European Commission

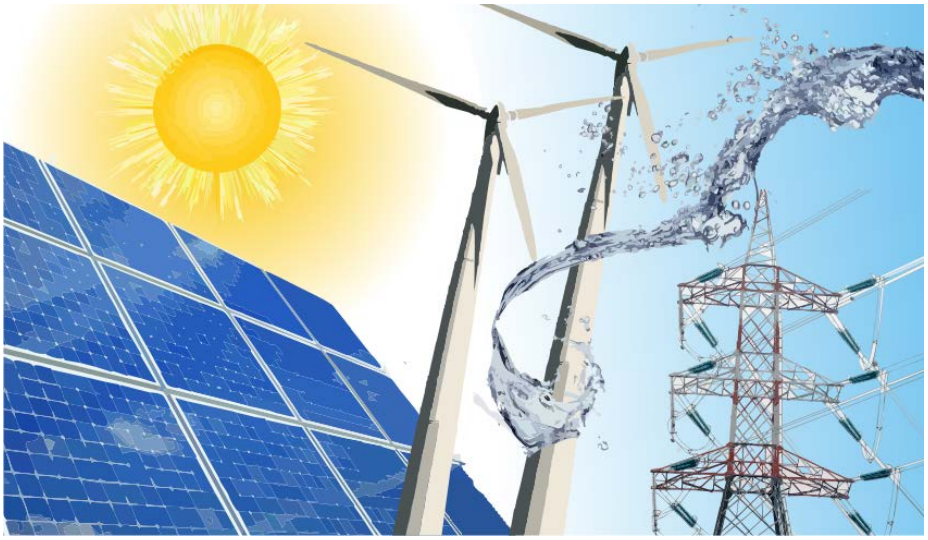
This fiche is part of the wider roadmap for cross-cutting KETs activities

'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.2.2: Coal-fired power plants based on clean coal technologies

Scope:

To develop coal-fired power plants based on clean coal technologies towards coal-based near-zero emission power production.

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:

- Reduce greenhouse gas emissions associated with power plants
- Cope with regulation related to greenhouse gas emissions
- Keep costs low under the EU’s Emissions Trading Scheme (ETS)
- Meet public acceptance

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

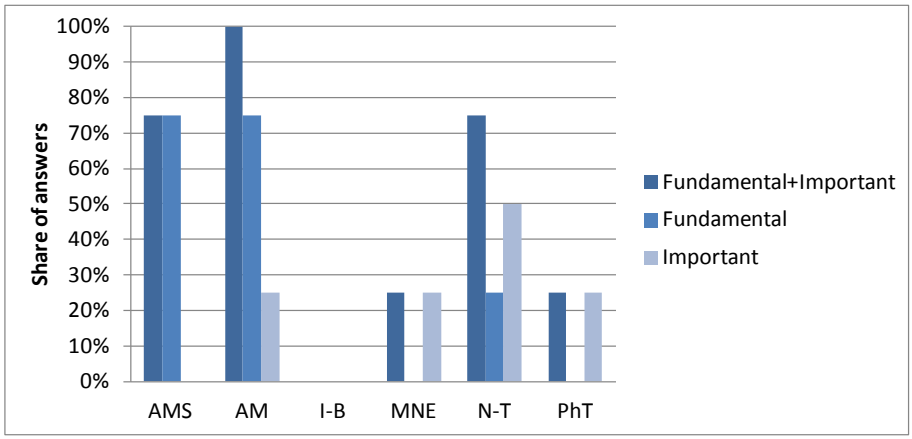
- Development of the new generation of coal-fired power plants with higher efficiencies and thus lower emissions
- Improvements and up-scaling of gasifiers, hydrogen-gas turbines, carbon monoxide-shift and CO2 capture for pre-combustion technology
- Development of supercritical cycles and equipment
- Development of high temperature materials (superalloys, ceramics, etc.) and surface treatments for high temperature resistance

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of the new generation of coal-fired power plants with higher efficiencies and thus lower emissions, thanks to improvements and up-scaling of gasifiers, hydrogen-gas turbines, carbon monoxide-shift and CO_2 capture for pre-combustion technology, the development of supercritical cycles and equipment, the development of high temperature materials (superalloys, ceramics, etc.) and surface treatments for high temperature resistance, etc.

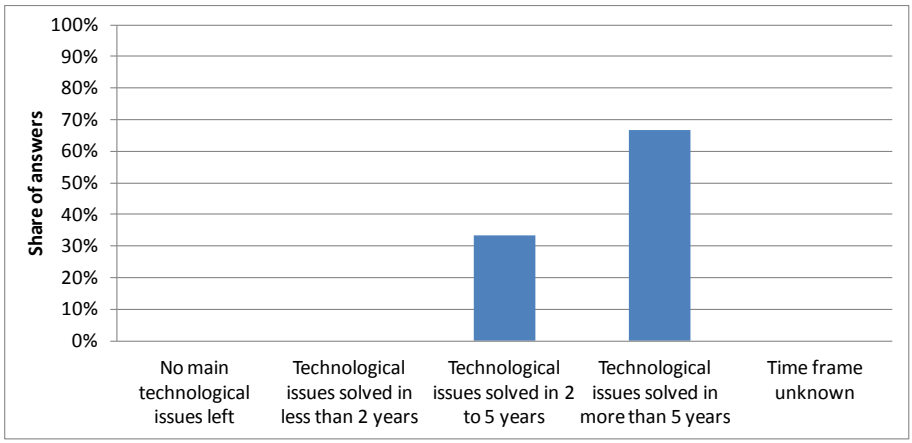
To this aim, the combination of KETs experts’ opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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

Additional information according to results of assessment:

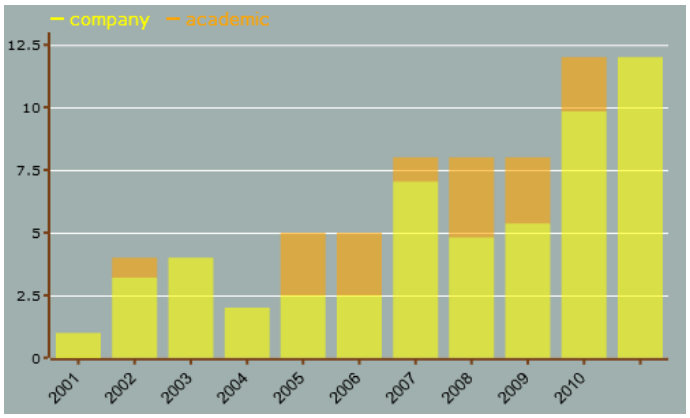
- ***Impact assessment:***
  - Due to its low cost and abundance, coal is today a vital fuel and is expected to continue to be a dominant fuel in power generation. Some 25% of primary energy needs are met by coal and about 40% of electricity is generated from coal today. The International Energy Agency (IEA) furthermore expects that the use of coal will increase of 43% from 2000 to 2020. Nonetheless, as it is widely known, conventional coal power generation is a leading contributor to global greenhouse gas emissions as coal is the most carbon-intensive among the fuels. However, given coal's abundance, this resource will continue to be exploited among the energy mix for energy security and economic reasons.
  - Clean coal technologies are expected to enable coal to remain an attractive fuel option thanks to improving the environmental performance of coal power generation. As clean coal technologies are being developed and increasingly adopted, the global value of electricity generated using clean coal technologies is reported to amount to around 48 billion Euro in 2010 and is further expected to grow to 65 billion Euro by 2020.
  - While coal washing, particulate control and emissions treatments have been in use for several decades, recent advances in technologies aimed at reducing SO_2, NO_x and particulate emissions have substantially improved the effectiveness and reduced the cost of these solutions, while advanced

combustion technologies along with advanced power plant designs, incorporating gasification and combined cycle power generation, are increasing the power conversion efficiencies of coal power plants, thus enabling simultaneous improvements in emissions and economics of coal-fired generation. Yet, the greatest opportunity for the coal industry to significantly improve its environmental performance seems to lie today in the maturation and deployment of carbon capture and sequestration technologies (CCS).

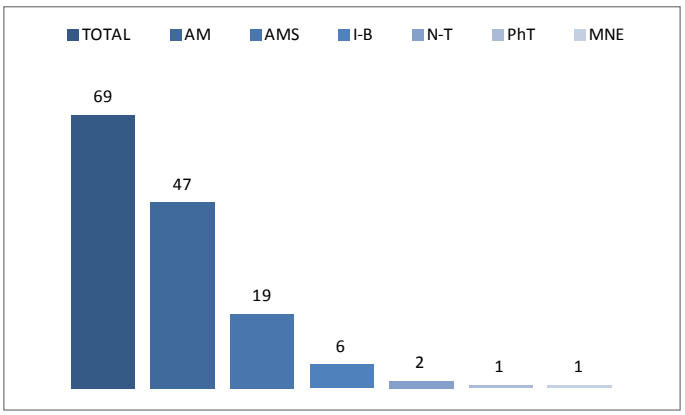
- Having the above situation in mind, from a value chain perspective the clean coal industry can represent an important opportunity for both the many EPC contractors and equipment manufacturers established in Europe; opportunities for growth and jobs creation will mainly be linked to the engineering, procurement and construction (EPC) related to plants upgrading as well as to the manufacture and supply of new equipment by equipment producers.
- Sources: International Energy Agency Coal Industry Advisory Board, Clean Coal Technologies, Accelerating Commercial and Policy Drivers for Deployment, February 2008; MarketResearch.com, Clean Coal Technologies Markets and Trends Worldwide, 2nd Edition, January 2012.

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

- 69 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- Increasing 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:



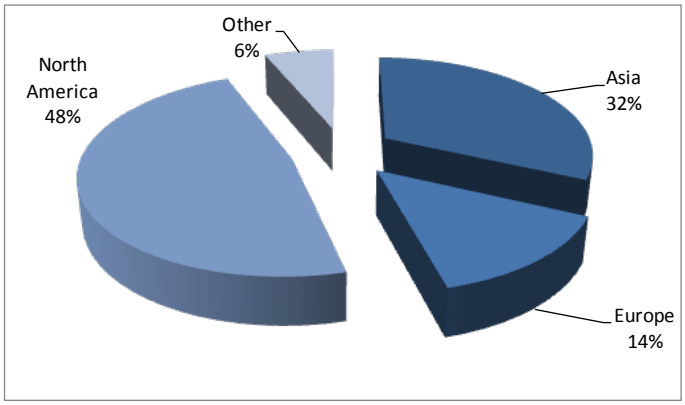
- Patents by KET(s):



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

KET(s)	*Number of patents*
AM	47
AM / IBT	1
AM / MNE	1
AM / N-T	2
AMS	19
AMS / AM	2
AMS / AM / N-T	1
AMS / N-T	1
AMS / PhT	1
IBT	6
MNE	1
N-T	2
PhT	1

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection: