European Commission

This fiche is part of the wider roadmap for cross-cutting KETs activities

'Cross-cutting KETs' activities bring together and integrate different KETs and reflect the interdisciplinary nature of technological development. They have the potential to lead to unforeseen advances and new markets, and are important contributors to new technological components or products.

The complete roadmap for cross-cutting KETs activities can be downloaded from:

http://ec.europa.eu/growth/industry/key-enabling-technologies/eu-actions/ro-ckets

Potential areas of industrial interest relevant for cross-cutting KETs in the Chemical Processes, Chemicals, Chemical Products and Materials domain

This innovation field is part of the wider roadmap for cross-cutting KETs activities developed within the framework of the RO-cKETs study. The roadmap for cross-cutting KETs activities identifies the potential innovation fields of industrial interest relevant for cross-cutting KETs in a broad range of industrial sectors relevant for the European economy.

The roadmap has been developed starting from actual market needs and industrial challenges in a broad range of industrial sectors relevant for the European economy. The roadmapping activity has focused on exploring potential innovation areas in terms of products, processes or services with respect to which the cross-fertilization between KETs can provide an added value, taking into account the main market drivers for each of those innovation areas as well as the societal and economic context in which they locate.

Taking the demand side as a starting point, cross-cutting KETs activities will in general include activities closer to market and applications. The study focused on identifying potential innovation areas of industrial interest implying Technology Readiness Levels of between 4 and 8.

CH.2.1: High-strength / low-weight fibre-reinforced polymer composite materials

Scope:

Fibre-reinforced polymer composite materials with superior strength and lower weight for application in transport applications (to reduce fuel consumption while guaranteeing strength), civil engineering (to provide for steel substitution in structures requiring strength combined with lightweightness or low maintenance), sports equipment, etc.

Demand-side requirements (stemming from Societal Challenges) addressed:

- Indirectly tackle challenges such as “climate action, resource efficiency and raw materials”, “smart, green and integrated transport” and “secure, clean and efficient energy” thanks to contributing higher performing materials for various applications that are key to the achievement of the aforementioned challenges

Demand-side requirements (stemming from market needs) addressed:

- Production of high performing materials with improved functionalities

Specific technical/industrial challenges (mainly resulting from gaps in technological capacities):

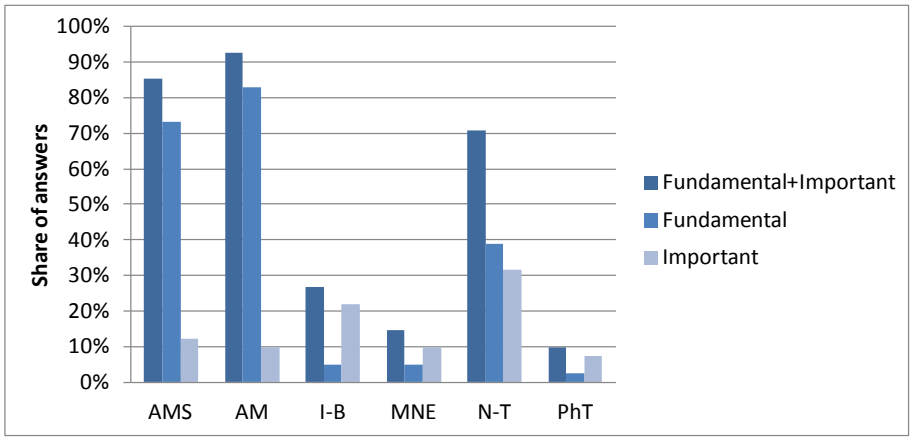
- Rational design, tailoring of properties, adaptation of design procedures as well as processing techniques towards automatized production of fibre-reinforced polymer composite materials
- Lifetime prediction for fibre-reinforced polymer composite materials
- Development and incorporation of stiffer and more rigid fibres into matrix materials (such as metals or plastics) to make a stiff but lightweight composite material with anisotropic properties

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of more advanced, high-strength/ low-weight fibre-reinforced polymer composite materials by tailoring their properties, thanks to the adaptation of processing techniques as well as procedures towards automated production and the development of stiffer and more rigid fibres for their subsequent incorporation into matrix materials (such as metals or plastics) to make the composite material stiffer but lightweight and with anisotropic properties.

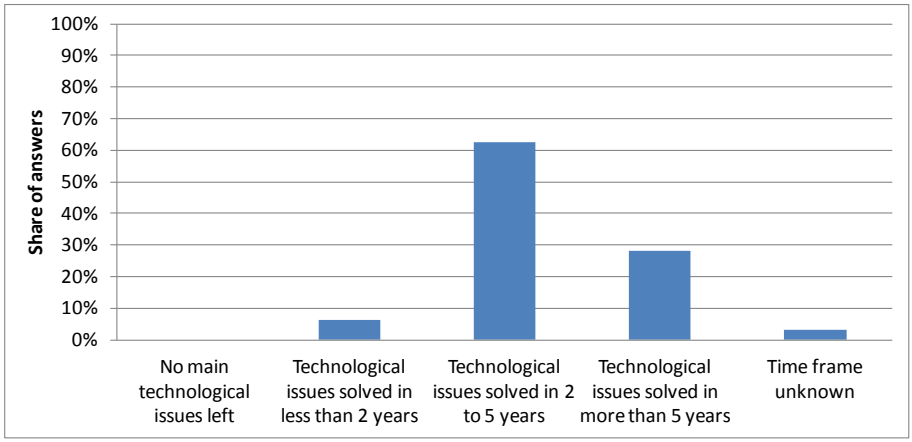
To this aim, the combination of KETs experts’ opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong interaction of KETs with respect to this Innovation Field, with either fundamental or important contribution mainly by the following KETs:

- Advanced Manufacturing Systems (AMS)
- Advanced Materials (AM)
- Nanotechnologies (N-T)



Timing for implementation:

According to the majority of KETs experts' opinions (whose result is depicted in the below bar chart), desk research, and in line with the KETs-related patenting activity in this field, it is considered that the main technological issues holding back the achievement of cross-cutting KETs based products related to this Innovation Field could be solved in a time frame of 2 to 5 years, yet minor consensus indicates also greater periods being necessary:



Hence, depending on the specific technical and/or industrial challenges holding back the achievement of cross-cutting KETs based products related to this Innovation Field, the provision of support in the short term should be taken into consideration within this framework.

Additional information according to results of assessment:

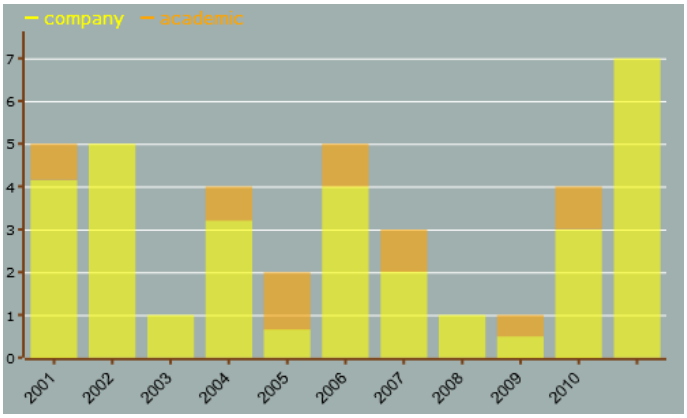
- ***Impact assessment:***
  - Fibre-reinforced polymer composite materials offer a number of advantages over some of the traditional materials they can replace. Such advantages mainly comprehend high structural efficiency (meaning strength-to-weight ratio) and corrosion resistance to a wide range of chemicals. As a result, the range of applications of these materials has increased exponentially in the last thirty years.
  - Fibre-reinforced polymer composite materials find today their application mainly in the space, aeronautics, marine/naval, automotive, industrial equipment, energy equipment (mainly wind turbines), electrical equipment, and general consumer commodities' sectors (mainly sports equipment). Although fibre-reinforced polymer composites were initially developed for cost-insensitive military and aerospace applications, improvements in manufacturing techniques and the development of lower-cost fibres have opened them up to the highly price-conscious sectors such as the structural and civil engineering sectors, their market relevance being therefore strictly related to the respective market sectors in which they find application.
  - Fibre-reinforced polymer composite materials are normally applied in order to provide high strength as combined with low weight. This, in relation to transport applications, can lead to savings in fuel consumption with consequent advantageous emissions reduction. They are moreover applied for their

corrosion resistance, thus providing longer useful life to components. Last but not least, they can provide tailor-made properties to components, thus enabling optimal design as combined with lower material usage as well as waste generation. Within this framework, they can indirectly contribute to tackle challenges such as “climate action, resource efficiency and raw materials”, “smart, green and integrated transport” and “secure, clean and efficient energy”.

