

## **Deliverable 2.4**

# **“Needs assessment for research, training and skills of emerging professionals in the bio-based product sector”**

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The dissemination of this report is restricted to CIP- EIP programme participants (including the Commission Services)

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## EXECUTIVE SUMMARY

This report gives an updated picture of the needs of European companies operating in the bio-based sector, taking into consideration in particular Small and Medium sized Enterprises and start-up companies. They have been analysed considering their needs from three different points of view:

- **knowledge and research needs**, in order to identify the ways for facing the challenges of the market of the future, that will require products comfortable, sustainable and safe;
- **skills needs**, in order to define a set of competencies able to support the company in its innovation path;
- **training needs**, in order to establish how to move towards the innovative skills from the available ones.

Throughout the analysis of the knowledge and research needs, a list of very promising research topics and technologies of the future has been identified, providing indication about competence areas influencing the industry's ability to remain close to the technological frontier of this sector. Among them, the two most important are the development of improved biomass pre-treatment approaches and technologies and the isolation of novel or more robust microbial strains for the fermentative exploitation of complex and/or raw feedstocks. Moreover, other needs have been listed with the aim of creating a suitable economic and societal environment for bio-based product acceptance. A huge amount of running and already completed innovative programmes, at local and international level, has been identified, giving the demonstration of a vital and effective R&D and Innovation system. This situation is also corroborated by the existence of excellent research centres and clusters in the partner's countries and throughout Europe able to support bio-based companies in their innovative programmes, although orientation to businesses needs to be further improved.

From the point of view of skills, the analysis confirmed the need of the firms to have access to top-level human resources, not so easy to be found on the labour market as they need to show not only a sound technical and scientific background, but also knowledge and expertise in business, IPR, finance, regulation, strategic and operative planning and internationalization.

High level education, such as Masters, is the preferred way to move towards the desired skills and continuous professional development should be perceived in order to keep updated and to gain a useful cross disciplinary education, including non-technical expertise.

Actually the bio-based product sector is quite a new one, therefore there is poor experience gained on training specifically addressed to companies operating in this area. Nevertheless the business environment stimulates companies to keep trained on technological innovation which is a key factor to gain or maintain a competitive advantage in the worldwide market.

Problems related to sustainability of bio-based products has to be taken into consideration as well, resulting in company competencies to be developed also in environmental, legal, ethical and social implications of biotechnologies applications.

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# Introduction

The present report has been realized within the BIOCHEM project, dealing with “ECO-IP” partnership for driving innovation in the sector of bio-based products.

A specific comprehensive assessment has been carried out on research, training and skills needs of enterprises (particularly SMEs and start-up companies) aiming to face the current and future market challenges and overcome barriers that hamper innovation in the bio-based product sector. The analysis has been made starting from the collection of available updated information from sector organisations, technology transfer agencies and sectoral clusters contacted by the BIOCHEM partners which involve 17 organisations distributed in 7 European countries.

The assessment on available knowledge and research needs has been focused on the following aspects:

- Most promising research topics, namely topics with high innovation potential for companies;
- Recent innovative projects dealing with bio-based products developed in collaboration between companies and universities/ research centres;
- New or current challenges which need to be addressed for companies to develop a business in bio-based products in the areas of process technology, product formulation, material technology and feedstocks;
- Excellent research centres;
- Existing clusters.

The assessment on skill needs has been based on the analysis of the following aspects:

- Description of the profiles of employees more requested from bio-based companies, in order to define an ideal employee for successful, innovative SMEs in the area of bio-based products;
- Services requested by companies to sector associations, including emerging needs and distinguishing – if possible- SME needs, large company needs and start –up needs;
- Leading companies in the partner’s countries, specifying the respective area of excellence.

Finally, the assessment on training needs explored the following aspects:

- Type of training requested from bio-based companies;
- Preferred way for updating competencies and skills;
- Propensity to continuous professional development;
- Propensity to work in an international environment.

## **PART A - AVAILABLE KNOWLEDGE AND RESEARCH NEEDS**

### **A1 Most promising research topics**

A survey on bio-based company needs in terms of research and development has been conducted by the BIOCHEM partners aiming at identifying the research topics having the highest exploitation potential for the companies themselves, in the near future. The survey has been based on the experience of the project partners, taking into consideration the contacts they have with research and academic institutes both at national and European level and the point of view of sectoral organisations about the actual interest of the industrial biotech enterprises in innovative technologies.

On the basis of the feedback collected, the following “top ten” of R&D priorities have been identified as strategic issues to be included in the innovation agenda of the European bio-based companies. The research topics are presented in decreasing order of relevance, starting from the most innovative and attractive ones:

1. Development of improved biomass pre-treatment approaches and technologies;
2. Isolation of novel or more robust microbial strains for the fermentative exploitation of complex and/or raw feedstocks;
3. Development of new biological and integrated bio- and chemical routes for the preparation of conventional and novel Chemical Building Blocks;
4. Development/obtainment of novel enzymes and biocatalytic systems;
5. Preparation of new bio-based polymers or composite materials;
6. Intensified, efficient and cost effective downstream processing procedures and technologies;
7. Development of strategies and tools for the integrated valorisation (biorefinery concepts) of biowaste and other organic waste streams;
8. Synthetic biology for the development of improved microbial strains;
9. Development of strategies for the production and the industrial exploitation of Lignin derivatives;
10. Identification, production and exploitation of new biomass sources (e.g. micro-algae).

Other R&D priorities that arose during the consultation and that deserve to be mentioned, can be summarized as follows:

- Development of more effective strategies for industrial scale-up of Biotransformation processes;
- Improvement of Agricultural practices for the production of more abundant industrial biotech tailored biomass. In this area, research into farming technologies and management practices are necessary to increase biomass availability and to lower the impact on the environment. Research into farm management "models" are also necessary to identify how a transition from (abundant) food crops to energy and other non-food crops (on appropriate lands) could be achieved economically. Relevant would also be research into market mechanisms to decrease the volatility of feedstock cost and to create a continuous and consistent availability of feedstock at competitive cost in the EU. Finally, additional research in feedstock harvesting, collection and pre-treatment technologies are also necessary.

- Testing and assessing the processing and conversion technologies already available or under implementation on pilot/demo scale level.
- Improvement of the flexibility- in terms of exploitable feedstocks without lowering yields- of the currently available processes and biorefineries
- Further development of LCA methodologies to improve their performance and to reduce their cost, often too high/prohibitive for SMEs.

Finally, as general considerations, it can be highlighted the need of actions addressed to catalyse a robust development of bio-based economy in Europe, such as a) the assessment of policies and regulations in the different EU member states that are bottlenecks for the instalment of bio-based economy b) research into consumer (public) acceptance of Industrial Biotechnology products and processes, and c) accelerated research into the acceptance of primary and co-products applications and markets opportunities.

## **A2 Recent innovative projects**

The following table presents a list of recent innovative projects dealing with bio-based products developed in collaboration between companies and University/ Research Centres. In some cases also local networks, clusters and/or industry associations have been involved as well. Both European and regional projects have been taken into consideration.

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
	Novel Hydrolases from Hyperthermophilic Procaryotes	Enzymes	Research Center, University
ANIMPOL	Biotechnological conversion of carbon containing wastes for eco-efficient production of high added value products	Biopolymers	Research Center, University
BIOCELSOL	Biotechnological Process for Manufacturing Cellulosic Products with Added Value	Biopolymers; Enzymes	Research Center, University
BIOCOMP	New Classes of Engineering Composite Materials from Renewable Resources	Biocomposites; Biopolymers; Biomass	Research Center, University
BIOCOMPAC	Bioprocessed wood fibres for composites and food packaging materials	Biocomposites; Biopolymers; Enzymes	Research Center, University
BIOMADE	Biocatalytic Approach to Material Design		Research Center, University
BIOMASS PRESERVATION	Novel methods to preserve specialized bacteria for biodegradation of complex industrial wastewaters	Biomass	University
BIOMON	Towards long-life bio-lubricants using advanced design and monitoring tools	Biolubricants	Research Center
BIOPOL	Assessment of biorefinery concepts and the implications for agricultural and forestry policy	Biomass	non profit, Research Center, University
BIOPRODUCTION	Sustainable Microbial and Biocatalytic Production of Advanced Functional Materials	Biopolymers; Biosurfactants; Chemical building blocks; Enzymes	non profit, Research Center, University
BIORENEW	White Biotechnology for added value products from renewable plant polymers: Design of tailor-made biocatalysts and new industrial bioprocesses	Biopolymers; Biosurfactants; Enzymes	Research Center, University
BIOSEAL	Development of Biotechnology derived alternatives for sustainable detergents and innovative strategies of using Sustainable ingredients by encapsulation and surfactants structuring	Biopolymers; Biosurfactants; Enzymes	University
CATAFLU.OR	OrganoCATAlytic approaches towards easily synthesized, economical, and high yielding oseltamivir derivatives	Pharmaceutical products; Enzymes; Natural products	University

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
COMBIG-TOP	Combinatorial Biosynthesis of Industrial Glycopeptides: Technology, Optimization and Production	Pharmaceutical products; Enzymes; Antibiotics; fermentation	University
COMBIO	Composite materials for the immobilisation of biocatalysts	Biocomposites; Enzymes	University
DATAGENOM	Post-genomic datamining of enzymes for the synthesis of chiral pharmaceutical intermediates	Chemical building blocks; Pharmaceutical products; Enzymes; Amino acids	Research Center, University
EA-BIOFILMS	Electrochemical control of biofilm-forming micro-organisms: screening, identification, and design of new knowledge-based technologies		Research Center, University
ECOBINDERS	Furan and lignin based resins as eco-friendly and durable solutions for wood preservation, panel, board and design products	Biosolvents; Biomass	Cluster & Networks, Research Center, University
ENEFP	European network on directed evolution of functional proteins	Enzymes	University
ENZUP	Enzymatic up-grading of wool fibres	Biopolymers; Enzymes; Dyes	Authority, University
ERUDESP	Development of electrochemical reactors using dehydrogenases for enantiopure synthon preparations	Enzymes	Research Center, University
FORESTSPECS	Wood Bark and peat based bioactive compounds, speciality chemicals, and remediation materials: from innovations to applications	Biocomposites; Biolubricants; Pharmaceutical products; Cosmetics; Plant extracts, natural products	Research Center, University
GEMINI	Gene mining of metagenomes for novel enzymes and therapeutics	Pharmaceutical products; Enzymes	Research Center, University
GLYCOGOLD	GlycoGold: Exploration of the nature and potential of Glyco-nano-particles		Cluster & Networks, Research Center, University
HIPERMAX	High Performance Industrial Protein Matrices through Bioprocessing	Enzymes	non profit, Research Center, University
HOTSOLUTES	New applications for compatible solutes from Extremophiles	Enzymes	Research Center, University
IBIOLAB	Improvement of biolubricant manufacturing and development thanks to the obtaining of ecolabels in a wide range of industrial sectors	Biolubricants; Feedstock	Cluster & Networks, Research Center, University

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
ICON	Industrial crops producing added value oils for novel chemicals	Biolubricants	Research Center, University
INBIOSYNAP	Integrated process for biosurfactant synthesis at competitive cost allowing for their application in household cleaning and bioremediation	Biosurfactants	University
INTESY	Investigation of biochemical and genetical diversity of terpenoid biosynthesis for the production of high value-added compounds	Enzymes; Cosmetics	Research center, University
LIPOYEASTS	Mobilising the enzymatic potential of hydrocarbonoclastic bacteria and the oleaginous yeast <i>Yarrowia lipolytica</i> to create a powerful cellular production platform for lipid-derived industrial materials	Biopolymers; Enzymes; Fermentation, marine	Research Center, University
MARINE GENOMICS	Implementation of high-throughput genomic approaches to investigate the functioning of marine ecosystems and the biology of marine organisms	Marine	Authority, Cluster & Networks, Research Center, Science park, University
MAXFUN	Novel enzyme-aided extraction technologies for maximized yield and functionality of bioactive components in consumer products and ingredients from by-products	Enzymes	Cluster & Networks, Research Center, University
MGATECH	Multigenome access technology for industrial catalysts	Enzymes	University
NANOFOLDEX	Exploiting the secretion machinery of pseudomonads for the nanotechnological production of pharmaceuticals	Pharmaceutical products; Enzymes	Research Center, University
NEPSA	New products from starch-derived 1,5-anhydro-d-fructose	Enzymes	Research Center, University
PERCERAMICS	Multifunctional percolated nanostructured ceramics fabricated from hydroxylapatite		Cluster & Networks, Research Center, University
POLYMODE	Novel polysaccharide modifying enzymes to optimise the potential of hydrocolloids for food and medical applications	Biopolymers; Pharmaceutical products; Enzymes; Cosmetics; Fermentation	Research Center, Technology Transfer, University
POLYVER	Production of polyhydroxyalkanoates from olive oil mills wastewater	Biopolymers	Research Center, University
PROBACTYS	Programmable bacterial catalysts		Research Center, University
PROTENG	Engineering Proteases	Pharmaceutical products; Enzymes	Research Center

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
PURATREAT	New Energy Efficient approach to the operation of Membrane Bioreactors for Decentralised Wastewater Treatment		Research Center, University
QUORUM	Discovering Quorum sensing in industrially useful Fungi, a novel approach at molecular level for scaling-up in white biotech	Biopolymers; Enzymes; Dyes, fermentation, natural products	Research Center, University
RED CAT	Natural products and related redox catalysts: basic research and applications in medicine and agriculture	Pharmaceutical products; Enzymes; Antibiotics, natural products	non profit, Research Center, University
SOILCY	New sustainable compressor oil production and use; towards a long eco-efficient life cycle	Biolubricants	Research Center, University
SOPHIED	Novel sustainable bioprocesses for the European colour industries	Enzymes; Dyes	Research Center, University
SPONGES	Sustainable production, Physiology, Oceanography, Natural products, Genetics and Economics of Sponges	Natural products, marine	Research Center, University
STANLUB	Development of new bio-lubricants and coatings using standoils from linseed, castor and tung oils	Biopolymers; Biosolvents; Biolubricants; Feedstock	Research Center
TRICHOEST	Functional genomics and proteomics of trichoderma antagonist strains for industry and agriculture	Enzymes; Antibiotics	Research Center, University
	Novel ferulic acid esterase – enabling technology for the production of high value biochemicals.	Enzymes, biochemicals	
	Extracting high value chemicals from microalgae through industrial biotechnology	Biochemicals	
	Process evaluation and development for a novel nutraceutical	Biochemicals	
EXTRACTOCOL	Clean Extraction and separation processes to obtain high-value biomolecules from sustainable resources	Biochemicals	
	Engineering of enzymes and chemistry for improved transaminase bioprocesses	Enzymes, Biochemicals	
	Feasibility Study for Production of High Value Unnatural Amino Acids by Exploiting Novel Phenylalanine Ammonia Lyase (PAL) Biocatalysts,	Biocatalysts	

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
	Development Limited Novel Bioprocess to a Natural High Impact Aroma Chemical Utilising a Dual Activity Plant Enzyme	Enzymes, Biochemicals	
	Carbonyl reductase-based production of enantiopure alcohol libraries for use as pharmaceutical building blocks	Enzymes, Pharmaceutical products	
	Highly Expressed Protein Analogues - a platform technology to create proteins with novel functions by incorporating unnatural amino acids	Biopolymers	
	Achieving greater consistency in the modification of human recombinant proteins through scalable continuous-production process technology	Biopolymers	
	Development of ultra-low cost novel oxidase biocatalyst manufacturing processes using yeast	Biocatalysts	
	Development of innovative processes for the manufacture of high value nutritional probiotic food additives	Biochemicals	
ENSUS	Largest biorefinery in Europe, make high quality animal feed	Biorefinery	
	Employment of wastematerials in the development of biodegradable polymers (PHAs) usable in agriculture and food industry	Biopolymers	Technology park, Universities, research centres
GREEN OIL	Realization of a pilot plant for experimental purpose of sustainable biorefinery processes (biodiesel and other fine chemicals)	Biofuels and other bioapplications (fine chemicals from renewable feedstock)	Technology park, Universities, Industrial Association
ETOILE	Bioethanol production via lignocellulosic fermentation of olive oil residues	Biofuels	Universities, research centres
TARPOL	Targeting environmental pollution with engineered microbial systems á la carte	Bioremediation	Universities, research centres
PACE	Programmable Artificial Cell Evolution	Bioscience and Biotechnologies, CBB	
DICE	Designing Informative Combinatorial Experiments" for living technology	Bioscience and Biotechnologies, CBB	
MATCHIT	MATrix for CHEMical IT	Bioscience and Biotechnologies	

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
ENCROP	Increasing knowledge along the energy crop production chain, as well as the general public, on the ecological, technical, economic, logistic and administrative matters related to energy crop production and utilisation, thus leading to resolving potential bottlenecks and resulting in an improved public perception and more widespread production and utilisation of energy crops	Biofuels and other energy applications	Universities, research centres, sectoral associations
BIOPAL	Algae as raw material for the production of bioplastics and biocomposites contributing to sustainable development of European coastal regions	Biopolyme, Biocomposites	Universities, research centres, local authority
BIOTEX	Enzymes to produce high-quality textiles, sustainable and innovative, with less chemicals and energy (being proposed biocatalical processes)	Enzymes	Universities, research centres
ULYSSES	Smart Exploration of the Sequence Space for Enzyme and Protein	Enzymes	
Sunlight	Lipids and renewable energy form micro-algae	Algae, lipids, biofuel	University, cluster
Bi-Cycle	Single Cell oils from algae and yeasts	Algae, lipids, biofuel	Universities
ALCHEMIS	Algae for chemicals production and emission abatement	Algae	Research centres, Universities, Government, Sector federation
ValiCel	Valorization of lignocellulosic waste streams	Lignocellulose, biofuel	Universities
	Bio-ethanol from lignocellulosic feedstock available in Flanders	Lignocellulose, biofuel	Universities
	Evaluation of pyrolysis for the valorization of organic waste streams	Pyrolysis, waste	Universities
LIPOYEASTS	Mobilising the enzymatic potential of hydrocarbonoclastic bacteria and the oleaginous yeast <i>Yarrowia lipolytica</i> to create a powerful cellular production platform for lipid-derived industrial materials	Bacteria, yeast, lipids	Universities, research centres
BIOMEL	Fermentative production and applications of mannosyl erythritol lipide biosurfactants	Fermentation, biosurfactants	Universities
Biosurf	Biotechnological production platform for new tailor-made glycolipid biosurfactants	Biosurfactants	Universities

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
PlasmaCat	Plasma-assisted conversion of greenhouse gases to value-added chemical	Catalysis, greenhouse gases	Universities, research centres
NEMO	Novel high performance enzymes and microorganisms for conversion of lignocellulosic biomass in bioethanol	Lignocellulose, biofuel	Universities, Technology Transfer centre
Aqua-Fuels	Algae and aquatic biomass for a sustainable production of 2nd generation biofuels	Algae, biofuels	Universities, Research centres
Change2Bio	Change2Bio	Formulation, Processing, Plastic	Research centres, industry associations
	Laboratory Analysis and Processing Facilities and Cryopreservation	Biotechnology	
	Calcium Antagonists	Online Research and Development	Research centre University
	Alternatives to oral administration	Online Research and Development	Research centre
	New antitumor compound	Biotechnology	University, consultants
	Therapeutic Mechanism Stem Cells	Online Research and Development	Consultants
	Polyolefin COLLECTION	Online Research and Development	Research centre, University
	Creation of DNA sequencing companies	Line of Business Creation	
	Cultures for cell therapy	Biotechnology	Research centre
	Antitumor CLINICAL DEVELOPMENT	Human Health	Research centre
	Antitumor CLINICAL DEVELOPMENT	Online Research and Development	Research centre, University
	Development of biosensors for clinical diagnostics	Line of Business Creation	Research centre
	Engineering for the production of biopharmaceuticals	Human Health	Consultants
	MOLECULAR TOOLS FOR DETECTION OF MUTATIONS	Online Research and Development	Research centre
	Active substances against skin disorders	Online Research and Development	University
	Development of a molecular differential diagnostic method	Online Research and Development	Research centre, University
	Development of microarray processing system	Online Research and Development	
	Development of therapeutic vaccines against cancer	Online Research and Development	Consultants

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
	Advanced Preclinical Development of new antitumor compounds	Online Research and Development	Research centre
	Preclinical development	Online Research and Development	University
	Preclinical Development	Human health	Research centre University
	Preclinical development and Elucidation of Antitumor Action Mechanisms	Online Research and Development	
	Clinical Diagnosis of Genetic Factors	Biotechnology	Research centre
	Automatic diagnosis of diseases	Biotechnology	Research centre
	Viral pneumonia	Online Research and Development	
	Rapid diagnosis of bone diseases	Online Research and Development	
	Establishment of a cell bank for screening	Online Research and Development	Research centre, consultants
	Study of the viability of the use of DNA polymerases	Online Research and Development	consultants
	Business viability of stem cells	Biotechnology	Research centre
	Diagnosis of Nervous System diseases	Human Health	consultants
	FEASIBILITY OF PROTEASES	Produc. and Tec Industrial (General)	Certification body
	Feasibility of diagnoses in nervous system diseases	Online Research and Development	University
	Biohydrolysis	Online Research and Development	Research centre, University
	Evaluation of peptide factors in the treatment of neurodegenerative diseases	Line of Research and Development	Research centre, University
	Predictive factors in fertilization	Human Health	University
	Therapeutic vaccines against cancer	Biotechnology	University
	Vaccine candidates	Biotechnology	Research centre
	Genetic studies of animal diseases	Online Research and Development	
	Sclerosis Therapies	Biotechnology	
	New anti-tumor compounds	Human Health	Research centre
	Biohydrolysis	Biotechnology	Research centre

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
	Proteins in ovarian dysfunction	Human Health	
	IMMUNOTHERAPY in transplant recipients	Online Research and Development	Research centre
	Early detection of neural diseases	Biotechnology	
	New Drug Research	Biotechnology	Research centre, University
	IMPROVING THE DETECTION OF DIGESTIVE SYSTEM BACTERIA	Online Research and Development	Research centre
	Neuroprotectors	Human Health	Research centre, University, consultants
	Therapeutic targets	Human Health	Research centre, University
	NEW ANIMAL DISEASE DIAGNOSIS	Biotechnology	
	NEW METHODS FOR SELECTION OF RECOMBINANT ANTIBODIES	Online Research and Development	Research centre
	PROCUREMENT OF DHA	Produc. and Tec Industrial (General)	Certification body
	Automated system for aptamers	Biotechnology	Research centre, Consultants
	Protein expression	Biotechnology	Research centre
	Treatment of cutaneous immune diseases	Biotechnology	Research centre University, Consultants
	CHEMICAL DEVELOPMENT PROJECT, microbiology studies and Preclinical Development	Online Research and Development	Research centre, University
	Laboratory testing phase I clinical trials	Biotechnology	Research centre, University
	Regenerative Medicine	Biotechnology	University
	Simulation of biological processes	Biotechnology	University, consultants
	Information System	Biotechnology	
	Stroke therapy	Online Research and Development	Research centre
	Cell therapy for joint failure	Biotechnology	Consultants
	controlled release technology	Biotechnology	
	Xenoregeneración	Online Research and Development	Consultants
	Removing organic matter from polluted soil with fungi	Biotechnology	
	Enhancing propionifermentation	Enzymes	
	New enzyme development for low temperatures	Enzymes	
	Biotechnology application development for fibre treatment	Enzymes	

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
	Trichoderma reesei protein production development	Biotechnology	
	Biocatalytic reaction improvement	Pharmaceutical products	
	Method development for studying yeast and mould lactase encapsulation	Biotechnology	University
	Utilizing metagenomics in screening of biocatalytes and analysing biochemical routes	Biotechnology	Research centre
	Utilizing biotechnology in metall bearing waste treatment	Biotechnology	Research centre
	Enzyme modification for milk treatment	Enzymes	Research centre
	Enzyme based processes for purification of pharmaceutical products	Pharmaceutical products, Enzymes	
	Discovery and exploitation of novel lipid functionalizing enzymes in industrial processes	Enzymes	Research centre
	Development of new enzyme based processes and development of biocatalysis	Enzymes	University
	Enzyme utilisation in TMP- process	Enzymes	
	New biocatalysts bacterial strains capable efficiently prepare various modified nucleosides	Biotechnology	
	Yeast development for VHG fermentation process	Biotechnology	
	Scalable production process for efficient trapeutic proteins	Pharmaceutical products	
	Biobased dissolving process development for mining industry	Biotechnology	
	Treated enzyme development and use in biocatalytic synthesis	Enzymes	University
	Development of production method for recombination antidote	Pharmaceutical products	
	Development project of dosage and optimization of enzymes in TMP process	Enzymes	
	Separation of valuable compounds from the northern berries	Biotechnology	University
	Second generation technical enzyme (protease)	Enzymes	
	Development of Ad-VEGF-C including GMP-production, biodistribution and toxicology studies	Pharmaceutical products	

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
BIOCROP	Converting forest related waste streams to growth retardants and pesticides for agriculture	Biotechnology	University
	Enzyme development for fibrous biomass and treatment of waste	Enzymes	
	Rational antibody design by de novo protein sequencing and affinity maturation	Biotechnology, Pharmaceutical products	
	Rumen Reactor Development Programme, fermentation of paper industry waste streams, utilizing waste streams more efficiently	Biotechnology, Biomass	
	Replacing chemical pesticides and biosides with birch extract	Biotechnology	
	Developing biomass filtering	Biotechnology, Biomass	
	Business potential from fractionation of sludge	Biotechnology	Research centre, University
	Development of new biochemical processes and products for pulpmills	Biotechnology	University
	Value chain of biorefineries focus on service business and food supplies	Services, business development	Research centre
	New preprocessing techniques for biomass	Biotechnology, Biomass	Research centre
	Developing risk control and production flexibility in biorefineries	Biotechnology, Biomass	University
	Catalytic changing of renewable raw-materials	Biotechnology	University
	Recovery of organic acids from biomass	Biotechnology	
	Bioactive and wood-associated stilbenes as multifunctional antimicrobial and health promoting agents	Biotechnology, Natural products	University
	Development of bioactive feed from industrial sidestreams	Biotechnology, Biomass	
	Utilising different wood derived compounds in cosmetics, food and pharmaceuticals	Biotechnology, Pharmaceutical products, Natural products	
	Development of new products from industry and agriculture waste streams	Biotechnology, Biomass	
	Using hydrolysis technology for sugar production from biomass to raw material for the chemical industry	Biotechnology, Biomass	Research centre
	Protein and organic fertilizer development	Biotechnology, Natural products	

<b>Acronym</b>	<b>Title</b>	<b>Topics addressed</b>	<b>Type of organisations involved (other than SMEs)</b>
	Functional natural fibre composites	Biotechnology, Natural products	
	Utilizing wood based materials in tyre manufacturing	Biotechnology	
	Functional biomaterial development	Biotechnology, Natural products	
	Sustainability of biomass utilisation in changing business environment	Services, business development, Biomass	Research centre
	Agrocellulose and native lignine fractination	Biotechnology, Biomass	
	Utilisation of wood bark chemical compounds	Biotechnology, Natural products	
	Process technology study of ABE-fermentation	Biotechnology	
	Bioprocesses in Resource efficient utilisation of biomass	Biotechnology, Biomass	

### **A3 New or current challenges which need to be addressed for the companies to develop a business in bio-based products**

In this section of the report we would like to introduce the most interesting challenges foreseen in the present scenario for bio-based companies aiming to be innovative.

#### Process Innovation Challenges

- New processes for the highly efficient conversion of ligno-cellulosic materials
- New processes for the effective utilization of low value biomass
- New processes which enable the use of a wider variety of biomass sources
- New fermentor design giving improved efficiency in terms of yield, productivity and/or lowering energy consumption
- Cost effective manufacture of bio-based composites
- Rapid isolation and purification

#### Product Formulation Innovation Challenges

- Replacement of toxic, non-biodegradable formulations with low environmental impact, biodegradable alternatives

#### Material Technology Innovation Challenges

- New bio-based composites with application for the construction, aerospace, automotive and sports industries
- Improvements in the mechanical properties of bio-based composites e.g ductility, modulus of elasticity
- Bio-based material technology for the development of materials with unique properties

#### Chemical Feedstock Innovation Challenges

- Delivery of high yield, consistent quality feedstocks
- Manufacture of chemical feedstocks from ligno-cellulosic biomass

### **A4 Excellent research centres**

The following table contains a list of excellent research centres in the field of bio-based products obtained from the analysis on recent EU project activity carried out by these institutes.

Research Centre	Country	Area of excellence									Other
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	
Centre National de la Recherche Scientifique	France		x		x	x	x	x	x	x	Biomass, Dyes, Fermentation, Marine, Natural products, Plant extracts
Delft University of Technology	The Netherlands	x	x		x		x	x	x		Amino acids, Antibiotics, Fermentation
French National Institute for Agricultural Research	France		x	x				x	x	x	Fermentation, Marine
Ghent University	Belgium	x	x		x	x			x		Fermentation, Marine
Graz University of Technology	Austria		x	x	x				x		Dyes
Imperial College London	United Kingdom						x	x	x		Biomass, Natural products
John Innes Centre	United Kingdom		x			x		x	x		Antibiotics, Natural products, Plant extracts
KTH Royal Institute of Technology	Sweden	x	x	x			x		x		
Lund University	Sweden		x		x		x	x	x		Amino acids, Antibiotics, Biomass, Fermentation
Max Planck Society	Germany						x	x	x	x	Marine, Natural products
National Research Council	Italy							x	x		Marine
New University of Lisbon	Portugal		x	x					x		Dyes, Fermentation
Paul-Verlaine University in Metz	France							x	x		Antibiotics, Biomass, Natural products
Saarland University	Germany							x	x		Antibiotics, Natural products

Research Centre	Country	Area of excellence									Other
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	
Spanish National Research Council	Spain		x	x	x		x	x	x		Biomass, Fermentation, Marine, Natural products
Technical University of Denmark	Denmark							x	x		Antibiotics, Fermentation
University of Bergen	Norway							x	x		Biomass, Marine, Natural products
University of Copenhagen	Denmark								x	x	
University of Groningen	The Netherlands						x	x	x		Antibiotics, Fermentation, Marine
University of Helsinki	Finland	x	x	x		x		x	x	x	Biomass, Fermentation, Marine, Natural products, Plant extracts
University of Minho	Portugal		x	x	x			x	x		Antibiotics, Dyes, Fermentation, Natural products
University of Naples Federico II	Italy		x		x				x		Antibiotics, Dyes, Fermentation, Natural products
University of Nottingham	United Kingdom		x	x	x			x	x		
University of Pisa	Italy		x		x			x	x		Marine, Biomass
University of Stuttgart	Germany		x	x			x	x	x		Amino acids
University of Warwick	United Kingdom					x		x	x		Amino acids, Biomass, Marine

Research Centre	Country	Area of excellence									Other
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	
VTT Technical Research Centre of Finland	Finland	x	x			x		x	x	x	Biomass, Dyes, Natural products, Plant extracts
Wageningen University	The Netherlands		x					x	x	x	Antibiotics, Biomass, Fermentation, Marine, Natural products

Additional relevant research centres at national level have been identified by the BIOCHEM Partners in their respective countries and are listed here below.

#### UNITED KINGDOM

Research Centre	Area of excellence
School of Chemistry, University of Edinburgh	Chemical polymerisation
Department of Chemistry/Chemical Engineering, Imperial College London	Chemical polymerisation
Centre for Sustainable Chemical Technologies, University of Bath	Chemical polymerisation
Department of Chemistry, University of Warwick	Chemical polymerisation
Bicomposites Centre, Bangor University	Modification of biopolymers
Warwick Manufacturing Group, University of Warwick	Modification of biopolymers
School of Chemistry and Chemical Engineering, Queen's University Belfast	Chemical transformations of renewable molecules
Department of Chemistry, University of Nottingham	Chemical transformations of renewable molecules
Green Chemistry Centre of Excellence, University of York	Chemical transformations of renewable molecules
School of Chemistry Cardiff University	Chemical transformations of renewable molecules
Centre for Sustainable Chemical Technologies, University of Bath	Chemical transformations of renewable molecules
School of Applied Sciences, Cranfield University	Biocatalysis
Biomedical Research Centre, Sheffield Hallam University	Biocatalysis
Institute for Cell and Molecular Biosciences, University of Newcastle upon Tyne	Biocatalysis
Centre for Extremophile Research, University of Bath	Biocatalysis
Biocatalysis Centre, University of Exeter	Biocatalysis
Department of Biochemistry, University of Leicester	Biocatalysis
School of Science & Technology, University of Teesside	Fermentation
The Satake Centre for Grain Process Engineering, University of Manchester	Fermentation
Centre of Excellence for Biocatalysis, Biotransformations and Biocatalytic Manufacture	Fermentation
Genomics Research Centre, University of Warwick	Fermentation

## BELGIUM

Research Centre	Area of Excellence
BioBaseEurope	A leading initiative for the development of the biobased economy in Europe
VITO	Remote sensing, separation and conversion technology, environmental modelling, transition energy and environment, energy technology, materials technology, environmental risk and health
VIB	Biotechnology
BCCM-Belgian coordinated collections of micro-organisms	Microbiology

## FINLAND

Research Centre	Area of Excellence
MTT Agrifood Research Finland	Agricultural and food research and agricultural environment research
A. I. Virtanen Institute for Molecular Sciences:	Molecular medicine of major diseases of high importance for health care, including cardiovascular diseases, neurodegenerative diseases, and metabolism-related diseases.
Institute of Biotechnology Core Facilities and Service Units	Integrative Biology in the areas of molecular cell biology, genomics in model organisms and plants, developmental biology and structural biology and biophysics
Clinical Research Institute Helsinki University Central Hospital Ltd	Medical science
Finnish Forest Research Institute (Metla)	Forest science
Biomedicum research center	Health care studies, Medical science

## ITALY

Research Centre	Area of Excellence
Area Science Park	Chemical Building Blocks and other Bio-applications
Associazione Tessile e Salute	Bio-applications for textiles
Biococca Biotechnicum Center	Development of new biotech products (proprietary industrial strains) and processes (fermentation and bioconversion processes) for the production of commercially interesting proteins, metabolites and enzymes.
C.E.T.A. - Centro di Ecologia Teorica ed Applicata	Bio-applications for the environment
CEBIB	Chemistries synthesis and fermentations in GPL (good practice in laboratory), bioinformatics; molecular and cellular biology
Centro Biotecnologie Avanzate	Biotechnology and Biosciences
Centro Tessile Cotoniero e Abbigliamento S.p.A.	Bio-applications for textiles
CNR - ISM (Institute of Structure of Matter)	Biotechnology and Biosciences
CNR c/o University of Florence	Bio-applications for the Agro-Food sector
CNR - IAMC (Institute for the Coastal Marine Environment)	Algal Bio-applications

<b>Research Centre</b>	<b>Area of Excellence</b>
CNR - ICB (Institute of Biomolecular Chemistry)	Biotechnology and Biosciences
CNR - ISTEC (Institute of Science and Technology of Ceramic Materials)	Biotechnology and Biosciences
CNR - ISTM (Institute of Molecular Science and Technology)	Biotechnology and Biosciences
CNR - ICCOM (Institute of Chemistry of Organometallic Compounds)	Biocomposites
CNR – DPM (Molecular Design Department)	Biotech in general
Consorzio Catania Ricerche	Biocomposites & Biopolymers
CrESIT (Research Centre for Innovation and Life Sciences Management)	Pharma, Chemical Building Blocks, Enzymes
CRP - Centro Ricerche Plast-Optica S.p.A.	Biopolymers
ENEA (Italian National agency for new technologies, Energy and sustainable economic development)	Biomass for energy
European Centre for Living Technology	Chemical Building Blocks, Enzymes and other Bio-applications
Fondazione Istituto Insubrico di Ricerca per la Vita	Pharma and other Bio-applications
Istituto Sperimentale per le Colture Industriali Sezione Di Miglioramento Genetico	Agro-Food
PO.TE.CO. S.c.r.l.	Bio-solvents, Enzymes and Other Bio-applications (leather)
Politecnico di Milano	Biopolymers and other Bio-applications
Politecnico di Torino	Bio-application for textiles
Stazione Sperimentale Oli e Grassi	Bio-lubricants and other Bio-application of vegetable oils and fats
Stazione Sperimentale per la Seta	Bio-application for textiles
Tecnogranda	Algal Bio-conversion for Bio-lubricants
University Cattolica Sacro Cuore	Bioenergy / Agrosiences
University of Bergamo	Bio-application for textiles
University of Bologna	Chemical Building Blocks, Enzymes and other Bio-applications
University of Catania	Agro-Food Bio-applications
University of Florence (Dipartimento di Biotecnologie Agrarie)	Bio-applications for the Agro-Food sector
University of Insubria	Chemical Building Blocks, Enzymes and other Bio-applications
University of Milan - Bicocca	Biotechnology and Biosciences
University of Modena-Reggio Emilia	Biopolymers
University of Naples "Federico II"	Biotechnology and Biosciences and different Bio-applications
University of Padova	Biotechnology and Biosciences
University of Pavia	Biocatalysis and Enzymes
University of Pisa	Biopolymers

Research Centre	Area of Excellence
University of Salerno	Pharma
University of Turin	Industrial applications, Agro-food / Biotextile applications

## SPAIN

Research Centre	Area of Excellence
National Biotechnology Center (CNB )	Structure of Macromolecules Molecular and Cellular Biology Microbial Biotechnology Plant Molecular Genetics Immunology and Oncology Systems Biology Program
"Severo Ochoa" Molecular Biology Centre (CBMSO)	Cell Biology and Immunology Virology and Microbiology Development and Differentiation Molecular Neurobiology Genome Dynamics and Function Bioinformatics
Centre for Genomic Regulation (CRG)	Bioinformatics and Genomics Cell and Developmental Biology Differentiation and Cancer Gene Regulation Genes and Disease Systems Biology
National Cancer Centre (CNIO)	Molecular Oncology Programme Structural Biology and Biocomputing Programme BBVA Foundation – CNIO Cancer Cell Biology Programme Molecular Pathology Programme Human Cancer Genetics Programme Experimental Therapeutics Programme Biotechnology Programme Clinical Research Programme
National Cardiovascular Research Center	Cardiovascular Biology Myocardial regeneration Genetics and regulation of cardiovascular development Epidemiology and population genetics Cardiovascular Translational Research Research in Atherosclerosis and cardiovascular imaging
Institute of Molecular Science (ICMol)	Molecular Science

<b>Research Centre</b>	<b>Area of Excellence</b>
Institute of Chemical Technology (ITQ)	Layered materials, delaminated and pillared. Mesoporous, mesostructured and organic-inorganic materials. Microporous materials with isolated active centres. Nanomaterials. Fine chemistry. Selective hydrocarbon oxidation. Fuel cells and hydrogen storage. Catalytic processes with acid-base bifunctional catalysts. Hydrocarbon synthesis from natural gas and synthesis gas. Catalytic processes for pollutant removal. Computational catalysis. Combinatorial catalysis. Renewable energy: solar energy use; biomass valorization; hydrogen production and storage. Photochemistry, photochemical processes and photobiology
CENTRO DE INVESTIGACIONES CIENTIFICAS ISLA DE LA CARTUJA (CICIC)	Institute of Plant Biochemistry and Photosynthesis (IBVF) Institute of Materials Science of Seville (ICMS) Institute of Chemical Research (IIQ)
Organic Chemistry Centre Lora Tamayo (CENQUIOR)	(Industrial Fermentations Institute (IFI) (Industrial Fermentations Institute (ICTP) Institute of General Organic Chemistry (IQOG) Institute of Medical Chemistry (IQM)
CarboChemistry Institute (ICB)	Fossil Fuels Conversion and Wastes Valorisation Combustion and Gasification Environmental Research Carbon Nanostructures and Nanotechnology (G-CNN) Advanced Chemical Processes Chemical Technology for Separation and Detection
Institute of Catalysis and Petroleum Chemistry (ICP)	Structure and Reactivity Applied Catalysis Engineering of Catalytic Processes Biocatalysis
Materials Science Institute of Aragon (ICMA)	Organometalics Coordination Chemistry and Homogeneous Catalysis Organic Chemistry Materials
Institute of Natural Products and Agrobiolgy (IPNA)	Agrobiolgy and Environment Applied Phytochemistry and Ecology Biological Chemistry and Biotechnology Natural products synthesis

<b>Research Centre</b>	<b>Area of Excellence</b>
Institute of Advanced Chemistry of Catalonia (IQAC)	Biological Chemistry and Molecular Modelling Biomedical Chemistry Chemical and Biomolecular Nanotechnology Chemical and Surfactants Technology
Physical Chemistry Institute ROCASOLANO (IQFR)	Crystallography and structural biology Structure, energy and reactivity Biological physic-chemistry Surfaces and condensed matter
CIC Nanogune	Basic research of nanostructures and low-dimensional structures.  Synthesis, assembling, and nanofabrication of nanomaterials (nanoparticles, nanotubes, thin films, nanocomposites) and nanostructured materials.  Development of nanodevices and its impact on molecular electronics, spintronics, nanomagnetism, and nanophotonics.  Biofunctional nanoparticles and nanobiotechnology
CIC BIOMAGUNE	Biofunctional nanomaterials  Biosurfaces
Material Physics Centre-Joint Centre CSIC UPV/EHU	Chemical physics of complex materials Electronic properties at the nanoscale Photonics Polymers and Soft Matter
University Institute of Organometallic Chemistry "Enrique Moles"	Organometallic Chemistry
IMDEA	Network of international research centres including: Water Food Energy Materials Nanoscience Software

## **A5 Existing clusters**

Existing clusters within the BIOCHEM countries have been selected, taking into consideration the clusters whose areas of activity can be of interest for bio-based companies and investigating on the type of support/service mostly requested from the enterprises, trying also to identify strength and weakness points and ideas for the cluster future development.

The support requested from local companies revealed to be mainly focused on the following services:

- networking opportunities
- spin-offs, start-up and incubation services
- access to funding opportunities
- lobbying and sector representativeness.

Some clusters have been recently created and need to improve their visibility; anyway, many existing clusters feel a need to increase their contacts with businesses and to enlarge their areas of intervention moving more and more towards green applications.

Hereinafter the complete list of clusters, grouped per country, is presented, outlining their specific features.

## BELGIUM

Cluster name	Flandersbio	Region	Flanders
Focus	Biotechnology		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	CINBIOS	Region	Flanders
Focus	Industrial Biotechnology		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	Ghent Bioenergy Valley	Region	Flanders
Focus	Biomass-based energy		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	Bio-incubator Leuven	Region	Flanders
Focus	Biotechnology		
Support mostly requested	Spin-offs, start-up and incubation services		

Cluster name	BioLiège	Region	Wallonia
Focus	Biotechnology		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	GIGA Wallonia Biotech Coaching	Region	Wallonia
Focus	Biotechnology		
Support mostly requested	Spin-offs, start-up and incubation services		

Cluster name	Greenbridge	Region	Flanders
Focus	Life Sciences		
Support mostly requested	Spin-offs, start-up and incubation services		

Cluster name	Initialis (Materia Nova)	Region	Wallonia
Focus	Materials (including bio-based)		
Support mostly requested	Spin-offs, start-up and incubation services		

Cluster name	Innovatie-en incubatiecentrum UGent	Region	Flanders
Focus	Life Sciences		
Support mostly requested	Spin-offs, start-up and incubation services		

Cluster name	UBCA-University Business Center Antwerp	Region	Flanders
Focus	Bio-incubator		
Support mostly requested	Spin-offs, start-up and incubation services		

Cluster name	bio.be	Region	Brussels
Focus	Biotechnology		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	essencia	Region	Brussels
Focus	Chemistry and life sciences		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	BioWin	Region	Wallonia
Focus	(Red) biotechnology		
Support mostly requested	Networking opportunities/ lobbying and sector representativeness		

Cluster name	CHU Genetics PLEASE REMOVE	Region	Wallonia
Focus	Clinical research		
Support mostly requested	Cluster & Networks		

Cluster name	Aresa	Region	Wallonia
Focus	Clinical research		
Support mostly requested	Networking opportunities/ sector representativeness		

Cluster name	Biopôle	Region	Wallonia
Focus	Biotechnology		
Support mostly requested	Networking opportunities/ sector representativeness		

## FINLAND

Cluster name	Forestcluster Ltd	Region	0
Focus	Wood processing, fractioning, bio-refineries		
Support mostly requested	To initiate research and innovation programs and to channel research funds to selected focus areas		

Cluster name	Turku Science Park Oy	Region	Turku
Focus	drug development, diagnostics, biomaterials, and functional foods		

## ITALY

Cluster name	Area Science Park	Region	Friuli Venezia Giulia
Focus	Energy and environment, Life sciences, IT and ICT, Physics, Materials, Nanotechnology		
Support mostly requested	Logistic and infrastructural services		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Involvement of international companies (such as Sincrotrone, ICGEM, CBM, etc.)</li> <li>- The largest multi-sectoral Scientific &amp; Technology Park in Italy</li> </ul>			
Ideas for the future	Increasing engagement with private industries		

Cluster name	Friuli Innovazione	Region	Friuli Venezia Giulia
Focus	ICT, Biotechnology, Metallurgy, Energy and Environment, Wood		
Support mostly requested	Finance and incubation		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Integrated services including: Tech-transfer, incubation, finance and scientific matching with universities</li> <li>- Strong local scientific competencies</li> </ul>		<ul style="list-style-type: none"> <li>- Focus on traditional sectors (wood &amp; metallurgy)</li> <li>- Local industrial operators show late developments within the chemical sector</li> </ul>	

Cluster name	3A Parco Tecnologico Agroalimentare dell'Umbria S.c.ar.l.	Region	Umbria
Focus	Agricultural, agro-food and environmental sectors		
Support mostly requested	Information services regarding incentive availability		
Strengths		Weaknesses	
Direct participation to R&D projects through its own specialized laboratory for in vitro projects, including a germplasm bank serving the project "Vegetable Biodiversity in Umbria and its Preservation".		<ul style="list-style-type: none"> <li>- Being a regional initiative, it leverages mainly on local enterprise involvement</li> <li>- Bottom-up approach preferred to a top-down project selection.</li> </ul>	

Cluster name	Parco Tecnologico Padano S.r.l.	Region	Lombardy
Focus	Agro-food - Green biotech		
Support mostly requested	Start-up incubation		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Strong network with internal and external R&amp;D competences (both local and national)</li> </ul>		<ul style="list-style-type: none"> <li>- Being specialized in the food sector could be regarded as a limiting factor</li> </ul>	
Ideas for the future	Extension of focus area to Red Biotech		

Cluster name	Bioindustry Park Silvano Fumero S.p.A.	Region	Piedmont
Focus	Biotechnology		
Support mostly requested	Start-up incubation and financing search (Venture Capital)		
Strengths		Weaknesses	
Well balanced network (Small Companies, close academia and investors)			

Cluster name	Tecnogrande	Region	Piedmont
Focus	Agroindustry Park		
Support mostly requested	Different technical, incubation, infrastructure and R&D competence services for start-ups		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Recent estate investment</li> <li>- Updated facilities and services</li> </ul>		Financing seems limited to grant service (not Venture Capital)	

Cluster name	VEGA Parco Scientifico Tecnologico di Venezia S.c.a.r.l.	Region	Veneto
Focus	Nano-bio and Energy		
Support mostly requested	Utilities and incubator services		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Strong support by existing public and large enterprises</li> <li>- Consolidated presence of the oldest and most important chemical site in Italy</li> <li>- Good connection with the regional scientific centres and academies</li> </ul>		<ul style="list-style-type: none"> <li>- The area is suffering a decade-long decline in petrochemical activity, with associated employment losses and union mobilitation</li> </ul>	
Ideas for the future	Common belief that the area must move from traditional chemistry to green and environmental chemistry, and new energy applications		

Cluster name	IBIOCAT - Italian Biocatalysis Center partners	Region	Lombardy
Focus	R&D in the Biocatalysis innovation field		
Support mostly requested	Project development for funding requests and possibly network strenghtening		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Well balanced network (Small Companies, Accademia, Associations and individuals)</li> </ul>		<ul style="list-style-type: none"> <li>- Service portfolio could improve</li> </ul>	

Cluster name	Parco Scientifico e Tecnologico della Sicilia S.c.p.A.	Region	Sicily
Focus	R&D, innovation and tech-transfer support to agrofood and agroenergy among other secors		
Support mostly requested	Dissemination to the public of scientific knowledge Promotion of information on R&D projects		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Quite well articulated system of connections between Regional Universities, R&amp;D centres and Enterprises</li> </ul>		<ul style="list-style-type: none"> <li>- Poor the capacity of the local economic system to pick up and exploit innovative and successful initiatives</li> </ul>	
Ideas for the future	Support to widespread use of newly developed "Bioplastic bags"		

Cluster name	Sardegna Ricerche	Region	Sardinia
Focus	Applied Biotech (Biomedicine, Renewable energies, ICT)		
Support mostly requested	Financing		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Integrated R&amp;D, financing and incubation services (Polaris - Parco Scientifico e Tecnologico della Sardegna S.c.p.A.)</li> </ul>		<ul style="list-style-type: none"> <li>- Poor capacity of the local economic system to pick up and exploit innovative and successful initiatives</li> </ul>	

Cluster name	Metapontum Agrobios	Region	Basilicata
Focus	Valorisation of products from plant species and protection of crops from virus infection and insects.		
Support mostly requested	R&D project development capabilities in biotech; analytical and certification facilities		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Long history, as it has been funded in 1985 as a consortium between the Basilicata Region and the first chemical company in Italy, ENI.</li> </ul>		<ul style="list-style-type: none"> <li>- Poor the capacity of the local economic system to pick up and exploit innovative and successful initiatives</li> </ul>	

Cluster name	Pont-Tech - Pontedera e tecnologie	Region	Tuscany
Focus	New technology incubator		
Support mostly requested	Incubation services		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Proximity to one of the renowned Italian Academies (University of Pisa - Sant'Anna)</li> </ul>		<ul style="list-style-type: none"> <li>- Political support oriented mostly to Red Biotech, while the traditional Chemical Industry suffer image problems and public acceptance difficulties</li> </ul>	

Cluster name	Po.Te.Co S.r.l.	Region	Tuscany
Focus	Leather industry		
Support mostly requested	Training services		
Strengths		Weaknesses	
Proximity to one of the most important Italian leather goods district, in which the whole industrial sector (including leather producers, formulators of chemicals and manufacturers of finished ) use to collaborate proactively and intensively		The economic sector at present is experiencing a long-lasting decline due to difficult economic conditions	

Cluster name	Distretto Biotech Asse del Ticino	Region	Lombardy
Focus	Whole biotech sector (red, green, white and grey), clean & environmental technologies		
Support mostly requested	Networking SMEs with R&D centres and other service providers as incubators		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Very well integrated and differentiated membership (Institutions, Industry, Research and Incubators) in one of the most dynamic Italian region and connected to the rich Southern Swiss Ticino Region</li> </ul>		<ul style="list-style-type: none"> <li>- Sponsored by an R&amp;D centre (CrESIT), needs to gain wider visibility and to get stronger support by finance operators etc.</li> </ul>	
Ideas for the future	Establishing convenient permanent connections with the contiguous excellent area of Biovallé (CH)		

Cluster name	Insubrias BioPark	Region	Lombardy
Focus	Pharma and Diagnostic, Agrofood, Chemistry, Biomedical Engineering		
Support mostly requested	Large chemical libraries for screening		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Financial support from the "FIIRV - Fondazione Istituto Insubrico di Ricerca per la Vita"</li> </ul>		<ul style="list-style-type: none"> <li>- Incubated companies are mostly active within Red Biotech, while White Biotech is poorly represented</li> </ul>	

Cluster name	BioTekNet S.c.ar.l.	Region	Campania
Focus	Biotech		
Support mostly requested	Usage of high-tech facilities		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Scientific and Technological competences within the Departments from the various Regional Universities involved</li> <li>- Availability of high-quality and expensive high-tech facilities, financed with grants obtained by Regional and Central Government</li> </ul>		<ul style="list-style-type: none"> <li>- Networking with industry has proven to be difficult</li> </ul>	
Ideas for the future	Support to the growth of Biotech Spin-Offs (financed project BioStarNet)		

Cluster name	CamBio S.c.ar.l.	Region	Campania
Focus	Biotech		
Support mostly requested			
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Scientific and Technological competences of networked R&amp;D Centres and Departments</li> </ul>		<ul style="list-style-type: none"> <li>- Recently created</li> <li>- Still weak networking with users-companies, even if higher industrial participation is expected in the coming months</li> </ul>	

Cluster name	Consorzio Technapoli - Parco Scientifico e Tecnologico dell'Area Metropolitana di Caserta e Napoli	Region	Campania
Focus	Development of innovative projects including Biotech (Industrial and Red)		
Support mostly requested	Incubation services		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Government funding of Project BIO.SA.CI. – Biotechnologies for Company development (target: 4 new biotech companies)</li> </ul>		<ul style="list-style-type: none"> <li>- Bottom-up Approach could limit the success of the welcomed initiative</li> </ul>	

Cluster name	Bio.Mat.Ch.	Region	Lazio
Focus	Application of Biomaterials within Surgery and Medicine		
Support mostly requested	Support for the definition and organization of training modules.		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Scientific and Technological competences of networked professionals</li> </ul>		<ul style="list-style-type: none"> <li>- Voluntary association of professionals with limited potential to widespread uptake and exploitation of targeted biomaterials applications</li> </ul>	

## SPAIN

Cluster name	BIOCAT	Region	Catalonia
Focus	Biotechnology, Biomedicine and medical technology		
Support mostly requested	Support in R&D management		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- R&amp;D Capacity</li> <li>- Structure, made up of companies, research bodies, administrations and support structures for knowledge and innovation transfer.</li> <li>- Directory of entities. Catalonia is one of the chemical poles in Spain with lots of industry</li> </ul>		<ul style="list-style-type: none"> <li>- Services</li> <li>- Very focused on medicine. Little attention to Industrial Biotech.</li> </ul>	
Ideas for the future	Increase orientation to SME		

Cluster name	BIOBasque	Region	Basque Region - Euskadi
Focus	Industrial Biotechnology		
Support mostly requested	R&D: Research support. Entrepreneurial activities: Creation of start-ups		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Companies Development.</li> <li>- Strong government support, with a pro-business orientation has helped a thriving biosciences community, promoted the collaboration between the academic world, the health system and industry; and contributed essential infrastructures, useful also for internationalization.</li> </ul>			
Ideas for the future	More involvement of business, R&D centres and Universities		

Cluster name	BIOVal	Region	Valencia
Focus	Biotechnology		
Support mostly requested	Networking with companies. Consultancy Service for the creation of SME in the Biotechnology Sector. Internationalization support and help in the identification of R&D partners.		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Universities and Public Research Institutions.</li> <li>- High level of services</li> </ul>		<ul style="list-style-type: none"> <li>- Recently created.</li> <li>- Low number of companies</li> </ul>	
Ideas for the future	More orientation to businesses		

Cluster name	Andalucía BioRegion	Region	Andalusia
Focus	Biomedicine (specially), agro-biotechnology, environmental science and renewable energy		
Support mostly requested	Networking with companies.		
Strengths		Weaknesses	
R&D at Hospitals. Hospitals network		Recently created. Low number of companies	
Ideas for the future	More orientation to businesses		

Cluster name	CHEMICAL CLUSTER OF TARRAGONA	Region	Catalonia
Focus	Base chemicals, energy, gases, inorganics, intermediates, logistics, oil refining, organics, petrochemicals, phytosanitaries		
Support mostly requested			
Strengths		Weaknesses	
The most important chemical manufacturing cluster in Spain.			

Cluster name	Madrid BIOCLUSTER	Region	Madrid
Focus	Biotechnology		
Support mostly requested	Tax breaks for R&D+i activities; Memorandums of understanding; Support in proposal submission via their International Innovation Unit; Funding opportunities		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Over 40 companies and public and private bodies. The high number of companies involved provides a high degree of sector representativeness.</li> <li>- Deep involvement in developing International Relationships</li> </ul>			
Ideas for the future	The cluster seeks to achieve its economic independence and to strengthen its structure.		

Cluster name	VITARTIS	Region	Castilla y León
Focus	Food industry biotechnology		
Support mostly requested	Development of market strategies and support to spin-off and start-ups creation		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- To make use of existing synergies between development in biotechnology and innovation in food industry.</li> <li>- Large companies, SMEs, Technology Centres &amp; Universities involved in the cluster</li> </ul>		-	
Ideas for the future			

Cluster name	BIOIB	Region	Balearic Islands
Focus	Marine biotechnology, Health sciences, food and environmental engineering, bioinformatics and industrial biotechnology		
Support mostly requested	Information on funding opportunities support to spin-offs		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- BIOIB is integrated into the BioCluster of Southern Europe, promoted by the Mediterranean Pyrenees Euroregion.</li> <li>- Contacts and joint initiatives with other Bio Clusters in Spain and other regions in Europe</li> </ul>		-	

Cluster name	CLAN: Cluster Agroalimentación de Navarra	Region	Navarra
Focus	Food industry biotechnology		
Support mostly requested	Technology Offer & Demand Services Identification of potential partners		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- Strong network composed by companies, technology &amp; research centres, university research groups in the region</li> </ul>		-	

## UNITED KINGDOM

Cluster name	Chemicals North West	Region	North West
Focus	Chemicals		
Support mostly requested	Political lobbying Provision of networking opportunities		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- focused on chemicals</li> </ul>		-	
Ideas for the future	Industrial biotechnology for the production of high value chemicals. Biorefining as a substitute or add-on to the traditional petrochemical based industries in the regions		

Cluster name	Yorkshire Chemical Focus / Humber Chemical Focus	Region	Yorkshire / Humber
Focus	Chemicals		
Support mostly requested	Political lobbying Provision of networking opportunities		
Strengths		Weaknesses	
<ul style="list-style-type: none"> <li>- focused on chemicals</li> </ul>		-	
Ideas for the future	Industrial biotechnology for the production of high value chemicals. Biorefining as a substitute or add-on to the traditional petrochemical based industries in the regions		

Cluster name	NEPIC (North East Process Industries Cluster)	Region	North East
Focus	Chemicals		
Support mostly requested	Political lobbying Provision of networking opportunities		
Strengths		Weaknesses	
- focused on chemicals		-	
Ideas for the future	Industrial biotechnology for the production of high value chemicals. Biorefining as a substitute or add-on to the traditional petrochemical based industries in the regions		

Cluster name	Chemical Sciences Scotland	Region	Scotland
Focus	Chemicals		
Support mostly requested	Political lobbying Provision of networking opportunities		
Strengths		Weaknesses	
- focused on chemicals		-	
Ideas for the future	Industrial biotechnology for the production of high value chemicals. Biorefining as a substitute or add-on to the traditional petrochemical based industries in the regions		

Cluster name	NIBF (National Industrial Biotechnology Facility)	Region	UK
Focus	Biocatalysts		
Support mostly requested	The NIBF is currently under construction so isn't yet available		
Strengths		Weaknesses	
-		- Not yet widely known	

## **PART B - SKILL NEEDS**

### **B1 Characterisation of the profile of an ideal employee operating in bio-based company**

#### **Educational Profile**

There is a strong belief throughout industry that a sound fundamental education in chemistry or biology/biotechnology or engineering is still crucial. However there are increasing demands for new topics to be included in basic training – topics such as Sustainability are seen as particularly important. There is also concern from industry at the decreasing amount of laboratory based training within chemistry and chemical engineering degree courses.

It is also clear that most innovation occurs at boundaries between disciplines or business sectors; therefore new chemistry graduates need an appreciation of other subjects, particularly biology and engineering. In addition graduates need to develop more generic skills required for successful new business development, particularly focusing on awareness of business and social issues.

The type of requested educational background depends on the work to be developed but in general, the minimum educational level should be a degree, although most of the people involved will be at PhD level. Master of science, master of biotechnology and master of agriculture/forestry are examples of desirable qualifications.

As far as the area of competence is concerned, starting from a general knowledge of chemistry, cross disciplinary education and experience should be also achieved in the following fields: biochemistry, chemical engineering, process design, microbiology, organic chemistry, chem-pharma technology.

#### **Business and Personal Skills**

As a matter of fact, in today's world multidisciplinary is a must if an employee wants to succeed. Only scientific skills are not enough. Business and Personal skills are needed. Among the most important:

Business skills: project management, market knowledge, product commercialisation, innovation management, intellectual property rights.

Personal skills: communication skills, team work and creative thinking.

Moreover an ideal person for SMEs would have to show proactive attitude, capacity to cover different roles in the company and doesn't hesitate to take responsibility when needed.

Actually, a mix of technical and managerial background together with socio-economic skills is really welcomed, as most SMEs cannot afford to hire in both areas.

#### **Considerations related to company's peculiarities**

Actually a distinction has to be made considering SME and large companies' needs are not the same, since large companies have the ability to allocate resources for in-house training. Regardless of this, companies need well trained and skilled employees.

Specific consideration can be made taking into account that the sector is highly polarized in two types of businesses: large and small.

Very small enterprises need business skills, knowledge of intellectual property, finance, strategic planning and internationalization.

Large companies, as well as in other sectors, need updating, managers need MBAs (Master in Business Administration), in general as any other professional sectors. When a company leaves the field of science and its director has a scientific record, he is required to do an MBA or be accompanied by a good financial manager. They need the business basics, protect their knowledge and sell what they are doing.

Moreover, one of the main demands of businesses is to find good directors and senior scientists with experience. Such profiles in many cases come from pharmaceutical companies, in particular:

- CFOs are also required to manage businesses with losses during the first years of life,
- good business development managers who are able to negotiate licensing agreements with pharmaceutical companies,
- intellectual property experts who know how to defend patents against big companies in the pharmaceutical market.

At the technical level it is also very difficult to recruit staff because it requires people with experience in each particular field.

According to the representative bodies of the sector, human resource management has very specific peculiarities. The knowledge that biotech companies handle is not very common, they need highly qualified people with great experience, especially for management positions. These workers are not found without making attractive offers. They are given very competitive wages (rather than in the public sector) and people are often brought from outside the country and offered very flexible, attractive conditions.

Biotech companies, in the first four, five or six (in some cases eight) years of life, demand highly skilled workers, i.e. with qualifications between graduate and doctor. These companies need time to develop their product before they can profit from it, which requires an important investment in research and development. They often reach agreements with large companies from the sector, which absorb them before they reach the marketing stage. For this reason they do not have employees from FP (Professional Training Colleges).

The typology of these companies, usually small and focused on R&D, leads them to outsource most of the ancillary services such as accounting and human resources management, etc.

## **B2 Services requested by companies to sector associations, including emerging needs**

An indication about the bio-based company needs can be taken from the services requested to sector associations.

Undoubtedly the main request concerns information on *funding*: the interest goes from public funding programmes to private funding schemes and other business incentives like fiscal and tax deduction. Major interest is in public support given to Research and Development activities, especially considering the national and regional aids, but also the contributions from the European Commission are taken into consideration.

Companies usually are asking for support in identifying the most suitable funding scheme for their specific case and sometimes ask also for support in the proposal preparation.

As for private funding, although the capital injection required in this sector is less compared to red-biotech, it is fundamental indeed and especially spin-outs and start-ups show interest to establish contacts with Venture Capitalists and Business Angels. Moreover they need to be supported in business plan development.

Companies in general ask also for *legal aid*, and advice on how to comply with new legislation, including also implications from energy, environment and logistic points of view. Apart from general information on the regulatory framework, specific attention is put on *Intellectual Property issues*.

Large companies stimulate sector associations to represent their needs at regional, national and international level in order to favour appropriate policy actions to be implemented.

All companies, and especially SMEs need to be trained, coached or assisted on specialist topics.

Finally there is also a need for support in identification of suitable partners for collaboration in new projects, joint ventures and supply-chain development.

### **B3 Leading companies**

An idea of the area more developed in Europe at industrial level can be driven from the leading companies operating in the bio-based product market which are listed in the following table. The analysis of the area of activity of these companies shows that the labour market offers opportunities especially to people having competences on biopolymers and enzymes technologies.

Company	Country	Area of excellence									
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	Other
A&B Laboratorios	Spain			x							
Advancell Advanced in vitro Cell Technologies, S.A.	Spain							x	x		nanotechnologies
Ahlstrom	multiple	x	x	x					x		
Akzo Nobel	UK										Specialty chemicals, coatings
ARGUS Umweltbiotechnologie GmbH	Germany		x	x							
ARQUEBIO	Spain							x	x	x	
Artes Biotechnology GmbH	Germany		x	x			x	x	x	x	Fermentation
AstraZeneca	UK							x			
ATMOS Chrást s.r.o.	Czech Republic					x					
Avecom	Belgium										Waste water & biological waste stream treatment
Aveve/Groep Aveve nv	Belgium								x		Product & service supplier to farmers (oa plant nutrition & protection, biofuels)
AXEB BIOTECH	Spain						x		x		biochemical products for the agro-industry
Baraldi Lubrificanti Srl	Italy		x		x	x					Feedstock
Basell Italia S.r.l.	Italy		x								
BASF	Belgium										
Bayer Cropscience - Divisie Bioscience	Belgium										Biotech; Agro & breeding; Plants
Beneo Remy	Belgium										Exploration of rice varieties and the valorisation of rice derivatives into different food application
BfB OIL RESEARCH S.A.	Belgium		x		x	x					Feedstock
Bioeurope SA	France		x				x	x	x	x	Antibiotics
Biomedal SL	Spain		x	x			x		x		

Company	Country	Area of excellence									
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	Other
Bioorganic Research & Services, S.L (Bionaturis)	Spain							x	x		Vaccines
Bottega Verde S.r.l.	Italy									x	Biocosmetics/Nutraceuticals
BP	UK										Oil
Carlsberg Research Center	Denmark								x	x	
COVEX	Spain							x			dietary supplements and nutraceuticals
Croda	UK										Specialty chemicals
CropDesign	Belgium										Agro&breeding, plants
Danisco A/S	Denmark		x					x	x	x	Fermentation
Degussa AG	Germany						x	x	x		Amino acids, Fermentation
Domsjö Fabriker AB	Sweden		x	x					x		
DSM	The Netherlands		x				x	x	x		Antibiotics, Fermentation
Du Pont	Italy	x									
Dynea Oy	Finland			x							
Ecover	Belgium				x						Ecological wash- and cleaning products
EntreChem	Spain						x	x			Catalysts
EVC Compounds	Italy	x									
Fluka	Switzerland						x	x	x		
Galactic	Belgium		x				x				Producer of lactic acid
Genencor (Danisco)	The Netherlands	x	x						x		
Genencor International bvba	Belgium								x		
Genzyme	Spain, Italy										Biotech

Company	Country	Area of excellence									
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	Other
GlaxoSmithKline	UK, Italy							x			
Granit Recherche Développement SA	Switzerland		x	x	x				x		Biomass
Henkel Italia	Italy										Other Industrial Bioapplications
Huhtamäki Oy	Finland										Packing
Idroplax Srl	Italy		x		x						
Isagro Ricerca S.r.l.	Italy										Other Industrial Bioapplications
KliniPharm	Germany							x			Antibiotics, Biomass, Marine, Natural products
Lamberti S.p.A.	Italy										Other Industrial Bioapplications
Lumene	Finland									x	
Merck	Spain										Industrial Biotech
Neuron BPh	Spain		x				x	x	x		
Mossighisolfi	Italy		X								Biofuels
Novamont S.p.A.	Italy		x								
Novartis	Spain							x			Industrial Biotech
Novo Nordisk	Denmark		x		x				x		Antibiotics, Biomass, Dyes, Fermentation, Marine
Novozymes	Denmark		x	x				x	x		
Orion	Finland								x		
OryzonGenomics	Spain										Biotech
Pfizer	Spain, UK							x			Industrial Biotech
Pharma Mar SA	Spain							x			Marine, Natural products
Pharmamar	Spain										Biotech
Premier Foods	UK										Food
Procter and Gamble	multiple		x	x			x		x		Food, home & personal care

Company	Country	Area of excellence									
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	Other
Proviron	Belgium										Biodiesel, specialty chemicals and algae
Qualizyme Biotechnology (DI DR. ANDREAS PAAR KEG)	Austria	x	x						x		Dyes
Radici Novacips S.p.A.	Italy	x									
Reckitt Benckiser	UK										Food, OTC Pharmaceuticals, home & personal care
Roal Oy	Finland								x		
Rohm And Haas Italia S.r.l.	Italy										Other Industrial Bioapplications
Sapio Produzione Idrogeno e Ossigeno S.r.l.	Italy										Bioenergy/Biogas
Sappi Lanaken	Belgium										Paper and Pulp
SEA Marconi Technologies S.a.s.	Italy										Other Industrial Bioapplications
Shell	UK										Oil
SIPCAM	Italy										Other Industrial Bioapplications
Solutex	Spain							x		x	food, flavour, fragrances, nutraceutical elements
STAB/STAB VIDA	Portugal								x		Dyes
Syral Belgium (as Amylum)	multiple		x						x		Fermentation
TAKASAGO	various						x				flavour, fragrances & aroma chemistry
Tecnaro GmbH	Germany	x	x		x						Biomass
Tessengerlo Chemie	Belgium										Chemicals
Tintoria del Sole S.p.A.	Italy		x						x		Dyes
TransFurans Chemicals BVBA	Belgium	x	x		x						Biomass
Unilever	multiple		x				x				Biomass, Consumer goods, Feedstock
UPM	Finland	x									

Company	Country	Area of excellence									
		Biocomposites	Biopolymers	Biosurfactants	Biosolvents	Biolubricants	Chemical Building Blocks	Pharmaceuticals	Enzymes	Cosmetics	Other
Valagro S.p.A.	Italy										Other Industrial Bioapplications
Vandeputte Oleochemicals S.A.	Belgium		x		x	x					Feedstock
Wetlands Engineering SPRL	Belgium		x						x		Dyes, Fermentation, Natural products
ZEROWASTE	France		x		x	x					Feedstock

## **PART C - TRAINING NEEDS**

### **C1 Training activities requested by the companies**

The bio-based product sector is a quite new one, therefore there is poor experience gained on training specifically addressed to companies operating in this area. Nevertheless the business environment stimulates companies to keep trained on technological innovation which is a key factor to gain or maintain a competitive advantage in the worldwide market.

The knowledge base needed for biochemical production is very wide. In addition to traditional chemical process knowledge a deep understanding of biomass, biorefineries, separation methods, analysing and control equipment is required. Some areas where specific need for training is perceived by the companies are:

- Process operators for fermentation systems (this for example will be addressed by BioBase Europe, Terneuzen, The Netherlands)
- Master/Engineer level on bio catalysis
- Measurement and control techniques for the chemical sector.

Problems related to sustainability of bio-based products have to be taken into consideration as well, resulting in company competencies to be developed also in environmental (e.g. Life Cycle Assessment), legal (e.g. Intellectual Property Rights), ethical and social implications of biotechnologies applications.

Importance is increasingly given by enterprises to non-technical, more transversal skills: business management, commercialization, business development, customer orientation, communication skills, etc.

The general trend is that the industries themselves are qualifying agents, i.e. those who themselves generate some of the training needed, this training being "embedded" in productive structures. On the other hand this situation can be observed mainly in large companies.

Finally start-ups are looking mainly for help in business plan formulation and entrepreneurship.

### **C2 Preferred way for updating competencies and skills**

Currently the structure of most companies is lean and workload pressure does not allow the devotion of much time to training activities. For this reason specific training sessions arranged at workplace are generally preferred. Actually for some of the companies located in decentralized areas, on the job training is the only way to deliver training.

A possible alternative is training arranged at local level, so a need for regional training centers can be identified.

Participation to specific seminars and conferences is also a way often used to update competencies, especially from companies of Southern Europe.

Access to on-line training services (e-learning, self-directed training, etc.) is regarded as interesting, but not yet implemented very much. In general on-line service is more appropriate in case of short sessions and starting from a previous ground knowledge.

### **C3 Propensity to continuous professional development (CPD)**

Chemistry as a sector undoubtedly shows a strong need for life-long learning. Main reasons are the continuous technological developments requiring continuous training, the aging population of employees and the need to keep on top management skills to face the competition in the global marketplace.

On the other hand access to continuous education presents problems for companies in the sector, because it is not always easy to meet the specific company needs. This depends mainly from the fact that most of the existing training systems usually target only "traditional" sectors. Generally speaking, training systems adopt innovations quite slowly, which can be a problem for an industry as dynamic as biotechnology.

Moreover, sometimes companies refer to the need to incorporate more basic or nuclear skills, frequently alluding to the absence or difficulty of finding some other basic or nuclear skills and qualifications: verbal and written communication, responsibility, autonomy, problem-solving skills, teamwork, customer orientation, etc. Certification of these basic skills based on the training offered appears complex, and it will have little credibility.

### **C4 Propensity to work in an international environment**

Nowadays a high percentage of the companies are active in an international environment. Besides the multinationals, many companies, including SMEs, have import and/or export outside country boundaries. As a consequence, current daily contacts and businesses are managed at international level and many employees are being sent abroad.

The attitude to work in international teams is increasingly important, especially for the development of complex projects requiring complementary and synergic competences together with highly specialized facilities.

We see a need for training to work in an international environment. This could for example be addressed by stimulating exchange of personnel (Leonardo, Marie-Curie).

In this context language skills are obviously required, at least referring to English knowledge, and young generations are improving in this sense also in Southern Europe where SMEs are traditionally less confident with foreign languages.