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 Environment 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.

EV.1.1: Membrane filtration for municipal and industrial wastewater treatment

Scope:

To develop membrane filtration/separation processes (such as micro-filtration (MF), ultra-filtration (UF), nano-filtration (NF), reverse osmosis (RO)) including Membrane Bio-Reactors (MBR) for municipal and industrial wastewater treatment characterized by superior product water quality, reduced footprint at plant level and reduced energy consumption.

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

- Tackle the "climate action, resource efficiency and raw materials" challenge, indirectly also contributing to addressing challenges such as "food security, sustainable agriculture, marine and maritime research and the bio-economy" and "health, demographic change and wellbeing"

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

- Manage environmental hazards and pollution
- Reduce processing costs through recovery (of both energy and resources) in industrial activities
- Minimize waste thereby reducing related management costs

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

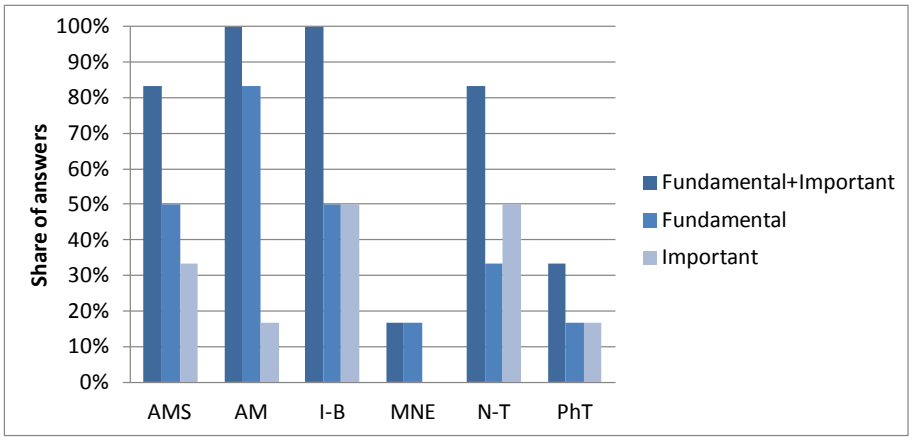
- Understanding of membrane microstructure and trans-membrane transport and tailoring of membrane microstructure and trans-membrane transport processes thanks to improved materials and precision manufacturing
- Engineering of membranes selectivity through design of pore size and selection of materials and related manufacturing
- Incorporation of membranes into housing modules designed to produce optimal hydrodynamic conditions for separation
- Development of the interfaces and control systems needed to integrate membrane modules into the various process configurations
- Cost reduction through membranes as well as process optimization
- General improvements in membrane filtration equipment to achieve increased performance and reduced operating as well as maintenance costs

Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of higher performance membrane filtration/separation processes for municipal and industrial wastewater treatment, characterized by superior product water quality, reduced footprint at plant level and reduced energy consumption. The integration of KETs could particularly contribute to tailoring membrane microstructure and trans-membrane transport processes thanks to improved materials and precision manufacturing, along with general improvements in membrane filtration equipment to achieve increased performance and reduced operating as well as maintenance costs.

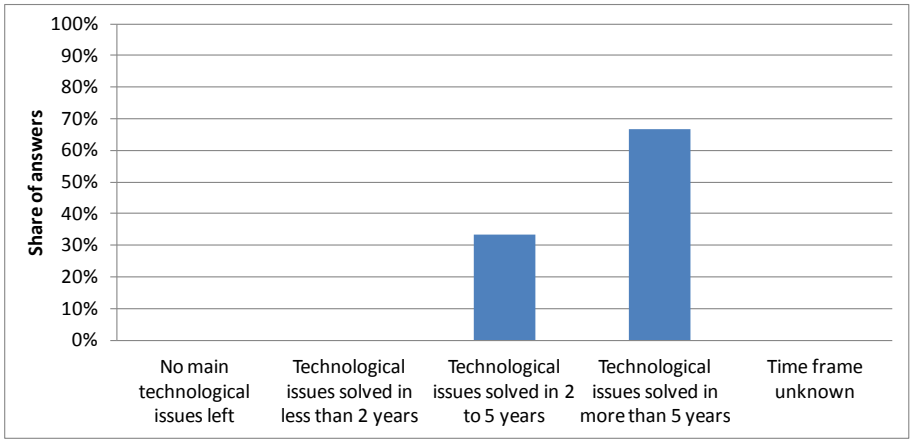
To this aim, the combination of KETs experts' opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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



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 by experts 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:***
  - Market drivers for water and wastewater treatment are dominated by the implementation of stricter regulations and the need to reduce energy costs in treatment processes. Innovation is therefore focused on applications that will produce higher quality water at lower costs. Energy efficient treatment processes such as low pump rate membrane technologies are particularly suited to meeting these objectives. The waste and wastewater treatment industry is a mature industry that has been subject to decades of continuous tightening of water quality regulations. The scope for innovation is therefore incremental, although there remain opportunities to refine essentially mature technologies. There is also a need to move away from offsite laboratory testing to low cost and compact test kits that provide real time data analysis on site and which can be used by staff with minimal training (Source: EPEC, Detailed Assessment of the Market Potential, and Demand for an EU ETV Scheme, June 2011).
  - Within this framework, the majority of investments in this field are expected to take place in the rehabilitation of wastewater treatment plants. In Europe there are 60 000 wastewater facilities and most of them still need to comply with the EU treatment directives and be upgraded to perform nutrient removal. A priority for wastewater utilities is to comply with the Urban Wastewater Treatment directive

by 2015. Frost & Sullivan estimate that most sewage purification plants partly need to be retrofitted by 2015 to meet stringent EU wastewater treatment legislation, requiring nutrient removal in sensitive areas. In parallel with rehabilitation investments necessary to address the Urban Waste Water Treatment Directive, wastewater utilities are also planning to introduce measures to improve operational performance and improve their economic efficiencies. According to the European Union, for sensitive areas "more stringent treatment is in place for 72% of the pollution load, with a compliance rate of 85%". Only the Netherlands, Germany and Austria are 100% compliant with the Directive. The other Member States are required to comply with this directive by 2015, thus new investments in tertiary and advanced treatment technologies are expected (Source: Frost & Sullivan, Analysis on Western European Water & Wastewater Utilities Market, 2011).

- In 2010, the total turnover of the EU water and wastewater treatment industry was 95 billion Euro. The EU was home to the top five utilities in the global market: Suez, Veolia, SAUR, Agbar and RWE. Together these industry giants, dominated by French and German utilities, accounted for 32% of the global market in 2010. As a result of many years of acquiring technology companies, the largest utilities such as French majors Veolia and Suez, have built up considerable technology capabilities across a diverse set of applications. This gives them unprecedented market strength and dominance (e.g. Suez acquiring Degrémont). Consequently, the largest utilities are both the leading water and wastewater treatment technology suppliers and users of such technologies (Source: EPEC, Detailed Assessment of the Market Potential, and Demand for an EU ETV Scheme, June 2011).
- Many of the other major suppliers in the sector are also multi-sector global technology giant OEMs such as Siemens (Germany) and GE (USA). To broaden their product portfolios, besides investing considerable proportions of their turnover in global R&D, these firms have also expanded through acquisition of innovative technology companies, particularly in the membrane market. Notable exemplars include Siemens' purchase of Memcor (Australia) and Inge Watertechnologies AG (Germany), and GE Power & Water's purchase of Zenon Environmental (Canada) (Source: EPEC, Detailed Assessment of the Market Potential, and Demand for an EU ETV Scheme, June 2011).
- Germany is the largest EU exporter of water technologies accounting for 33% of intra-EU and extra-EU exports. The next largest exporters are Italy and the Netherlands each with 10% of the EU export market (Source: EPEC, Detailed Assessment of the Market Potential, and Demand for an EU ETV Scheme, June 2011).

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

- No significant patent-related indicators can be reported in this field