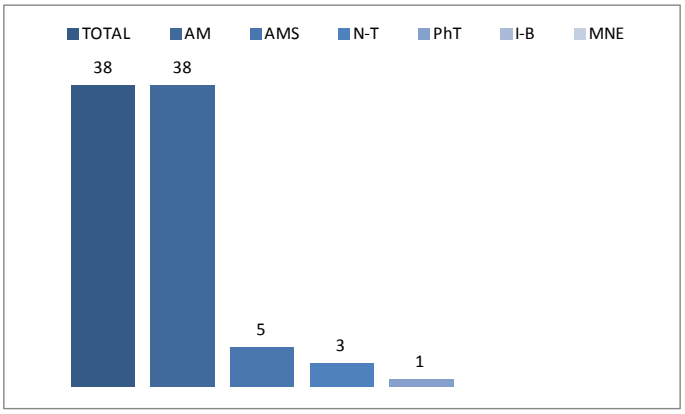
- Production of fibre-reinforced polymer composite materials is expected to grow annually of 6% in terms of value and 5% in terms of volumes, with thermoplastic matrix composites witnessing faster growth (8%/year) than thermo-hardening composites. In terms of volumes, composites remain largely dominated (85%) by fibreglass, despite the large increase in carbon fibres and natural fibres, with the global fibreglass reinforced plastic composites market being estimated to grow at a compound annual growth rate (CAGR) of 7.4% from 2014 to 2019 to reach a value of 35 billion Euro.
- Composites manufacturers in Europe stand at circa 10 000 companies and involve a total of about 100 000 employees, with the majority of these companies being SMEs.
- In light of the economic difficulties in Western Europe (Spain for instance) and the growth of regions such as Asia and the BRIC counties, in general terms, countries which export are faring much better than others. In 2012, largest growth was witnessed in Germany, the UK and Eastern Europe. In Benelux, production moved from 42 ktons in 2011 to 43 ktons in 2012. A certain decline was instead observed in Scandinavia mainly due to difficulties in shipping construction (which constitutes about 2/3 of production of composites in Finland). Outsourcing production to India and the ordering of composites in China (for wind turbine blades for instance) are affecting European countries.
- Sources: +Composites, Composites: materials of the future, Part 2: Market and market developments, 2012; Reportlinker.com, March 2014

➢ ***Results of patents scenario analysis:***

- 38 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- Almost stable trend curve (number of patents per year) with a generally low patenting activity per year
- Highest share of industrial applicants with intermittent relevant patenting activity by academic applicants, most probably standing for new technologies having been patented in the corresponding periods:



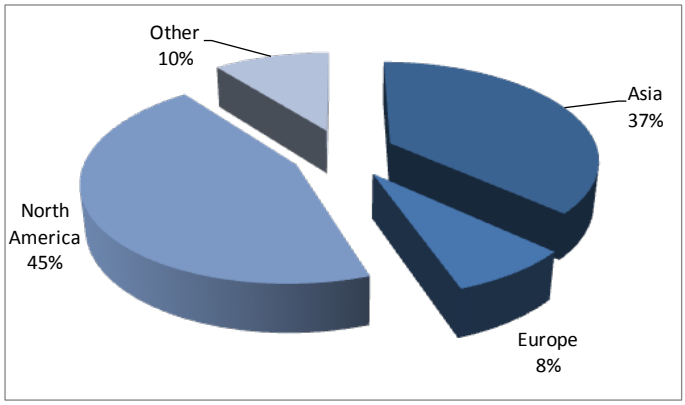
- Patents by KET(s):



- Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	38
AM / N-T	3
AM / PhT	1
AMS	5
AMS / AM	5
N-T	3
PhT	1

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: