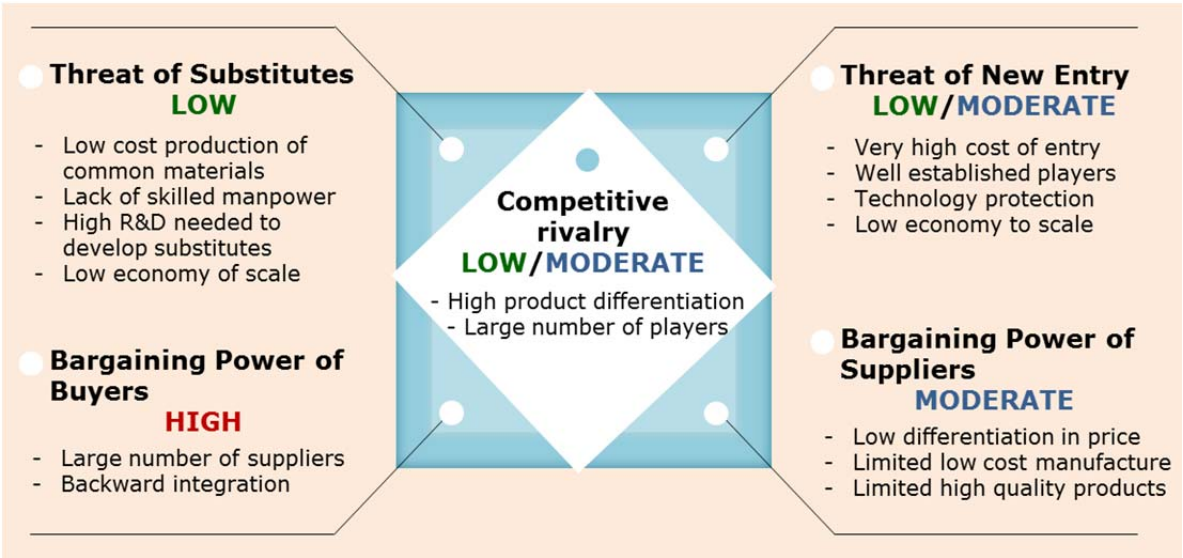


Source: JRC representation with data from Visiongain, 2017.

Different raw materials (i.e., cokes, base chemicals, minerals, metal oxides, etc.) are required for production of building insulation products. The raw materials determine the final properties of insulation products, for instance, water resistance, temperature range, durability, compressive strength, etc. Depending on climate conditions and level of insulation to be reached, different products are required in various forms, shapes and sizes to suit a variety of building insulation applications such as flat/pitched roof, internal/external walls and floors.

The competitive intensity of the global building insulation market was estimated from different perspectives using the Porter's five forces, namely: competitive rivalry, bargaining power of suppliers, the threat of new entrants, bargaining power of buyers and availability of substitutes (Figure 9). The actual situation might vary dependent on the material.

Figure 9. Porter's five forces analysis in global building thermal insulation market



Source: JRC representation with data from Visiongain, 2017.

According to Visiongain, the five competitive forces for the global building thermal insulation market could be defined as follows (Visiongain, 2017):

- **Competitive rivalry within the global industry**

Due to a large number of suppliers in the building insulation market, the global market is moderately competitive. Due to the growth rate expected for the building insulation market in the next 10 years and the high product differentiation offered by major players the competition in the market could slow down.

- **Threat of new entrants**

The capital required for opening new production facilities for thermal insulation materials is very high. The available technologies are often protected by IP (Intellectual Property); therefore a new entrant must either develop a new process or buy the licence of the technology from an incumbent or outside source. This might result in higher production cost of building insulation materials as compared to competitors. Also the economy of scale could be a disadvantage for new entrants. Therefore, the threat of new entrant is evaluated as low to moderate.

- **Bargaining power of suppliers**

In general, there is a low differentiation in the price of building insulation materials offered by most market suppliers, although some major producers have developed low cost manufacturing processes. The high quality of products required in the building insulation is a limiting factor, increasing the bargaining power of suppliers, which can be reduced as a consequence of backward integration. The overall bargaining power of suppliers is considered moderate.

- **Threat of substitutes**

Mineral wool insulation minerals and plastic foams account together for more than 90 % of the overall insulation material market due to their cost, vast availability and good insulation performance. Other materials such as wood fibre and perlite are also used despite their higher price. Low production cost is desired in the building and construction sector due to their direct interface with customers. Low R&D investments and lack of skilled manpower represent some barriers in development of alternative substitutes for insulation materials. Their low availability and higher production cost make the potential substitutes uneconomical for the end use industry. Therefore, the threat of substitutes is low.

- **Bargaining power of buyers**

A large number of buyers are active and most of them consider backward integration, resulting in the high bargaining power of buyers.

The top 10 global companies producing thermal insulation products are: BASF SE (Germany), Beijing New Building Material (Group) Co. Ltd. (China), GAF (USA), Johns Manville (USA), Kingspan Group (Ireland), Knauf Insulation (Germany), Owens Corning Corporation (USA), Rockwool International (Denmark), Saint Gobain (France) and Synthos S.A. (Poland). **Six out of the 10 major manufacturers of building insulation materials are European companies**. These key EU companies provide together a complete range of insulation materials for buildings applications and are major producers of one or two of them (Table **1**). For example, Rockwool group produces only mineral wool, but is the world leader of stone wool insulation products.

Table 1. Major European manufacturers of building insulation materials

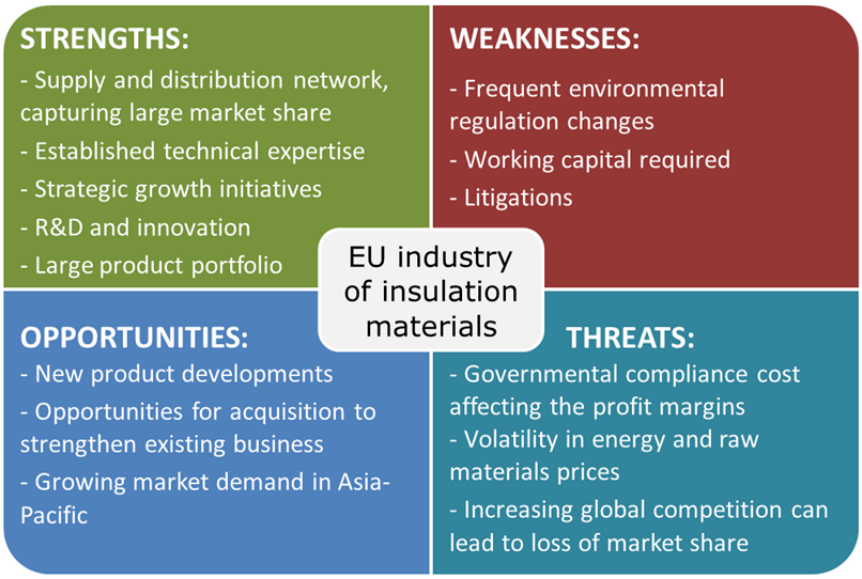
	Glass wool	Stone wool	EPS	XPS	PIR/PUR
BASF SE (DE)			√	√	√
Kingspan Group (IE)			√	√	√
Knauf Insulation (DE)	√	√	√	√	
Synthos S.A. (PL)			√	√	
Rockwool Int. (DK)		√			
Saint Gobain (FR)	√	√	√	√	√

Source: JRC compilation with information mainly from Visiongain, 2017.

There are many other large companies and SMEs in the EU that manufacture and supply materials for insulating residential and non-residential buildings, both new or being renovated. For example, the polyurethane insulation industry in the EU involves about 61 800 companies, providing 258 000 jobs (PU Europe, 2017). According to EUMEPS Construction, the expanded polystyrene industry is most fragmented with around 20 EPS raw material producers and around 1000 EPS converting companies, in total providing around 60 000 jobs (personal communication).

Overall, the global competitive landscape for thermal insulation materials is considered not highly competitive. An annual compound growth rate of 4.5 % is expected between 2016 and 2027 for building thermal insulations, which will stimulate the industry competition in the global market. The large product differentiation offered by the European companies and the growth strategies adopted by them in the last 5 years, such as geographic and capacity expansions, new product launches and acquisitions, place them in a good position in the global market of buildings thermal insulations. Therefore, the current competitive rivalry from other non-EU companies or countries could be considered to be low to moderate. This conclusion is also supported by the SWOT analysis of the major European companies operating in the insulation materials industrial sector (Figure 10).

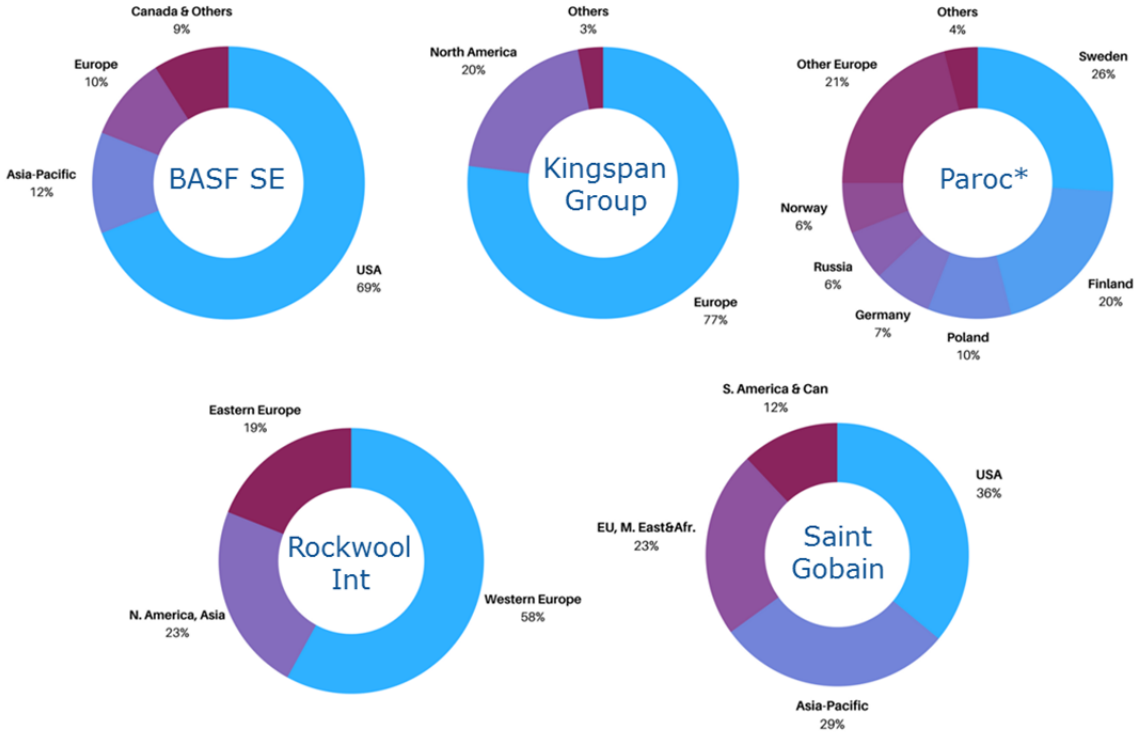
Figure 10. SWOT analysis of the EU industry of thermal insulation materials



Source: JRC representation with data from Visiongain, 2017.

The major European companies producing insulation materials are well represented on the international market as shown from their revenue mix broken down by geographical region (Figure 11).

Figure 11. Regional revenue mix in 2015 of some European companies of thermal insulation materials



Source: JRC representation with data from Visiongain, 2017.

*Note: On 5th February 2018, the US company Owens Corning announced that the acquisition of Paroc Group has been completed.

6 Advanced insulation materials for building envelopes — an opportunity for industrial innovation

Europe is a leader in innovation for deep renovation of buildings and has the potential to become an export market of these new techniques (e.g. prefabricated systems) in the future.

There are various innovation opportunities for improving a building envelope through developing advanced materials for renovation, for example, super insulating materials (SIM), phase change materials, etc. These opportunities will be driven by the increasing insulation thickness requirements as well as consumer demand/preferences, manufacturer choice, prices and resources. New government initiatives and regulation can be also a driver for innovation.

Although the new super insulating materials, such as vacuum insulation panels, gas-filled panels and aerogel-based products provide promising solutions, the manufacturers still remain focussed on conventional insulation materials, which have the large market value.

Performance declaration, IT readiness and tool integration (e.g. the Building Information Modelling – BIM, which represents an essential element towards a Digital Built Envelop – DBE), health and sustainability assessments, are seen as additional topics of innovation by the construction industry. These apply as well to assembled products and systems.

7 Conclusions

The European insulation materials industry has a key role in reducing the environment impact of buildings and maximising their energy efficiency by providing the materials needed in the insulation of the building envelope. In the recent years, the EU has made progress in adopting policies for promoting the renovation of Europe's building stock and preventing heat gain/loss through insulation. These measures are expected to boost both the construction sector and EU market of buildings insulation materials: in the period 2015-2027, the EU market is expected to increase at a GAGR of 3.48 %.

Mineral wool insulation materials (glass and stone wool) and plastic foams (EPS, XPS, PUR) are the most common type of materials currently used in building applications. Due to the good thermal properties, cost factor and reaction to fire, mineral wool insulation is still the most widely used for building insulation. On the other side, due to their products' better insulation properties and affordability (especially EPS), the plastic foam insulation segment is projected to increase faster by 2027.

Currently, the EU represents the largest market of buildings insulation materials globally in terms of value, closely followed by North America, Asia–Pacific and South America. Several key producers of these materials are located in the EU; six out of the top 10 manufacturers are European companies. Some of them are also world leader of insulation products. Overall, the EU is a net exporter of insulation materials. With many others companies acting in different steps of the value chain of insulation products, the current supply of insulation materials could be considered as sustainable.

The competitiveness of the European industry of thermal insulation materials for building applications in relation to non-EU international competitors is considered moderate to strong. However, such competitiveness can be affected by growing demand rate. Quality and environmental standards of insulating products can improve competitiveness. Increasing environmental standards related to the production can result in rising manufacturing costs. Europe should preserve its leadership in innovation for deep renovation of buildings and thermal insulation products. Additionally, there is a need to invest in research for development of smart solutions (e.g. reflective coatings, phase change materials, etc.), advanced materials with super insulating properties and IT integration (BIM).

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List of abbreviations and definitions

BIM	Building Information Modelling
CAGR	compound annual growth rate
EPS	expanded polystyrene
PIR	polyisocyanurate
PU	polyurethane
SET Plan	strategic energy technology plan
SWOT	strengths, weaknesses, opportunities, threats analysis
XPS	extruded polystyrene

List of figures

List of tables

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