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 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.4.2: Fuel cell-based systems for portable applications

Scope:

To develop fuel cell-based systems for portable applications with improved performance at both single component and system level toward miniaturisation, compatibility, simplicity and cost-effectiveness including hybrid systems solutions capable to optimizing system efficiency, dynamics and start-up time.

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

- Contribute to achieving competitive, sustainable and secure energy

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

- Enable more efficient power storage in order to guarantee power supply to mobile, portable and consumer products
- Larger supply availability of more reliable as well as small-sized / low-weight systems for power supply
- Increase power to weight ratio of storage systems in order to maximize yield at overall system level

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

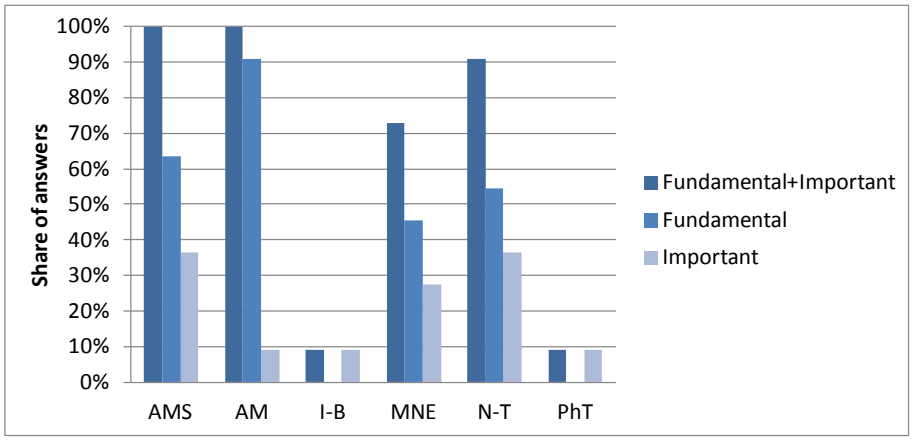
- Improvement of the performances of polymer electrolyte fuel cells (PEFCs) and direct methanol fuel cells (DMFCs) stacks: efficiency, power density, reducing precious metals, low costs stack components, decreasing methanol crossover
- Increase of system performance in fuel cell portable applications, toward miniaturization, compatibility, simplicity and cost-effectiveness: system efficiency, dynamics and start-up time (e.g. hybrid systems solutions), fluid handling components, water recovery, thermal integration, electronic equipment and components
- Improvement of the technology through developments in high temperature membranes, carbon-monoxide- and sulphur-tolerant catalysts, new membrane electrode assemblies (MEAs), components for polymer electrolyte fuel cells (PEFCs); cathode catalysts, and composite membranes for direct methanol fuel cells (DMFCs); alternative options for humidification, new battery and stack concepts
- Development of cost-efficient manufacturing

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of more performing fuel cells for small-scale, portable applications thanks to deploying solutions for solving degradation issues including through methods for lifetime prediction and the deployment of enhanced materials and structures. The integration of KETs could moreover contribute to increasing miniaturization, compatibility, simplicity and cost-effectiveness of small-scale, portable systems, contributing to enhance system efficiency, dynamics and start-up time. The integration of KETs could finally contribute to render manufacturing of such systems and equipment more cost-efficient.

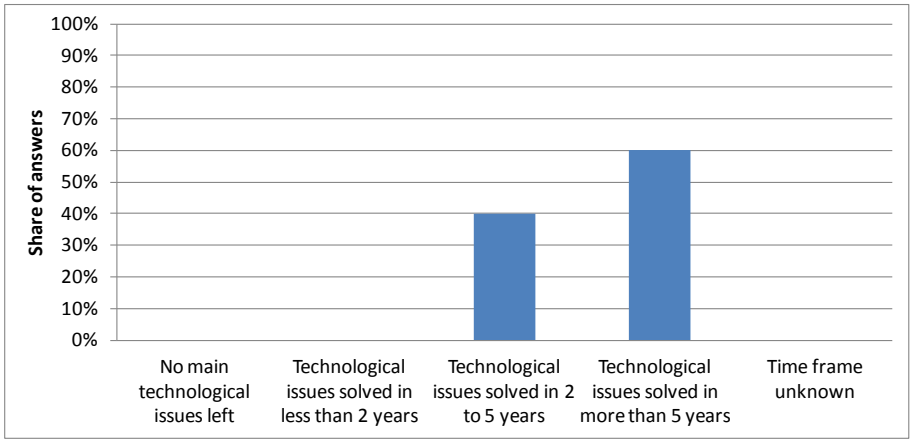
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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)
- 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 more than 5 years, yet significant consensus indicates also shorter 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:***
  - Portable power applications use fuel cells that are not permanently installed or fuel cells in a portable device. As for transport applications, fuel cell technology in this domain is also considered to be in the demonstration stage, requiring to become more cost-competitive with conventional technologies, such as batteries for cell phones and computers, in order to gain the market share.
  - The portable market segment is characterized primarily by fuel cell kits and toys, as well as by small battery chargers that are starting to enter the market. The kits and toys continue to be successful and to account for the largest proportion of annual fuel cell shipments by unit, whereby, according to the US Department of Energy (DOE), total fuel cell shipments (i.e. including any application for fuel cell technology) increased in 2012 by 34% over 2011 and 321% over 2008. Sales of battery chargers and other similar portable applications have yet to take off, in part because the business case for these products vis-à-vis batteries remains unclear.
  - Among the list of commercially available portable and micro fuel cells in 2012, two European companies appear (namely myFC, Sweden, and SFC Energy, Germany) besides one from the US and one from Singapore.

- Soldier wearable and portable power systems have already been largely developed in the defence sector, thus this application may significantly benefit from technologies already developed in the defence field.
- Source: Breakthrough Technologies Institute Inc. for DOE, 2012 Fuel Cell Technologies Market Report, October 2013

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

- 14 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- No significant patent-related figures can be reported in this field