

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 Mining, Quarrying and Extraction 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.

MI.1.2: Technologies for safe, profitable, energy- as well as cost-efficient mining and quarrying

Scope:

Improvements in technologies and processes to ensure safe as well as profitable mining or quarrying, with a focus on risk mitigation, cost reduction, productivity enhancement, energy efficiency, and environmental impact reduction.

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

- Tackle the “Climate action, resource efficiency and raw materials” societal challenge

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

- Secure the supply of raw materials and resources
- Reduce field operating costs while ensuring safety and decreasing environmental impacts
- Enable more efficient and sustainable resources utilisation
- Enhance productivity of mining, quarrying and other extractive activities
- Improve environmental management in mining, quarrying and other extractive activities
- Guarantee adequate waste management

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

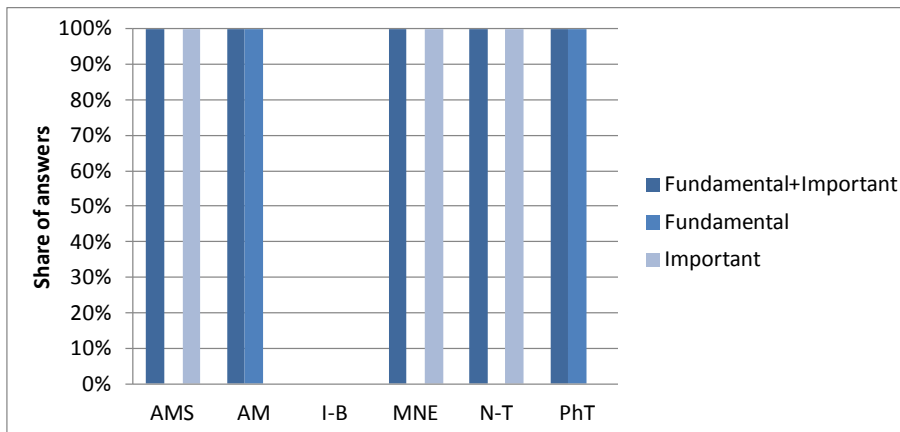
- Improvement of sensing while sampling techniques, e.g. Measuring While Drilling (MWD)
- Development of new technologies and processes to ensure safe, profitable mining or quarrying with a focus on risk mitigation, mechanized underground excavation or surface extraction, cost reduction, and productivity enhancement
- Technological improvements aimed at increasing energy efficiency in rock fragmentation as well as comminution (i.e. blasting, crushing, milling), excavation (e.g. by mechanical cutting, high-pressure water, microwaves, etc.), hauling and transportation
- Technological improvements in underground ventilation to decrease energy costs while ensuring the highest level of safety (e.g. through Ventilation of Demand)
- Development of fully automatic excavation as well as extraction technologies encompassing simulation, robotics, monitoring
- Development of more sustainable extraction methods capable to minimize mass transport, e.g. through maximization of in-situ processing, near-to-face beneficiation in mining, and the use of waste materials for backfilling
- Minimization of noise, dust, emissions and vibrations in drilling and blasting
- Optimization of tools and equipment used in aggregates production: drilling/blasting – loading/haulage – crushing/screening (including on-line size control of aggregates)
- Effective restoration of surface mining and quarrying sites
- Improvements in health and safety of workers including through enhanced communication as well as personal tracking devices, improved personal protection systems/equipment, gas detectors, etc.
- Improvements in rescue systems for the harsh environments
- Development of virtual reality-supported training modules for operators

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 technologies and processes to ensure safe, profitable mining or quarrying with a focus on risk mitigation, energy efficiency in rock fragmentation, excavation (e.g. by mechanical cutting, high-pressure water, microwaves, etc.), hauling and transportation.

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



Timing for implementation:

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 term should be taken into consideration within this framework.

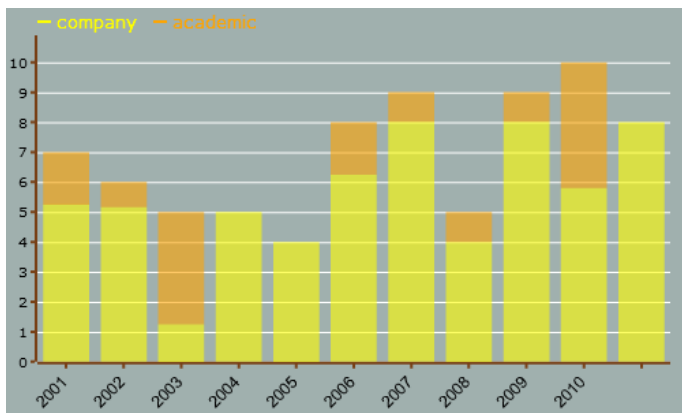
Additional information according to results of assessment:

➤ **Impact assessment:**

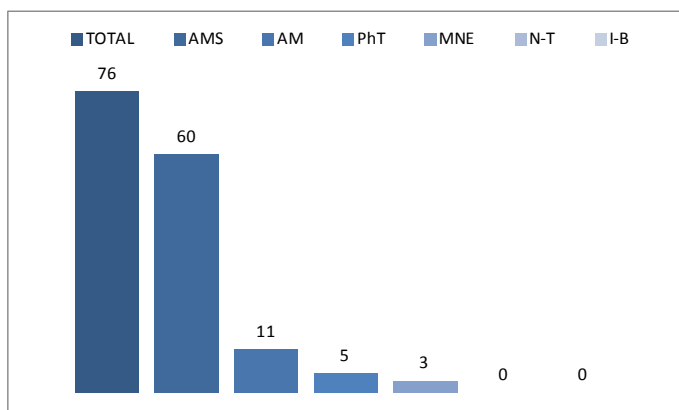
- The EU-27's mining and quarrying sector is an industry that has been in decline for several decades. The average reduction in output during the period 1997-2007 equated to 2.2% per year. This was entirely due to a decrease in mining and quarrying activity for energy producing materials (average decline of 3.2% per annum), as the EU-27 index of production for mining and quarrying of non-energy producing materials rose, on average, by 2.0% per year over the period considered (Source: Eurostat).
- The mining industry faces a confidence crisis. Low confidence in cost controls, return on capital and commodity prices are keeping industry leaders awake at night. To add to these concerns, the mining industry has recently stopped outperforming the broader equity markets—mining stocks fell nearly 20% in the first four months of 2013. In response, miners are trying to rebuild the market's confidence. Capital expenditures have been scaled back, hurdle rates are being increased and non-core assets are being disposed. There's a shift from maximizing value by increasing production volumes to maximising returns from existing operations from improved productivity and efficiencies (Source: <http://www.pwc.com/gx/en/mining/>).

➤ **Results of patents scenario analysis:**

- 76 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:



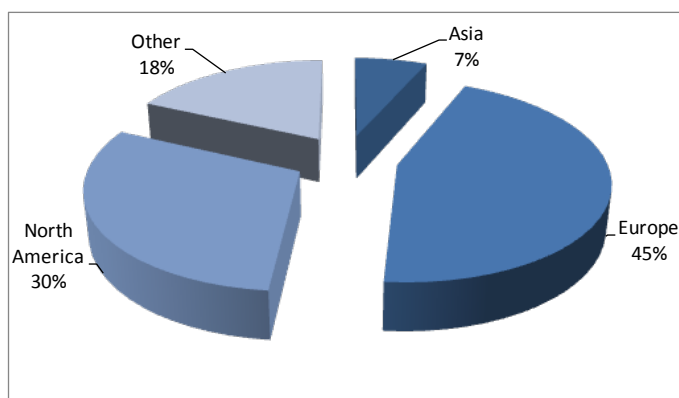
- Patents by KET(s):



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

KET(s)	Number of patents
AM	11
AMS	60
AMS / MNE	1
AMS / MNE / PhT	1
AMS / PhT	1
MNE	3
MNE / PhT	2
PhT	5

- Patent distribution by (Applicant) organization geographical zone:



- Patent distribution by geographical zone of priority protection:

