



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/rockets>

## Potential areas of industrial interest relevant for cross-cutting KETs in the Agro-Food 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.

## AF.2.1: Food packaging systems for preserving food from microbial contamination and for improving shelf life

### Scope:

Long food chains and storage times call for intelligent/communicative or functionalized packaging materials and/or coatings that improve food safety (e.g. through alerting risky events which may have occurred during distribution and/or storage), reduce the need of cold chain use and enable in-package food processing.

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

- Tackle the “Food security, sustainable agriculture, marine and maritime research and the bio-economy” societal challenge
- Contribute at the same time to the “Climate action, resource efficiency and raw materials” challenge as well as the “Health, demographic change and wellbeing” challenge

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

- Improve food chain management
- Improve food safety
- Improve food shelf life

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

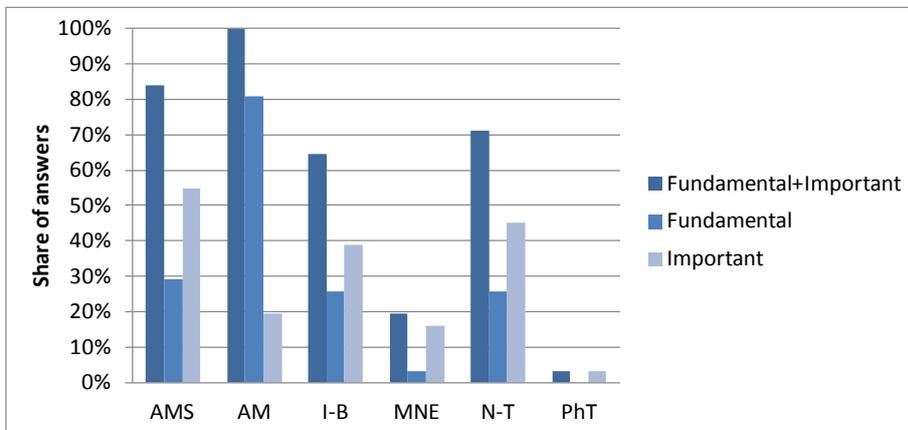
- Development of active food packaging materials (e.g. packages modified by the entrapment of biomolecules or useful micro-organisms)
- Development of multi-functional food packaging materials and coatings (e.g. packages coated or modified by the entrapment of (nano)particles)
- Development of smart intelligent/communicative packaging solutions

### Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of solutions to the challenges listed above, such as active food packaging materials, of multi-functional food packaging materials and coatings, of intelligent/communicative packaging solutions that are able to alert the consumer regarding risky events occurred during distribution and/or storage, etc.

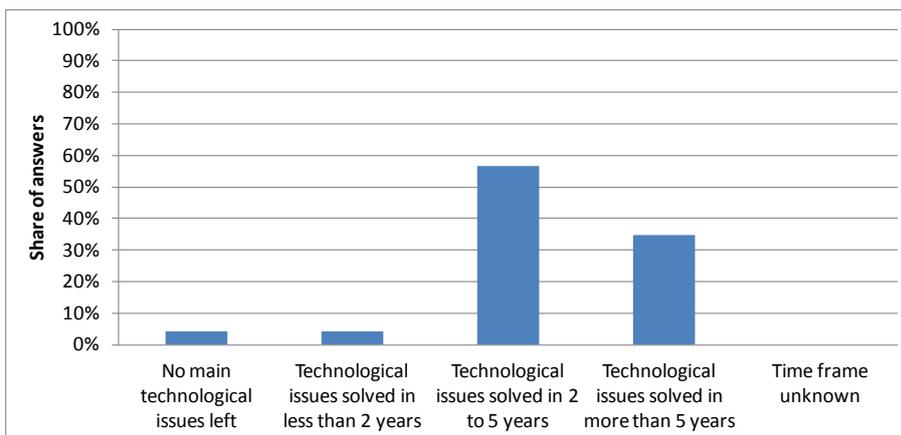
To this aim, the combination of KETs experts’ opinions collected through the dedicated survey (whose result is depicted in the below bar chart), the examination of KETs-related patenting activity in respect to this Innovation Field, and desk research activities, have allowed identifying a rather strong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

- Packaged, frozen, and ready-to-eat food has witnessed a significant surge in demand in recent times. With supply of exotic fruits and vegetables, meat products and frozen foods transcending geographical boundaries, the packaging industry has been focusing on development of solutions that provide maximum food safety, while maintaining nutritional value, at competitive prices. Out of the total market for the global advanced packaging, the contribution of the food sector is 51%, while that of beverage is 19%. Active packaging is mainly used for food packaging, which enhances the food quality with flavour, taste, colour. Intelligent packaging is used for both food and beverage packaging. New technologies such as intelligent packaging, smart packaging, active, and modified atmosphere packaging are replacing traditional methods such as canning. The industry is expected to witness significant growth in the years to come. Similar to the other aspects in the food industry, this market is also highly regulated with strict guidelines for packaging materials, testing, and labelling.
- Another emerging technology in the market is nanotechnology. Nanomaterials have various applications both in active and intelligent packaging. In active packaging, the nanostructures that can enhance the vapour permeability of plastics are used. They have various applications such as fruits and vegetables

packaging. The nanosensors categorized under intelligent packaging can help in detecting pathogens, toxins, and chemicals. With nanosensors incorporated inside the packaging, the consumer can easily know the status of food inside, which means these sensors can inform the consumers about the food's freshness level and nutrition status.

- As a result of these trends, in 2010, the active and intelligent packaging technology held the highest growth rate in the food and beverages packaging market. Modified atmosphere technology accounted for the largest share (approximately 54%) of the total market in advanced packaging technology. The global advanced packaging technology was estimated to grow at a compound annual growth rate (CAGR) of 8.2% from 2010 to 2015. The value of the global active, intelligent and smart food and drink packaging market was reported, in 2010, to reach 9 billion Euro in 2012. The largest market for active and intelligent packaging was forecast to be the US, with Japan and Australia ranking second and third respectively. Yet, in Europe, UK was considered to be a gradually emerging market, forecast to reach a value of 0.9 billion Euro in 2021, while Germany was predicted to jump from about 450 million Euro in 2011 to 1 billion Euro in 2021.
- Sources: Markets and Markets, Global Active, Smart and Intelligent Packaging Market By Products, Applications, Trends and Forecasts (2010-2015), [www.marketsandmarkets.com](http://www.marketsandmarkets.com); Visiongain, Active, Intelligent & Smart Food & Drink Packaging Market 2012-2022, 2011
- Actually, solutions that would allow the consumer to identify the safety of a given foodstuff might also reduce unnecessary food waste. Currently, a significant share of food discards consists in food that approaches or has passed its use-by or best-before date. By law, the producer has to indicate those dates on food packaging at time of production, usually with a margin that takes into account uncertainties on the way the product will be managed after production. Smart packaging and sensor-based technologies could pave the way for alternative approaches that might contribute to reducing food waste volumes in the future, in line with the legal proposal of the Commission amending the waste framework directive, which includes a new aspirational objective to cut food waste by 30% by 2025 (COM(2014) 397 final).

➤ **Results of patents scenario analysis:**

- 7 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