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 Electronics and Communication Systems 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&C.2.3: High efficiency power control and conversion electronics

Scope:

To develop efficient, effective, reliable and sustainable solid-state fast dynamics power electronics for the control and conversion of electric power, mainly for power grid or transport applications.

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

- "Innovative and reflective societies" and a competitive European economy need breakthrough innovations, smart capabilities or high performance, a large part of which will be made possible by improved or even radically new electronics components and circuits
- Energy and material resources efficiency are demanding much from electronic components, be it direct energy consumption reduction, advanced power management, low use of critical materials, recyclability, miniaturization, etc.
- Large areas monitoring – as for agriculture, forestry, marine resources, water resources, pollution monitoring, homeland security, etc. – require "smartification" of the environment, e.g. with high autonomy ubiquitous low cost sensing and communication capabilities, serviced by new components, circuits and architectures
- High value systems for energy, transport, health care as well as some industrial, space or military applications need components and circuits for highly demanding applications, severe vibration or temperature environments, high computing power, specific reliabilities, real time operations, miniaturization, upgrade/retrofit,etc.
- Electronic components being a basic bricks for all high added-value systems, maintaining an electronics industry in Europe is a critical matter of strategic non-dependence

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

- Electronics industry is a highly competitive market integrated into global value chains, with short cycles and requiring large investments. Keeping caught-up with Moore's law (computing power doubles every two years) as well as with new trends (non-computing capabilities grouped under the "More-than-Moore" concept) is a survival issue for the European electronics industry facing huge global competition
- With electronic and telecommunication systems getting more and more complex, developing circuits and components dedicated to a specific application is a key for competitiveness of entire industries. Industrial eco-systems in consumer or professional electronics require strong interactions with the components and circuits link
- Setting up the "Internet of Things", "Cloud computing" or "Big data" services are major requirements from many industries and services in Europe. It requires developments in components as well as from upper technical layers
- Cost is a key and all components design and production has to integrate competitive production aspects from the earliest phase

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

- Development of efficient solid state power electronics for power conversion into energy systems as batteries, fuel cells, photovoltaic and overall grid systems
- Adaptation of remote power supply/storage to specific requirements of application (e.g. very long lifetime without recharging)
- Development of mobile energy storage systems

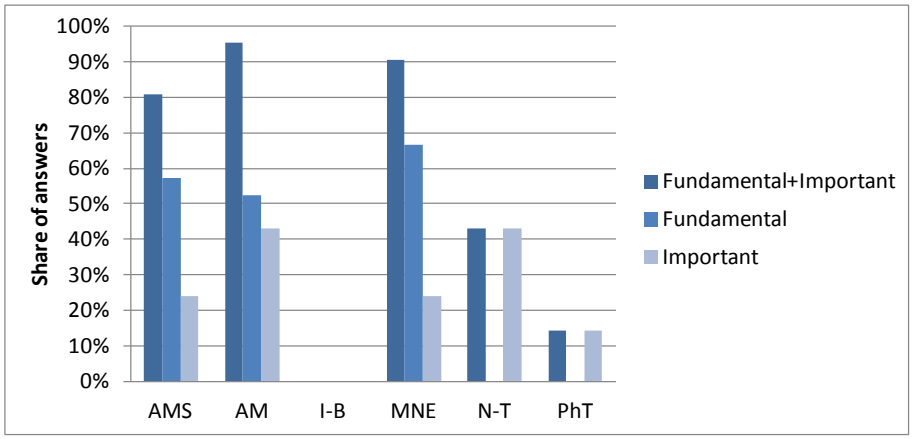
Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of more efficient solid state power electronics for power conversion into energy systems as batteries, fuel cells, photovoltaic and grid systems, contributing to the adaptation of remote power supply/storage to specific application requirements.

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

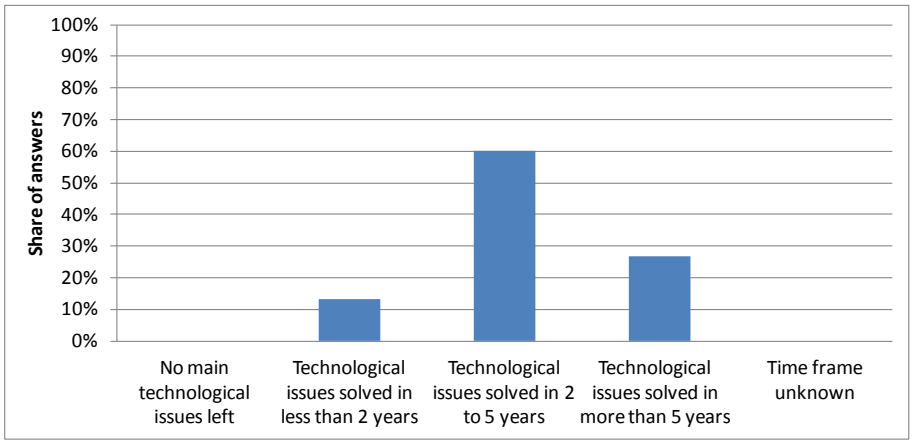
respect to this Innovation Field, with either fundamental or important contribution mainly by the following KETs:

- Micro- and Nano-Electronics (MNE)
- Advanced Materials (AM)
- Advanced Manufacturing Systems (AMS)
- To a lesser extent a possibly important but not fundamental contribution from 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:



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:

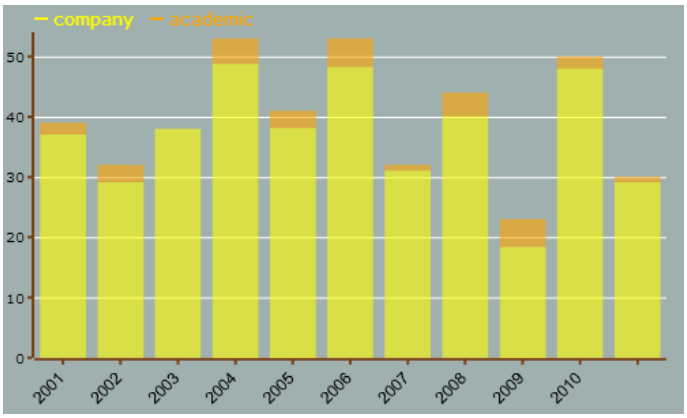
➢ ***Impact assessment:***

- Digital power control and conversion is at the heart of many nowadays energy challenges, namely e-mobility, energy efficiency in transport or manufacturing, power generation, transport and management into smart grids, autonomous systems and more specific aspects as for some space and science issues. Compared to previous analogue power technologies, these digital solutions allow reducing the number of discrete components and overall footprint of the subsystem, increasing power density, monitoring and optimizing power levels and system requirements whilst in operation and speeding up product time to market. Smart meters, on board vehicle advanced power management or the energy-efficient factory all need advanced power electronics to deliver their results.

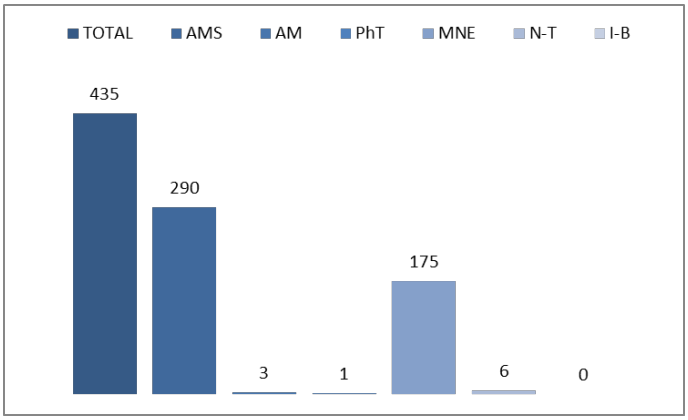
- The total global market for digital power components is forecast to quadruple to about 11.5 billion Euro from 2012 to 2017 (IMS Research 2012, quoted in Power Electronics Europe Jan/Feb 2013). With good positions in transport and energy, the two biggest application markets for power electronics, Europe has the potential for grasping major market shares from that growth.

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

- 435 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- Quite stable trend curve (number of patents per year), possibly slightly decreasing
- Highest share of industrial applicants:



- Patents by KET(s):

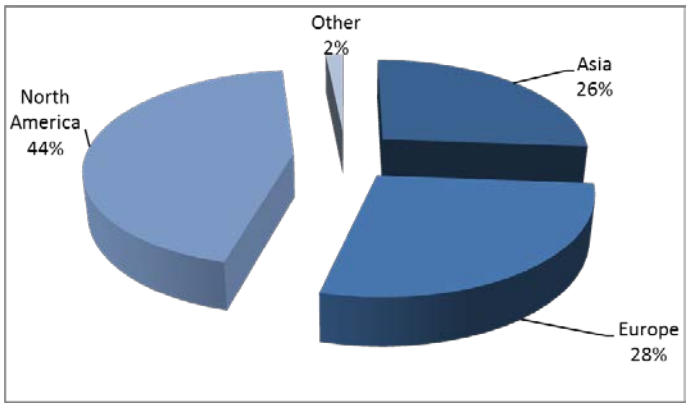


- Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	3
AM / MNE	1
AM / MNE / N-T	1
AM / MNE / N-T / PhT	1
AM / MNE / PhT	1
AM / N-T	2
AM / N-T / PhT	1
AM / PhT	1
AMS	290
AMS / AM	3
AMS / AM / MNE	1
AMS / AM / MNE / N-T	1
AMS / AM / MNE / N-T /	1

KET(s)	*Number of patents*
PhT	
AMS / AM / MNE / PhT	1
AMS / AM / N-T	2
AMS / AM / N-T / PhT	1
AMS / AM / PhT	1
AMS / MNE	46
AMS / MNE / N-T	1
AMS / MNE / N-T / PhT	1
AMS / MNE / PhT	7
AMS / N-T	2
AMS / N-T / PhT	1
AMS / PhT	13
MNE	175
MNE / N-T	1
MNE / N-T / PhT	1
MNE / PhT	44
N-T	6
N-T / PhT	1
PhT	62

- Patent distribution by (Applicant) organization geographical zone:
- Japanese and US industries are dominating the top applicants list, but European companies as Philips, Semikron, ST Microelectronics, Siemens, Robert Bosch, Nokia, NXP or Infineon maintain significant positions



- Patent distribution by geographical zone of priority protection: