



**Overcoming hurdles for innovation in
industrial biotechnology in Europe**

Biobased Surfactants

Summary



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The [BIO-TIC](#) project aims to identify hurdles and develop solutions to the large scale deployment of Industrial Biotechnology in Europe. Biobased surfactants are one of five product groups which we have identified to have significant potential for enhancing European economic competitiveness and which have the potential to introduce cross-cutting technology ideas.

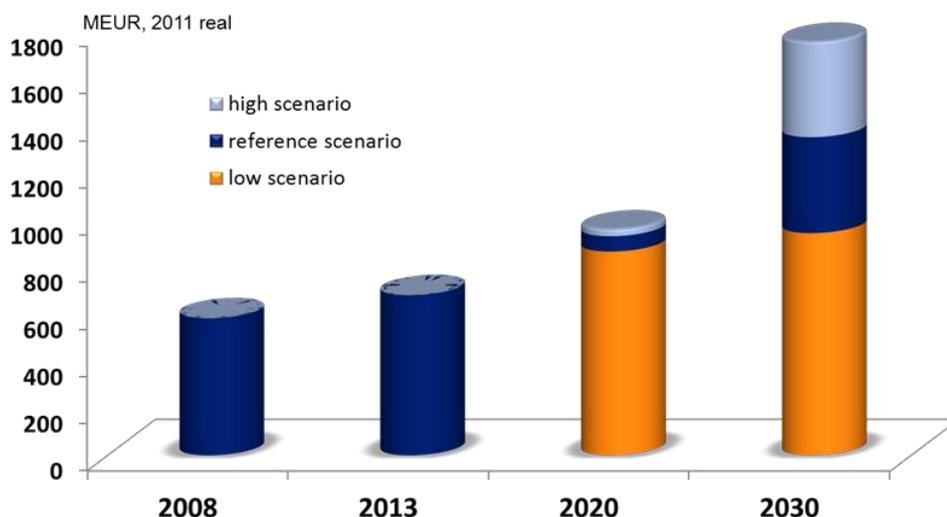
This document is a summary of the findings related to biosurfactants at the mid-way stage of the project and it has been produced as a discussion piece in order to collect stakeholder’s thoughts on the hurdles within this sector, and ideas for how these hurdles can be overcome to capture the full potential of biosurfactants.

Background

Biobased surfactants can be produced either from oils and fats via oleochemical production or from sugars, e.g. molasses by fermentation. Biobased surfactants can be used for a wide range of applications, the largest of which are currently detergents, followed by personal care products and industrial and institutional cleaners. While biosurfactants only represent a small share of the global surfactants market at present, a series of leading producers have entered the market and currently investing in product development. The biobased surfactants market is very concentrated with the top five producers accounting for almost 90% of the total market.

The EU has an established biosurfactants market, with an estimated demand of 679 MEUR in 2013 corresponding to half of the global demand. Between 2008 and 2013, the European bio-based surfactant market witnessed a compound annual growth rate (CAGR) of approximately 3 % per annum, making Europe the global leader in terms of both biosurfactant production and consumption. As shown in the diagram below the BIO-TIC project estimates that in 2030 the biobased surfactants market in Europe could have a market value of between 0.8 MEUR and 1.8 BEUR. The market value could be greater than this if the various hurdles to biosurfactants are addressed.

Figure 1. Biosurfactant Market Projections to 2030



The Vision for Biosurfactants in the EU

By 2030 biosurfactants will be available for a wide range of applications, but will however remain niche products due to limited cost competitiveness compared to conventional surfactants. On a global scale, Europe will persist as the largest consumer of biobased surfactants. The European biosurfactant demand is expected to follow the growth of the overall surfactant market through to 2030. Biobased surfactants will be produced from a variety of feedstocks including traditional plant oils, fats and sugar biomass, but also algae and waste streams.

Market drivers, innovation hurdles and proposed solutions

The main drivers for the market uptake of biobased surfactants are currently environmental concerns, regulatory compliance and fluctuating oil prices. Growing consumer awareness of the environmental hazards resulting from the use of conventional surfactants will most likely consolidate the alternative, biobased trend. The overall demand for biobased surfactants in 2030 is assumed to depend strongly on industrial activity in detergents and cosmetics where environmental concerns are more prominent. Due to the importance of safety in the cosmetics industry, developing products through IB is an advantage because it is more secure than via chemical pathways. Brand owners may be willing to pay a premium for biobased products if IB can offer market advantages in terms of sustainability, corporate responsibility and reducing carbon footprint, water use and waste.

Biosurfactants are usually produced as low volume, high value products, typically for high-end customer products. This means that there is less of a price hurdle to overcome than for bulk applications. The first company to enter the market with a competitive green product has a clear market advantage over the others. There are multiple end uses for biosurfactants and these many market opportunities in bioremediation, oil recovery, agriculture, processing etc. can create a critical mass, making biosurfactants an established player in the entire surfactants market.

Today, the main hurdle for biosurfactants is that the properties conferred by biobased surfactants are limited, and this limits their applications. Surfactants are mainly used in product formulations where a change in one component has an effect on the performance of the final product. Customers may not be aware of what a biobased surfactant is and that they can be used for. Brand owners need to perceive a clear added-value in switching to biobased surfactants as one-to-one substitutions of conventional surfactants are unlikely and new product formulation development is often required. Many industries are unwilling to reformulate products. Accordingly, the biosurfactants market is heavily driven by technology push: brand owners are observing what technology developers bring to market before taking any major product development decisions. Future progress may be hindered by the lack of biosurfactant suppliers as customers cannot afford the risks associated with one supplier. Having developed a new product, the EU legislation needed to register new products is time-consuming and very expensive, albeit necessary.

Glycolipid biosurfactants, such as sophorolipids, rhamnolipids and MELs can be used as, at least, partial replacements for the most common surfactant in washing powders and liquids such as linear alkylbenzene sulfonates (LASs). One of the major challenges in the use of these alternative biosurfactants is that each organism produces a mixture of congener molecules with a range of different structures and therefore properties, making the downstream processing extremely

complicated and costly. In addition, the main organism for producing rhamnolipids, *P. aeruginosa*, is classified as a class II pathogen in the UK. The majority of lecithin which could be recovered from soy oil production is not at present both because recovery of lecithin is poor and for other economic reasons.

The table below summarizes the hurdles and some solutions that can be envisaged to overcome the bottlenecks related to biosurfactants. The hurdles that are highlighted in green apply to biosurfactants specifically, but are also an issue for IB in general. The white cells apply only to biosurfactants. The cells that have been left blank indicate that no solution has yet been formulated with regards to that barrier. Stakeholders are invited to consider both the blanks and the proposed solutions and send in their feedback to bio-tic@europabio.org

Short term hurdles	Solution proposed by stakeholders	
	R&D	Non technological
Production costs and yields	<ul style="list-style-type: none"> -Use of GMOs -Use of waste and generally cheaper renewable substrates for biosurfactant production e.g. glycerol -Integrated optimization and development of bioconversion, product recovery and DSP -Sharing of utilities, logistics and feedstock handling between SMEs and companies 	
Conversion into final product (scale-up and DSP)	<ul style="list-style-type: none"> -Develop realistic models of the production process and reactor types such as the computational systems already used in other engineering fields -Train more chemical engineers by developing new masters, Ph.D programs and apprenticeships focused on combining chemistry and chemical engineering disciplines -Modelling of entire process -New, more efficient biocatalytic systems -R&D for integrating bioconversion with DSP -Increase the value of waste and by-products through improved DSP yields -DSP processes and equipment need to be designed so as to be able to operate with flexibility and accommodate various inputs while achieving product specifications 	
Lack of willingness to make new product formulations (cosmetic industry)	-Biosurfactant producers could support the customer in this process	-Critical mass through consumer demand
Acceptance of GM and consumer knowledge (consumers don't differentiate GMOs from GM crops)		<ul style="list-style-type: none"> -Recognized scientists and experts, not politicians should educate the public -Develop a communications strategy addressing: <ol style="list-style-type: none"> 1/Mobilization of intermediary associations (e.g. NGOs,

		<p><i>umbrella organisations) to promote biobased products based on scientific fact finding.</i></p> <p><i>2/Involvement of all stakeholders (including the media & consumers) in innovation projects from the beginning</i></p>
<p>Consumers' willingness to pay a bio-premium</p>	<p><i>-Development of cheap products with equal or superior properties so that consumers can easily make environmentally friendly choices</i></p>	<p><i>-Reduction of the price through investments and payment of the premium by companies in a B2B environment</i></p> <p><i>-Stimulation of engagement of large consumer product companies in biobased products</i></p> <p><i>-More awareness of producers of Biobased products of the product functionalities and added value of their products compared to fossil based products</i></p> <p><i>-More communication towards consumers on added value of the Biobased products compared to alternatives on the market. This could be done by the authorities in collaboration with consumer organisations.</i></p> <p><i>-Awareness creation through outreach activities oriented to the public at large and other specific target groups (e.g. visits at biorefineries for secondary schools)</i></p> <p><i>-Entering into dialogue with consumer organisations through inviting representatives in workshops, panels, discussion fora</i></p> <p><i>-Appointment of a good science communicator, spokesman, at government institutions, industry and research organisations</i></p>
<p>Lack of piloting facilities</p>	<p><i>-More capital to be made available for piloting and demonstration activities</i></p> <p><i>-Support investors in risk-taking (also related to the lack of knowledge of the benefits of IB)</i></p> <p><i>-Foster scale-up to industrially relevant production</i></p>	<p><i>-Development of technology & science parks, and bioclusters covering the entire value chain. Partners in the cluster can collaborate in the innovation process until market phase.</i></p> <p><i>-Share R&D facilities and attract joint and alternative routes for funding of demonstration projects and scale-up activities</i></p>

	<ul style="list-style-type: none"> -<i>Techno-economical evaluations for the entire production process and potential synergies between (bio)processes</i> -<i>Create plants that use the same feedstock for chemicals and biofuels</i> -<i>Mobile or smaller, decentralized biorefineries or opt for product specialisation</i> 	<p><i>(public and private investors, private foundations etc.)</i></p> <ul style="list-style-type: none"> -<i>Implementation of R&D funding programmes for pilot and demonstration projects as proof of concept in cooperation with industrial partners at a 50% co-funding basis</i> -<i>Promotion and financial support for interregional pilot and demonstration activities in frame of a joint strategic bioeconomy agenda</i> -<i>Start specific national/regional PPP for projects starting at demo phase</i> -<i>Construction of shared laboratories and improved pilot plant facilities, open to all companies (pre-competitive R&D)</i>
<p>Too little R&D funding</p>		<ul style="list-style-type: none"> -<i>Increasing R&D funding at EU, national and regional level for pioneering public research in collaboration with the industrial sector in a co-funding scheme</i> -<i>Shift part of the funds allocated to biofuels research to biobased research on value added products</i> -<i>Implementation of a public and private funding scheme</i>
<p>Low demand</p>		<ul style="list-style-type: none"> -<i>More awareness of producers of Biobased products of the product functionalities and added value of their products compared to fossil based products</i> -<i>More communication towards consumers on added value of the Biobased products compared to alternatives on the market. This could be done by the authorities in collaboration with consumer organisations.</i> -<i>Awareness creation through outreach activities oriented to the public at large and other specific target groups (e.g. visits at biorefineries for secondary schools)</i> -<i>Entering into dialogue with consumer organisations through inviting representatives in workshops, panels, discussion fora</i> -<i>Appointment of a good science communicator, spokesman, at government institutions, industry and research</i>

		<i>organisations</i>
Time taken for the EU to decide on how to implement policies and targets		<i>-Clear targets need to be set for biobased</i>
Lack of clear definitions of biosurfactants (biobased versus IB)		<i>-Development of standardised systems to obtain feedstock that correspond to certain sustainability criteria, e.g. drying technologies, physic-thermal processes(cfr the “Biobased Raw Materials Platform” in the Netherlands)</i>

Medium term hurdles	R&D	Non technological
EU legislative requirements are time consuming and costly, especially for new products		<i>-EU could take part of the risk themselves by helping to pay for tests that fail and instead raising the cost for tests that pass</i>
Carbon footprint (due to low efficiencies in IB)	<i>-Development of more efficient microorganisms and new raw materials</i>	
Raw material development is time consuming and expensive		
Lack of willingness to invest in R&D for longer periods of time		<i>-Increasing R&D funding at EU, national and regional level for pioneering public research in collaboration with the industrial sector in a co-funding scheme -Shift part of the funds allocated to biofuels research to biobased research on value added products -Implementation of a public and private funding scheme</i>
Lack of willingness to take large risks that could lead to breakthroughs		<i>-Attraction of foreign VC and private investors through capital fiscal incentives. -The implementation of tax reduction measures or tax bonuses -Creation of a stock option market for green (biobased) or environmental technology companies promoted at EU and</i>



		<i>national level</i>
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Long term hurdles	R&D	Non technological
Raw material cost and availability will be an issue in the future	<ul style="list-style-type: none"> -Develop processes that can utilise alternative feedstocks -Use microalgae biomass feedstocks -Co-production of high value products -Reduction in transportation costs and post harvest losses through decentralized biorefineries -Develop perennial non food crops for agriculture on arid land 	<ul style="list-style-type: none"> -Better collaboration with farmers and the feed sector. Install win-win scheme for buyers and producers (farmers) -Create new forms of ownership in the forest sector e.g. collectives rather than traditional family forestry -Re-utilization and recycling materials as a resource efficiency strategy, to decrease the demand for feedstock -Promotion of cascading use of feedstock in order to decrease the demand for feedstock -Feedstock could be partially imported from elsewhere. -Wheat is either food grade or non-food grade categorised. The surplus of wheat could be utilized as feedstock.
Share of biosurfactant in the final product		

Based on the number of non-technological solutions, it is clearly suggested that regulatory incentives could be the most efficient method to develop a market for biobased surfactants, especially in the short term. Industry believes that flexible and supportive regulatory incentives for the commercial scale production of biosurfactants and their subsequent market entry are needed to ensure the uptake of biobased surfactants.

How to get involved

*Stakeholder engagement is crucial in ensuring that actions are developed which best fit the needs of this sector. The [BIO-TIC](#) project would greatly welcome any comments you might have on this document, hoping that your valuable input will contribute to setting the groundwork for a targeted workshop dedicated to biobased surfactants which will be held on **3rd September 2014 in Berlin**.*

We are particularly interested in your views on the market projections to 2030, whether we have missed any key hurdles and on any solutions which you could envisage to overcome these hurdles. Please send any comments to bio-tic@europabio.org by end of August 2014.