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.2.1: Low consumption high computing power components (“More Moore”)

### Scope:

To develop affordable and sustainable high computing power low consumption components and circuits, basically “more Moore” (e.g. based on Complementary Metal-Oxide Semiconductor (CMOS) and Silicon technology), for further miniaturization, higher performance, increased energy efficiency and better heat management of computing systems, supported by a shift to renewable, abundant and non-toxic materials and more cost effective production processes and higher transistor density, such as extreme ultra-violet (UV) photolithography and increased size of semiconductor wafers.

### 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):

- Continue following Moore's law on developing processes for very small size semi-conductor engraving, so as to further miniaturize electronics (i.e. put more transistors per surface unit)
- Increase of the number of chips per wafer to reduce cost
- Increase of energy efficiency and energy management of computing systems
- Improvement of thermal management of components and circuits, including active thermal management of integrated systems, usage of waste heat and highly effective cooling solutions
- Development of intelligent high-performance hardware for simulation purposes
- Preparation to shift to renewable materials and implementation of recycling by design (include life cycle of products and materials into ”product planning”)

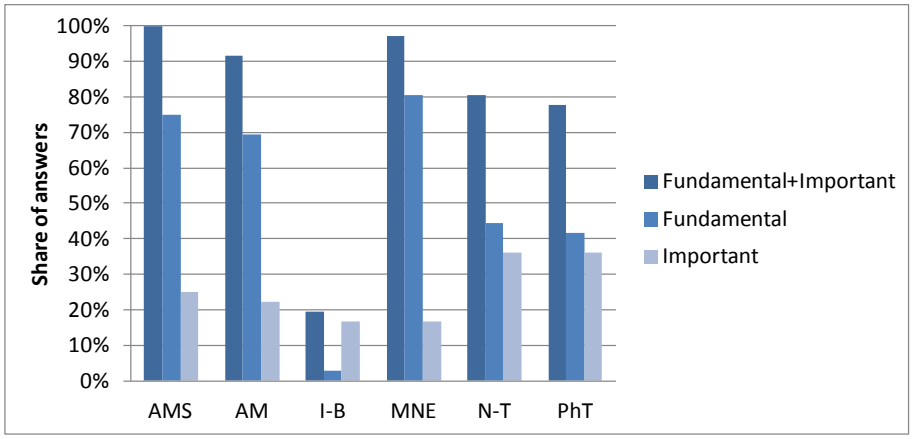
- Increase of performance of embedded computing
- Ensure affordable production of optimized for application chipsets and modules for communication infrastructure (typically low volumes), connection stations and cells (low to medium volumes, set top boxes (medium volumes) and handsets (high volumes)

### 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, affordable and sustainable high computing power, low consumption components and circuits, thanks to very small size semi-conductor engraving , increase of the chips density, thermal management improvements, as well as the use of renewable materials and recycling by design approaches.

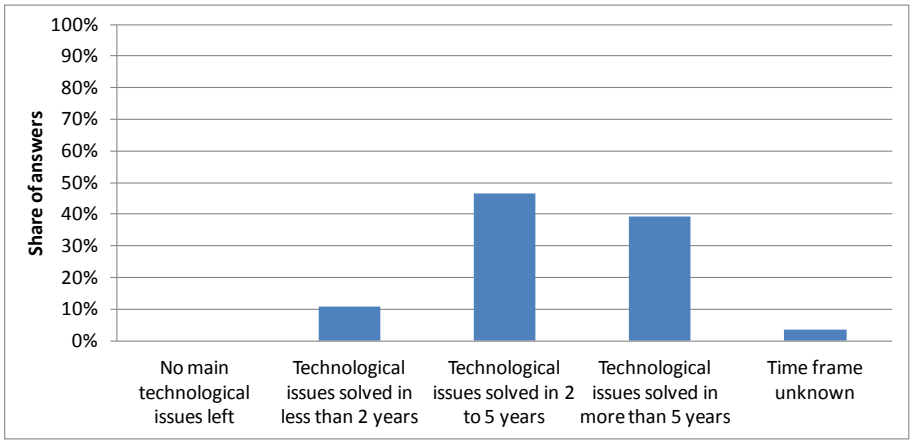
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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

- Advanced Manufacturing Systems (AMS)
- Micro- and Nano-Electronics (MNE)
- Advanced Materials (AM)
- Nanotechnologies (N-T)
- Photonics (PhT)




### 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 significant consensus by experts indicates also longer 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 to medium term should be taken into consideration within this framework.

### Additional information according to results of assessment:

- ***Impact assessment:***
  - In the highly competitive environment of the electronic components industry, developing high added-value "more Moore" products and their advanced production lines at the cross-roads between different KETs is mandatory for guaranteeing that an electronics industry remains viable in Europe, with impacts on European economic and strategic non-dependence and security, as well as on European capability to develop and produce products and systems with advanced, innovative and ground breaking capabilities.
  - Keeping in line with Moore's law means continuing to increase the available computing power, which is important not only for enabling new services but also for just continuing delivering today's services within an environment where running data volumes are continuously increasing. Future internet and all future communication networks, big data services, advanced modelling and simulation capabilities, large integrated information-based services, all these will need increased computing power and "more Moore" components.
  - The defence sector has in the past years strongly contributed to the development of advanced products. The knowledge, technology and services developed may strongly contribute in improving the civilian sector applications by transferring the know-how into the market.
- ***Results of patents scenario analysis:***
  - Many different KETs-related technologies apply to this Innovation Field, but too few of them highlight the final application or target functionalities, so that the RO-cKETs study patent analysis approach is not suitable to delivering significant results in this field.