



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 Chemical Processes, Chemicals, Chemical Products and Materials 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.

## CH.3.2: Processes for the cost-efficient conversion of various biomass to basic chemicals and intermediates

### Scope:

Bio-chemical and thermo-chemical processes for the cost-efficient conversion of biomass (e.g. agro-biomass, organic waste, forestry, etc.) to basic chemicals and intermediates, characterized by high performance, stability and selectivity (through integration of bio, chemical and catalytic processes), paying special attention to cope with the natural variability in the quality of biomass-derived raw materials.

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

- Tackle the “climate action, resource efficiency and raw materials” challenge, indirectly also contributing to address challenges such as “smart, green and integrated transport” and “secure, clean and efficient energy”

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

- Reduce dependency on hydrocarbon-based chemicals as well as materials production, subject to a long term price increase tendency, and related operational costs
- Decrease dependency of chemical production from oil by shifting the feedstock base towards alternative feedstocks
- Support the transition from our current fossil fuel-based industries to bio-based industries

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

- Development of customized enzymes and modification of microorganisms for the production via biotechnological routes of basic chemicals and intermediates
- Development of customized enzymes and modification of microorganisms to use organic waste / residues as an efficient substrate
- Development of customized enzymes, which can cost-effectively break down cellulose to easily-fermentable glucose
- Development of thermo-chemical and biochemical conversion processes with feedstock flexibility for different lingo-cellulosic biomass
- Development of integrated biorefinery concepts making full use of a variety of biomass feedstocks to obtain diverse high-value bio-products
- Discovery, evolution and development of novel, robust and selective biocatalysts suitable for industrial use
- Development of methods to cope with the variability of raw materials derived from biomass
- Integration of bio-, chemical and catalytic processes into novel synthetic routes for efficient conversion of biomass-derived raw materials with high performance, stability and selectivity
- Development of robust processes based on new reactor engineering solutions to improve energy and process efficiency and economics, and which combine reaction and separation, paying special attention to cope with the natural variability in the quality of raw materials
- Development of separation agents (i.e. adsorbents, “green” extractants) and understanding of transport processes through membranes and bio-reaction mechanisms for in situ product removal in bio-reactive separations

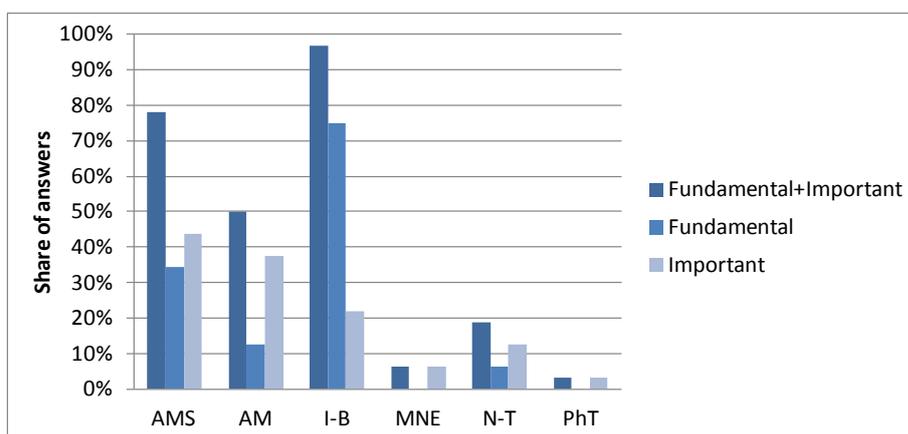
### Contribution by cross-cutting Key Enabling Technologies:

In respect to this Innovation Field, the integration of KETs could contribute to the development of more advanced bio-chemical and thermo-chemical conversion processes for the cost-efficient conversion of various types of biomass to basic chemicals and intermediates, characterized by high performance, stability and selectivity, thanks to the integration, into the industrial production within integrated biorefineries, of novel bio, chemical and catalytic processes allowing for the introduction of novel, improved synthetic routes for production.

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

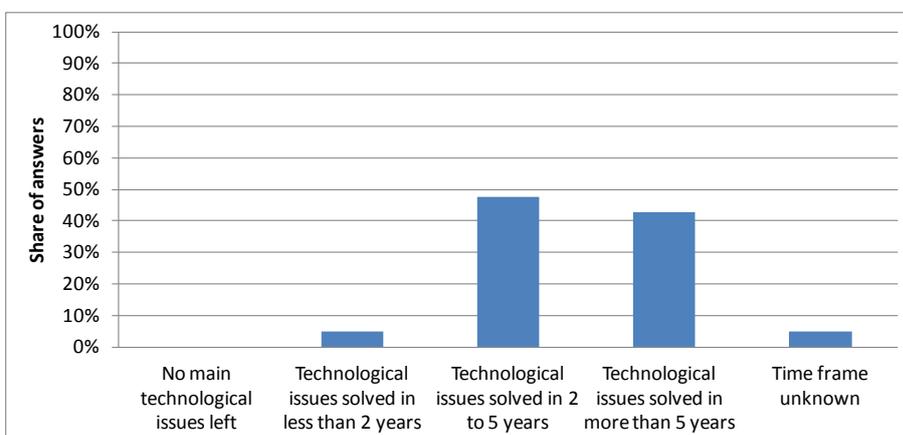
Innovation Field, and desk research activities, have allowed identifying a rather strong interaction of KETs with respect to this Innovation Field, with either fundamental or important contribution mainly by the following KETs:

- Advanced Manufacturing Systems (AMS)
- 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 2 to 5 years, yet significant consensus by experts indicates also greater 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:

- Several forces, including high oil prices, consumer preference, corporate commitment, and government mandates and support, are driving development in the area of bio-based chemicals and materials (see as well Innovation Field CH1.2), for which production the production of basic chemicals and intermediates is necessary. As a result, the bio-based industry has reached a tipping point, with production expected to double in the upcoming years. Current developments (which include several investments being made in pilot production facilities) let assume that especially the bio-based chemicals sector will likely have a strong expansion in the next future. Platform chemicals obtained from renewable resources are expected to grow substantially over the next five years. This will open up

perspectives for new applications for bio-based products including fine as well as specialty chemicals, bio-polymers and other bio-based derivatives and will also generate a strong boost for the cost effective production of biofuels within a biorefinery context (Source: IEA Bioenergy, Bio-based Chemicals, Value Added Products from biorefineries, 2012).

- As stated within COM(2012) 60 final, the bio-economy sectors in Europe are worth 2 trillion Euro in annual turnover and account for more than 22 million jobs and approximately 9% of the workforce. However, in order to remain competitive and maintain jobs in the light of major societal challenges and rising markets, the European bioeconomy sectors need to innovate and further diversify. Within this framework, it is estimated that direct funding for research and innovation associated to the Bioeconomy Strategy under Horizon 2020 could generate about 130 000 jobs and 45 billion Euro in value added in bioeconomy sectors by 2025. Further growth is expected from other – direct and indirect – public and private investments in all parts of the bioeconomy (Source: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions titled 'Innovating for Sustainable Growth: A Bioeconomy for Europe' (COM(2012) 60 final)).

➤ **Results of patents scenario analysis:**

- 10 exclusively KETs-related patents identified in the period 2001-2011 for the specific Innovation Field
- No significant patent-related indicators can be reported in this field