European Commission

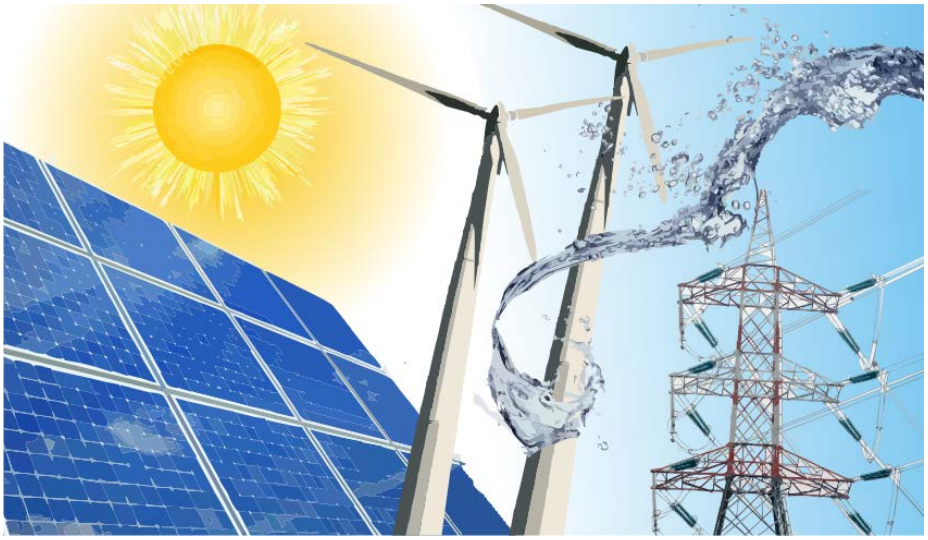
This fiche is part of the wider roadmap for cross-cutting KETs activities

'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.2.1: Next generation thermal energy storage

Scope:

To develop next generation thermal energy storage solutions and systems for the storage of heat and cold towards reducing costs of actual systems and improving their ability to effectively and efficiently shift heat demand over days, weeks or seasons.

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

- Contribute to tackle the “secure, clean and efficient energy” challenge
- Contribute to the reduction of greenhouse gas emissions

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

- Increase use of effective energy storage solutions into existing energy distribution networks in order to resolve the mismatch issue between energy generation and demand

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

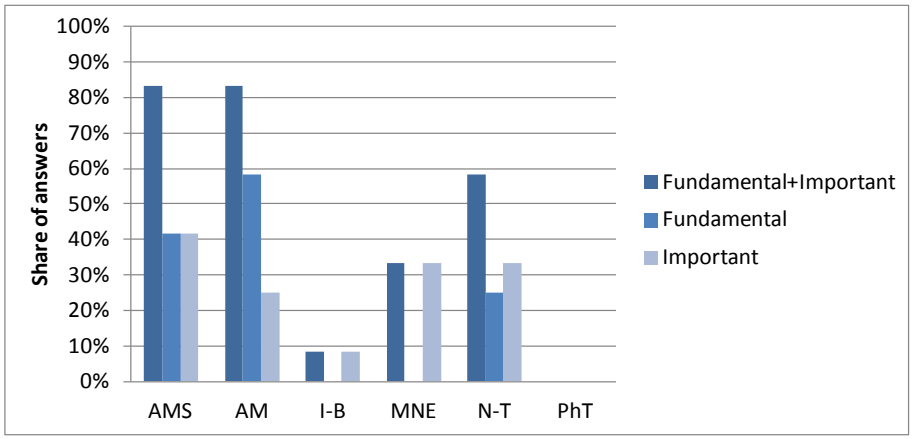
- Increase of the energy density of storage materials relevant for all different heat storage types
- Development of latent heat storage solutions based on solid-to-liquid as well as solid-to-solid phase change
- Development of new technologies and solutions for the storage of thermo-chemical energy
- Further development and improvement of fluids that combine the heat transfer function with thermal energy storage
- Development of novel and compact heat exchangers using improved concepts, geometries and perhaps new materials, like polymers, in order to improve the charging and discharging process by increased heat transfer power and therefore reduce charging and discharging time and disturbances of the temperature stratification
- Reduction of thermal losses and therefore increase in the efficiency of the heat storage system
- Improvement of storage insulation by the development of long lasting, low-cost and easy to apply high performance insulation materials or solutions, e.g. vacuum insulation
- Improvement of charging and discharging as well as stratification devices, i.e. intelligent state-of-charge determination systems fully integrated in the storage
- Reduction of the costs and thermal conduction of containment materials by replacing metal with polymer casings, with or without fibre reinforcement

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of the next generation thermal energy storage solutions, thanks to increasing the energy density of storage materials, which is relevant for all different heat storage types, along with improving charging and discharging as well as stratification devices, e.g. by intelligent state-of-charge determination systems fully integrated in the storage. To this end, the integration of KETs could contribute to the development of latent heat storage solutions based on solid-to-liquid as well as solid-to-solid phase change, or of new technologies and solutions for the storage of thermo-chemical energy, or the further development and improvement of fluids that combine the heat transfer function with thermal energy storage. Moreover it could contribute to the development of novel and compact heat exchangers using improved concepts, geometries and new materials.

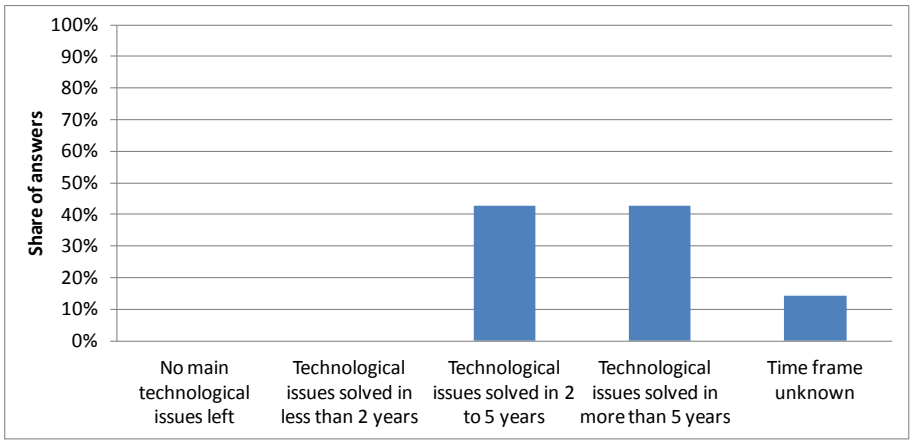
To this aim, the combination of KETs experts’ opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong 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)
- 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 or longer (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 short to medium term should be taken into consideration within this framework.

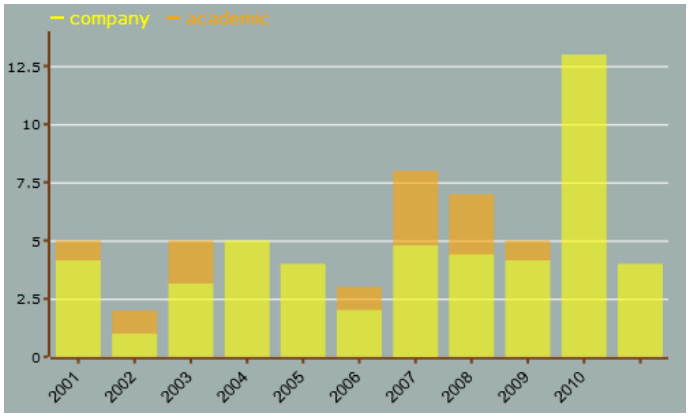
Additional information according to results of assessment:

- ***Impact assessment:***
  - Thermal energy storage will be key, along with other energy storage systems and methods, in supporting the transition towards a secure, competitive and decarbonised energy system in Europe. The increasing intermittency at the generation side due to an increased integration of renewable as well as distributed energy generation in the energy system requires technologies and procedures for balancing energy demand and supply on a daily, weekly and even seasonal basis, thus allowing displacement between consumption and generation to take place in both time and space. Within this framework, thermal energy storage will become an integral part of future's energy systems and related value chains.
  - Thermal energy storage systems are used particularly in buildings and industrial processes. Furthermore, the conversion and storage of variable renewable energy in the form of thermal energy can also help increase the share of renewables in the energy mix. Thermal energy storage is for instance becoming particularly important for electricity storage in combination with concentrating solar power (CSP) plants where solar heat can be stored for electricity production when sunlight is not available.

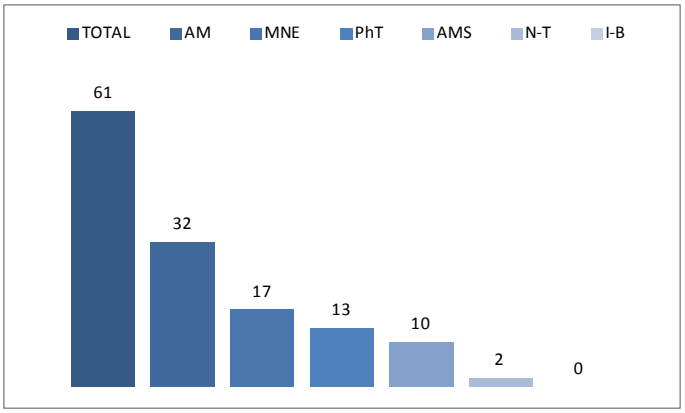
- In Europe, it has been estimated that around 1.4 million GWh per year could be saved— and 400 million tonnes of CO2 emissions avoided—in the building and industrial sectors by more extensive use of heat and cold storage.
- Today, thermal energy storage technologies still face some barriers to market entry, cost being in most cases a major issue. Though, if such market barriers will be overcome, potential market perspectives for thermal energy storage technologies will be high, their market being very strictly related to the energy efficiency solutions' market.
- Sources: IEA-ETSAP and IRENA©, Thermal Energy Storage - Technology Brief, January 2013; Joint EASE/EERA recommendations for a European Energy Storage Technology Development Roadmap towards 2030, March 2013.

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

- 61 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 with intermittent relevant patenting activity by academic applicants, most probably standing for new technologies having been patented in the corresponding periods:



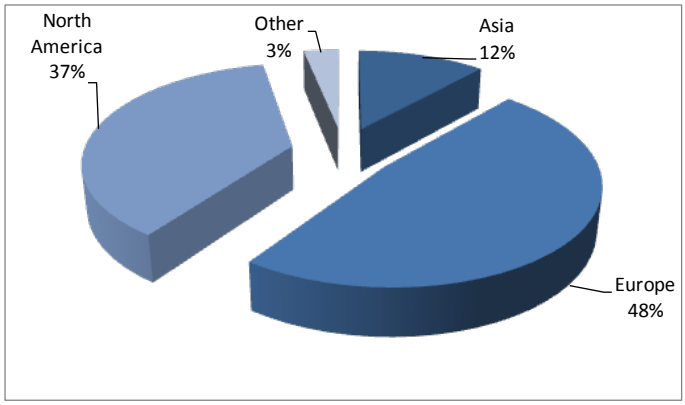
- Patents by KET(s):



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

KET(s)	*Number of patents*
AM	32
AM / N-T	2
AMS	10
MNE	17
MNE / PhT	11
N-T	2
PhT	13

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: