European Commission

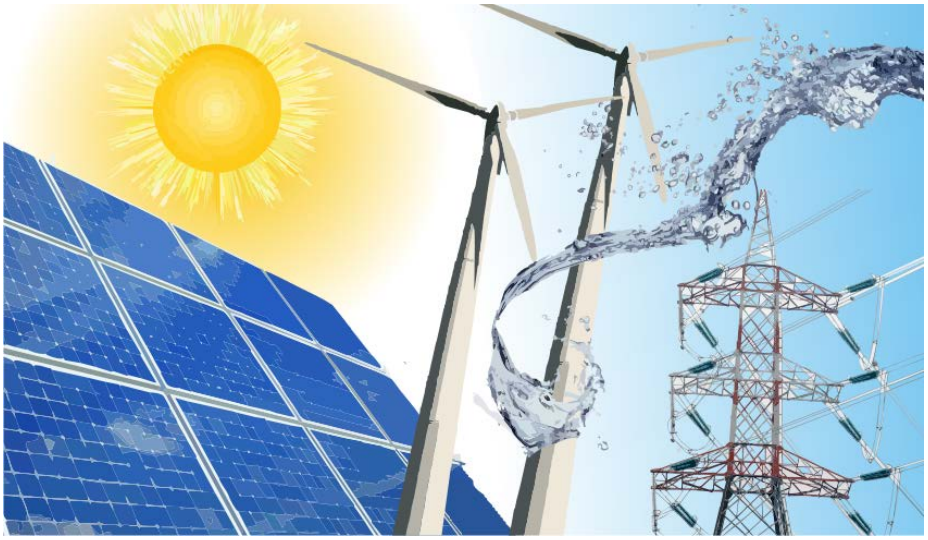
This fiche is part of the wider roadmap for cross-cutting KETs activities

'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.2.4: High flexibility combined cycle gas turbine power generation

Scope:

To develop Combined Cycle Gas Turbine power generation systems whose flexibility is maximized along with efficiency including through improvements in materials addressing the important issue of durability.

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:

- Cope with fluctuating power demand
- Increase durability of energy generation equipment in order to ultimately reduce operation and maintenance costs

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

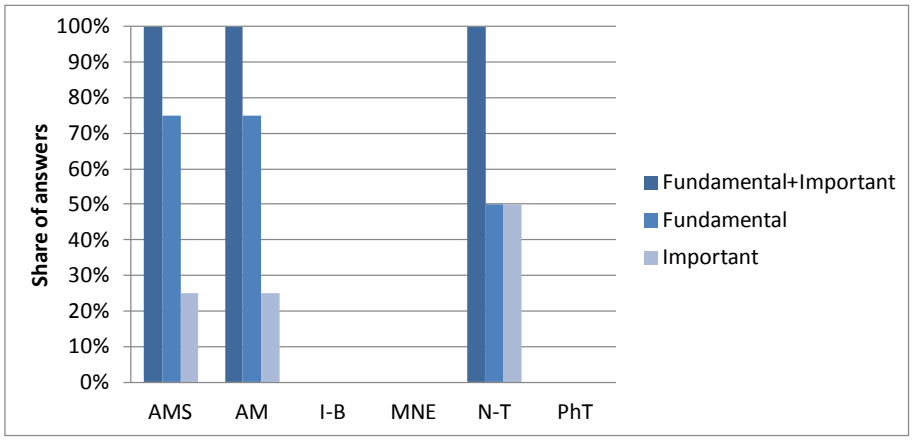
- Development of novel materials for energy applications addressing the important issues of durability, efficiency and cost of energy systems
- Increase the steam data, i.e. pressure and temperature, of power plants through developments in new materials (austenitic alloys, Ferritic alloys, FeCrAl alloys, ceramics) tackling problems such as creeping, cracking, Thermal Mechanical Fatigue (TMF), corrosion, erosion, etc.
- Development of efficient hydrogen turbine systems, including system optimization for combined heat and power (CHP) generation, trigeneration, combined cycle, etc.
- Development of heat transfer concepts that avoid deposit formation on and fouling of heat exchangers for combustion-based cogeneration
- Improvements in combustion systems and high temperature chamber testing (towards high efficiency and low environmental impact)

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of novel materials for energy applications addressing the important issues of durability, efficiency and cost of energy systems, allowing to increase the steam data of power plants through developments in new materials, tackling problems such as creeping, cracking, Thermal Mechanical Fatigue (TMF), corrosion, erosion, etc., along with the development of specialized coatings improving heat transfer concepts and avoiding deposit formation on and fouling e.g. of heat exchangers for combustion-based cogeneration. The integration of KETs could moreover contribute to improvements in combustion systems (towards high efficiency and low environmental impact).

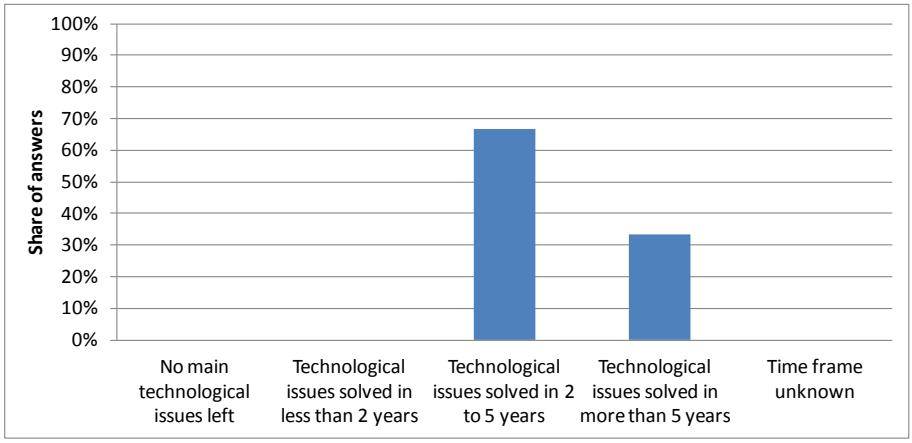
To this aim, the combination of KETs experts’ opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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



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 term should be taken into consideration within this framework.

Additional information according to results of assessment:

- ***Impact assessment:***
  - Gas turbines, increasingly in combined cycle applications with heat recovery steam generators converting waste heat into steam, and steam turbine generators using that steam for increased generation efficiency, will continue to be the workhorses in the power generation industry. In evaluating the market for gas turbine electrical power generation over the next decade, many factors lead to the conclusion that annual growth will most likely exceed 2.5-3.0% worldwide in order to keep up with demand, while the market is forecast to reach a value of over 110 billion Euro over 10 years (Sources: The Market for Gas Turbine Electrical Power Generation, Special Focused Market Segment Analysis by Forecast International, 2011; MarketResearch.com, Industrial & Marine Turbine - Gas & Steam Turbines: The Market for Gas Turbine Electrical Power Generation, 2012).
  - Europe is home to important and well-known manufacturers of both heavy gas turbines (such as Alstom, Rolls-Royce, Siemens) and light gas turbines (such as MAN Diesel & Turbo, OPRA Turbines, Safran Turbomeca among others) that actively participate the global market. Furthermore, as the segment of micro-turbine machines of under 250 kW grows along with distributed generation, there are several smaller and lesser-known players participating mainly the domestic market.

- According to the Diesel & Gas Turbine Worldwide's Power Generation Order Survey 2013, providing details on the market of larger reciprocating engines, steam turbines and gas turbines used in power generation, gas turbine orders fell 34% compared to 2012 in favour of reciprocating engines. The 2013 survey revealed 447 gas turbine orders while 2012 had reported 677 units. Yet, steam turbine orders rose by 4% compared to 2012, with 128 steam turbine orders catalogued in 2013 and 123 units in 2012. It is also reported that steam turbines continued to grow in popularity, boasting a 64% growth in the last two years. Total units ordered in 2012 (combined gas turbine, steam turbine and reciprocating engine order data) were 32 271.
- The top five markets revealed in the 2013 Power Generation Order Survey are North America (19%), Western Europe (16%), the Middle East (14%), Central Asia (13%) and the Far East (12%), with Middle and Far East markets driving demand.

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

- No 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