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.3.2: Small scale embedded energy systems

Scope:

To develop power systems and solutions, such as battery or fuel cell systems, for supplying mobile and autonomous devices with embedded energy in an operational, safe, cost-effective, user-friendly and long-lasting format.

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

- "Inclusive, innovative and reflective societies" and a competitive European economy need breakthrough innovations, smart capabilities, personalized services and high performance systems to be made available to consumers and citizens
- Twentieth century consumer society produces huge wastes of energy and resources. Waste Electrical and Electronic Equipment Directive (WEEE), the European Community directive 2002/96/EC, highlights the specific role to be played by the consumer electronics industry in building up a sustainable model
- Individual behaviour changes can have a dramatic impact on environment and climate impact; they have to be supported with life-easing technological solutions. Smartification and convergence of consumer electronics have a role to play in a better organization of society consumptions
- Protecting citizens security and freedom requires personal data and personal equipment and systems to be protected against misuses and malevolent actions

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

- Consumer electronics markets deliver a wide variety of services to European customers, including for entertainment, education, sports, well-being, lifestyle, communication, home services, connected mobility, etc. These markets experience rapid shifts based on evolution of the needs or on product-based new opportunities that create their own markets. Open innovation driven by the use is requested to quickly identify and support fast-adoption technologies
- Context-aware, personalized and convergent capabilities embedded into seamless experiences and serving smart services are necessary for citizens to go on with buying new products and services without being stuck in a growing complexity
- Guaranteeing a sufficient level of trust, privacy and security is mandatory for supporting a sustainable acceptance of Information-based services

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

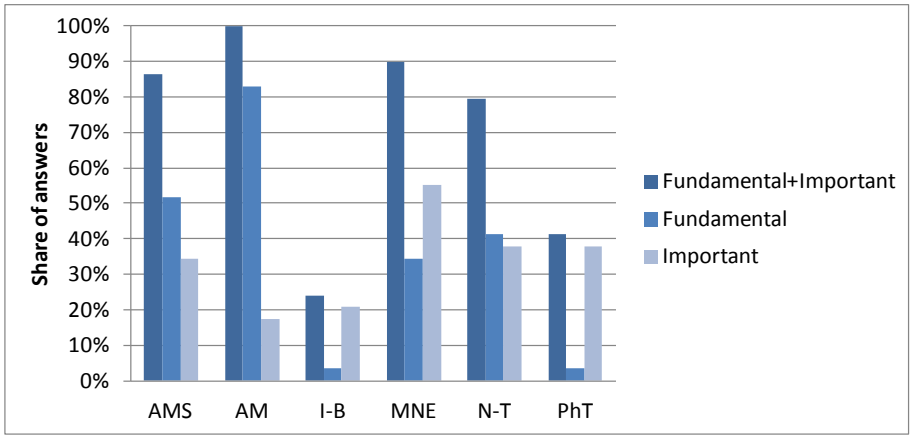
- Development of small scale high energy density storage systems, such as micro-batteries or small fuel cells, that are suitable for mobility-portability and/or autonomous applications
- Ensure production is cost-effectively feasible on the large scale, i.e. materials used are available in sufficient quantities at a reasonable cost (in particular critical materials are replaced by synthetic equivalent) and processes are cost-effective
- Ensure operations are safe in all operating conditions (temperature, humidity, vibrations), resilient to manipulations and chocks, including in terms of connectivity
- Package the energy systems so as to be easy to plug and charge
- Development of solutions, e.g. printed batteries, for very small power storage, particularly for very small autonomous devices as distributed sensors, eventually coupled with energy harvesting solutions
- Development of high scalability and modularity systems through improved encapsulation of small capacities
- Ensure long-enough campaign life of energy storage systems, and/or monitor system ageing with embedded sensing and interpretation capability

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of small-scale, high energy density storage systems, such as micro-batteries (also printed ones) or small fuel cells, suitable for mobility-portability and/or autonomous applications, ensuring cost-effectiveness, reduced dependency on critical materials, safety in operating conditions, long life cycle, scalability and modularity.

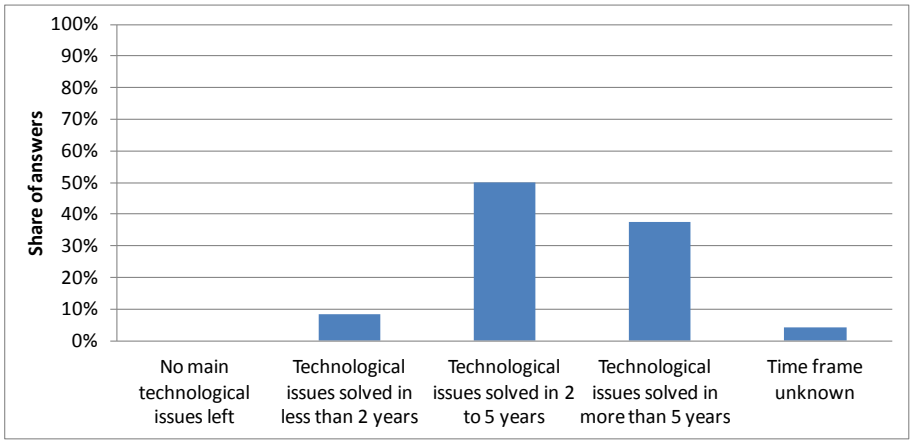
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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

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



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:***

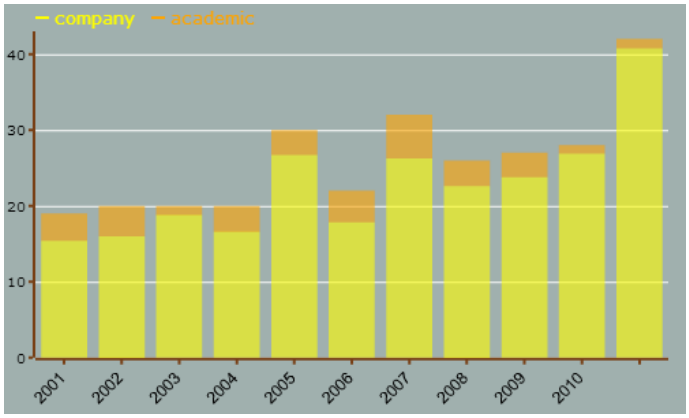
- Considering the evolutions of mobility and nomadic uses, energy systems embedded in any sort of devices are becoming a critical point. Lithium-ion batteries have played a major role in the development of the mobile phone market and they continue being a best seller, highly demanding needs on power or autonomy require alternatives in battery technologies, other sorts of energy storage (as fuel cells),

energy scavenging (as energy captured from motion or micro-solar PV) and their combination into integrated energy systems to be driven to market deployment.

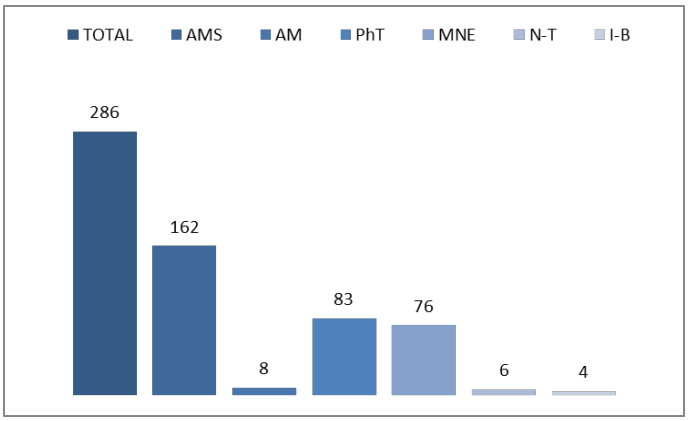
- Developing more diverse sets of nomadic energy systems will also help relieving pressure on critical raw materials, especially considering that new technologies are developed taking into account the recyclability requirement.
- Small scale embedded energy systems have been developed in the defence sector. This background can be applied to the civilian market by using already developed technologies and consolidated know-how.

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

- 286 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- Increasing trend curve (number of patents per year)



- Patents by KET(s):

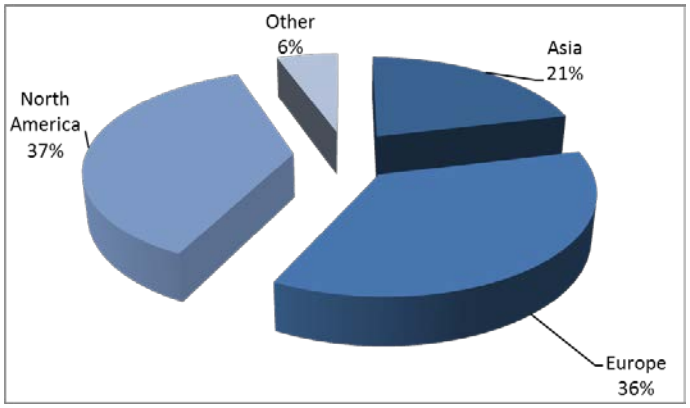


- Patents by KET(s) and relevant combinations of KETs:

KET(s)	*Number of patents*
AM	8
AM / MNE	1
AM / MNE / N-T	1
AM / N-T	3
AMS	162
AMS / MNE	2
AMS / MNE / PhT	1
AMS / PhT	2
IBT	4
MNE	76
MNE / N-T	1

KET(s)	*Number of patents*
MNE / PhT	45
N-T	6
N-T / PhT	1
PhT	83

- Patent distribution by (Applicant) organization geographical zone:
- Patent application is very little concentrated, with the biggest applicants (Philips and Honeywell) having only applied 6 patent families each in the period



- Patent distribution by geographical zone of priority protection: