

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 Energy 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.

E.3.2: High Voltage AC-DC converters and High Voltage as well as Ultra High Voltage DC transformers for grid applications

Scope:

To develop High Voltage AC-DC converters and High Voltage as well as Ultra High Voltage DC transformers for grid applications to transmit electric power efficiently and reliably over long distances and distribute power to utilities while helping to reduce costs of operation and maintenance of energy transmission/distribution facilities.

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

- Contribute to achieving competitive, sustainable and secure energy
- Cope with the various European efforts (directives, policies as well as initiatives) aimed at deploying Smart Grids
- Cope with the various European efforts (directives, policies as well as initiatives) aimed at developing a single energy market for Europe
- Cope with the increasing levels of renewable energy deployment within the European Union (the Renewable Energy Directive (2009/28/EC) mandating to achieve levels of renewable energy consumption of 20% by 2020)

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

- Reduce energy consumption (resulting in savings over the conventional energy purchase for private as well as industrial end-users and in the overall reduction of the energy demand on a global scale)
- Provide for easier integration of renewables in general with existing energy distribution networks and with other energy generation systems
- Increase use of effective energy storage systems into existing energy distribution networks (to resolve the mismatch issue between energy generation and demand)
- Increase electricity usage flexibility in order to cope with today's lifestyles

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

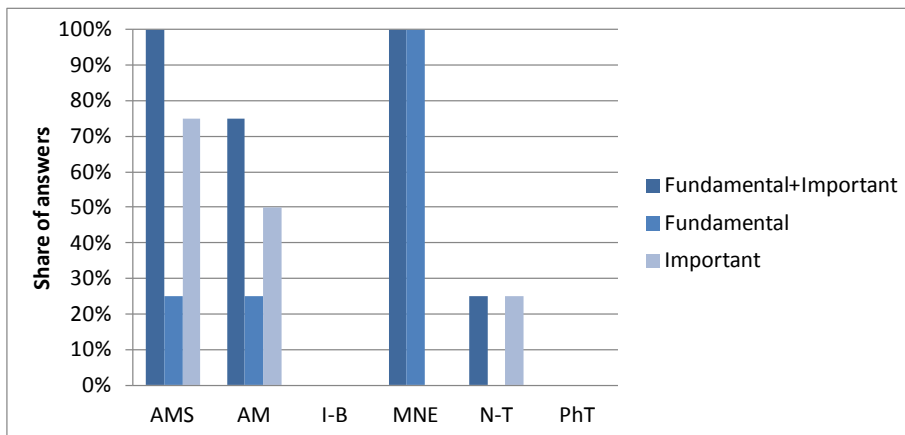
- Development of improved equipment to increase the distance of electric power transmission (especially equipment for subsea application for offshore wind energy and in any case for transmission to or from remote areas)
- Development of improved equipment to increase efficiency and reliability of power transmission and distribution

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 Voltage AC-DC converters and High Voltage as well as Ultra High Voltage DC transformers, building on improved semiconductors and equipment able to increase efficiency and reliability of power transmission and distribution over long distances.

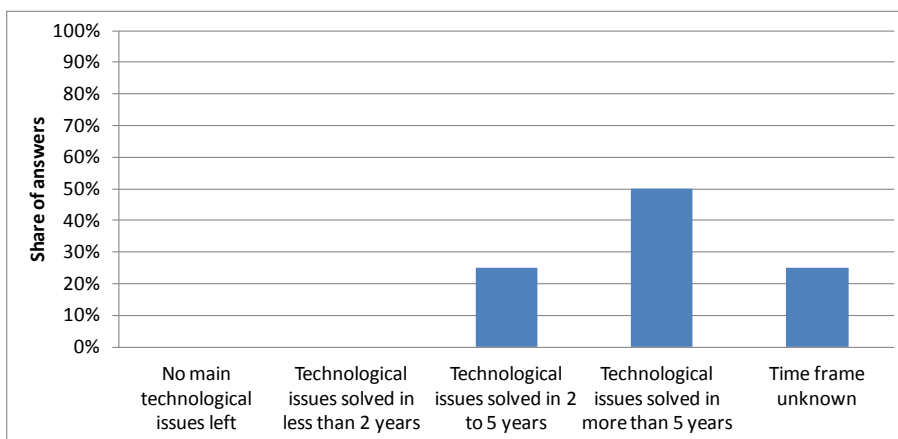
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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)
- Micro- and Nano-Electronics (MNE)



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 more than 5 years:



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 medium term should be taken into consideration within this framework.

Additional information according to results of assessment:

➤ **Impact assessment:**

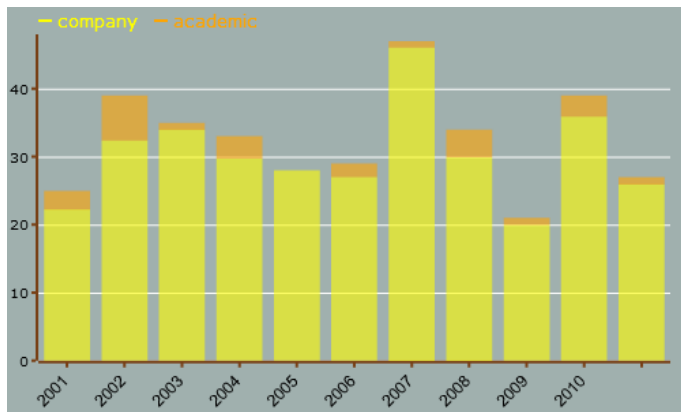
- Along with the increasing basic electrification of remote areas as well as the growing offshore as well as remote area power generation facilities installations, improved High Voltage as well as Ultra High Voltage DC converters / transformers are needed to enable power transmission to occur to or from remote areas over long distances. These systems allow the transmission of power over long distances and are also solutions for interconnection of networks with different characteristics and frequencies.
- Furthermore, the combination of an ageing infrastructure, the rising use of renewables which need to be integrated into the existing grid, the rising demand for electricity, and the need to improve transmission as well as distribution efficiency including by minimizing losses are translating into growth in the electric power transmission and distribution transformer market. Within this framework, Visiongain has calculated that the global electric power transmission and distribution transformer market would reach 24.7 billion Euro in 2012 (Source: Visiongain, The Electric Power Transmission and Distribution (T&D) Transformer Market 2012-2022, 2012).
- Over the forecast period many regions and countries will experience strong growth in the electric power transformer market as a number of governments and utility companies rush to upgrade and expand the transmission and distribution infrastructure. Emerging national electric power transmission and

distribution equipment markets such as China, India, and Brazil will drive growth in the market while the US and major European countries will remain central to transmission and distribution transformer market sales over the forecast period to 2012-2022, as these economies continue to invest heavily in their electricity generation, transmission and distribution networks. Growth in other national and regional markets is expected to increase sharply, as national, regional and continental electricity grids are interconnected. Competition between transformer manufacturers will be stiff as new entrants into the global market from China, South Korea and India challenge the market dominance of European and American manufacturers (Source: Visiongain, The Electric Power Transmission and Distribution (T&D) Transformer Market 2012-2022, 2012).

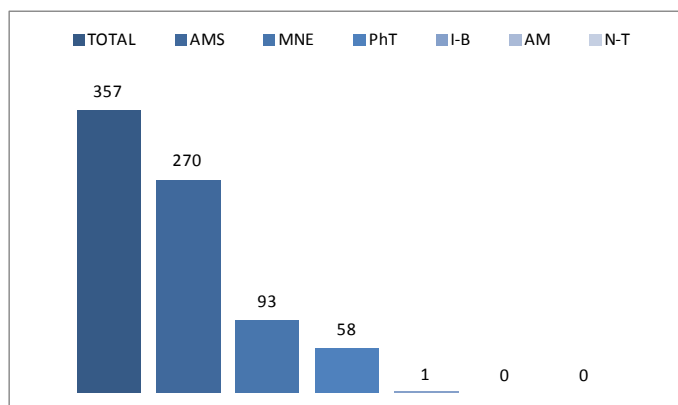
- Within the framework of High Voltage as well as Ultra High Voltage DC transformers for grid applications, Europe is home to top multinational leading players in this field, particularly ABB, Alstom Grid, Artech, EFACEC Engenharia, Schneider Electric, Siemens and Siemens Energy, SGB-SMIT International and SMIT Transformatoren, capable of supplying all the required critical materials and components as well as providing for the design, manufacture, and installation or installation supervision. As regards High Voltage AC-DC converters, leading European players on the market are STMicroelectronics and Philips.

➤ **Results of patents scenario analysis:**

- 357 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- Stable trend curve (number of patents per year)
- Highest share of industrial applicants:



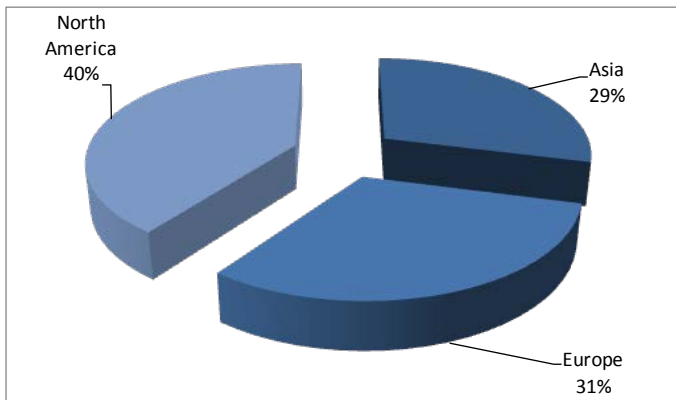
- Patents by KET(s):



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

<i>KET(s)</i>	<i>Number of patents</i>
AMS	270
AMS / MNE	21
AMS / MNE / PhT	2
AMS / PhT	9
IBT	1
MNE	93
MNE / PhT	37
PhT	58

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection:

