Progress

Priorities for Addressing **O**pportunities and **G**aps of Industrial Biotechnology for an efficient use of funding **res**ource**s**

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About PROGRESS

PROGRESS is a coordination and support action for the European Commission and aims to support and accelerate the deployment of IB in the EU industry by identifying high-value opportunities for IB and proposing actions to address them successfully. To do so, we will first provide a comprehensive and dependable information base (including modelling and simulation approaches) which allows plausible estimations on the future of IB in the EU in the short and medium term. Second, in collaboration with the relevant stakeholders, we will elaborate a future scenario and a common vision for IB in Europe containing the most promising value chains, related R&D&I needs and the required policies. Based on these steps, we will provide research, industry and policy makers with strategic advice regarding potential issues/topics for collaboration, future policy programmes, the required technological infrastructure, capabilities, and economic structures. A main focus will be to identify opportunities for collaboration between EU member states and to propose actions to increase awareness of and incentives for these collaborations. For more information, see www.progress-bio.eu

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1 Introduction

The Coordination and Support Action PROGRESS aims to identify high value opportunities and corresponding R&D&I gaps in Industrial Biotechnology in the context of innovation and commercialisation patterns as well as technological and non-technological issues. A value chain perspective is therefore adopted in Work Package (WP) 2: This allows the simultaneous analysis of market needs, innovation potentials and the identification of (missing) European competencies and concrete bottlenecks affecting innovation and commercialisation. Opportunities and related R&D&I needs for Industrial Biotechnology can be derived from a holistic perspective that considers needs and gaps as well as potential future developments across the value chain. Corresponding analyses will be provided for **6 value chains**. In subsequent steps of the CSA, in-depth analyses and scenarios will be elaborated for each of the value chains and selected value chains will be modelled using a system dynamics model.[1]

This report describes the selection of the value chains and the related criteria.

[1] By using the system dynamics model we aim to provide an objective assessment of the relevance of different factors for IB deployment and the dynamic relations between them Moreover, the potential economic impact will be determined by quantitative modeling of different scenarios for the value chains.

2 Selection criteria for the value chains

In order to define a set of suitable criteria, the findings in Work Package 1 of PROGRESS have to be considered.

Work Package 1 conducted analyses of market demand, societal needs as well as the innovation potential of IB via extensive literature review and selected interviews across Europe.

These analyses revealed **the high heterogeneity of IB** in terms of development directions, maturity, market conditions, drivers and respective value etc. This heterogeneity makes it difficult to prioritise certain market segments / technologies etc. or to select specific value chains. However, some key relevant trends can be observed:

- The currently **low oil price** is impeding the demand for bio-based products; in particular, drop-in and potential IB mass markets are highly dependent on feedstock prices. Hence, it can be observed that many companies started out in commodities, but are now moving up the value chain looking for more profitable opportunities. High-value IB segments were often considered key opportunities for Europe in the expert interviews, but were usually not defined more concretely.
- A potential game changer is that **brand owners** in some segments are showing interest in bio-based products in order to establish a more sustainable supply chain And there are signs that this is increasingly expected by consumers.
- It is becoming increasingly difficult to **classify IB-relevant markets**. IB methods are combined increasingly with chemical or other processing methods and are converging with other technologies. The resulting question is how different processing technologies can be interlinked.
- The interviews frequently mentioned the opportunities associated with the use of certain **alternative feedstocks** (different types of waste, CO_2).
- **European regions are highly heterogeneous** with respect to their technological capacities and in terms of biomass availability. Therefore, which concept will be economic and sustainable must be determined individually for a given region.

Together, these observations show that different key entry points, characteristics and development directions are relevant for the future of IB and should be considered.

As a consequence, we propose to define a **portfolio of value chains** that covers **the heterogeneity of IB opportunities** (instead of a set of criteria that have to be fulfilled by each value chain as much as possible). This portfolio, but not necessarily every single value chain it contains, should cover aspects such as drop-in vs. new functionalities, different IB roles (in terms of cost share of product) and types of feedstocks (e.g.

waste valorisation), horizontal or vertical integration of IB in value chains, and low-volume, high-price products vs. high-volume, low-price products.

In addition to these criteria, value chains are selected and defined that show potential for innovation and for making a significant contribution to the EU economy.[2] An additional condition is that some of the value chains selected should be suitable for integration in the system dynamics model (Work Package 3). This requires that various indicators are available for some value chains (ideally market data, production capacities, feedstock prices, patents, etc.).

On this basis, IB-related opportunities and key gaps can be identified and analysed for Europe (the step of prioritising and concretisation, e.g. regarding R&DI topics, will take place in WP 5).

[2] In order not to miss important niche opportunities for IB in value chains that are not considered here, we will include a list of additional topics or value chains for further analysis in the final work package regarding R&D&I needs

3 Selected value chains

Based on the criteria shown, the project team conducted several internal workshops to identify five suitable value chains. The selection was reviewed by the Advisory Group and expanded to six by adding the microbiome value chain.

The value chains were also distinguished by referring to specific application fields[3]. For example, the enzymes value chain was specified for laundry & dishwasher detergents, cleaning products etc., as its other possible application areas such as pharma, food or biofuels are the focus of other selected value chains. Overall, the value chains cover the key sectors for industrial biotechnology. For instance, the chemical sector is of key importance for bio-based plastics, enzymes, personal and household care for flavour & fragrances. The selection, delineation and respective reasons for the selection are shown in Table 1.

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[3] Only for bio-based plastics it was not possible to define one specific application field as there are so many different potential applications.

Table 1: Selection of value chains in the PROGRESS project

"Value Chain"	**Delineation/description**	**Key characteristics or points of interest**	**Potential for EU**
Lignocellulosic ethanol	Lignocellulosic ethanol for fuels (road and air transport) from non-food biomass	• Role of Europe in drop-ins for mass markets with high impact of feedstock prices/ availability • Valorisation of side streams	• Potential to increase sustainability performance and improve EU's position in biofuels
Enzymes (for laundry & dishwasher detergents, cleaning products etc.)	Horizontal analysis for enzyme design/screening, application of laundry etc. as example for full VC analysis	• Rather high-value products (enzyme itself, not end product) with new functionalities as market driver • Good example to analyse horizontal and vertical value chain issues (e.g. bottlenecks at stages beyond enzyme supply; cross-fertilisation for different enzyme applications)	• Strong position of EU; high innovation potential regarding enabling competencies and platform technologies for enzyme screening, design, production platform optimisation, enzyme production etc. • High potential for addressing societal goals (e.g. reducing energy and environmental pollution; quality of life in emerging countries which represent growth markets)
Bio-based plastics	Biotechnologically produced* polymers based on biomass (biodegradables and non-biodegradables) for different applications	• Analysis of complexity of value chains (drop-in vs. non-drop-ins, high-value vs. low-value products, feedstock dependence, etc.) • Improvement in sustainability as key prerequisite for long-term development • Brand-owners as key market drivers (what is their role? How are cooperations characterised? What are the brand owners' needs?)	• High market demand in the EU as potential competitive advantage • Bio-based plastic is a value chain which the public associates with bioeconomy/industrial biotechnology and therefore has a signalling function for other IB-based developments

Production of biopharmaceuticals	Production technology and processes for biotechnologically produced biologics; boundary of analysis at the production stage (=> clinical trials, pharma market regulation etc. not included)	• High innovation potential in production processes	• Rather strong EU position in high value-added production
Biotech flavours & fragrances	Biotechnologically produced flavours / fragrances for food and/or cosmetic applications	• High-value, low-volume products with new functionalities as market driver	• Good position of EU (technological competencies; some key actors in Europe)
Microbiome for food, beverages, health nutrition	Targeting humans (not plants, animals,…); Food products that are available to consumers without prescription	• Example for a value chain in an earlier maturity stage	• EU is strong in R&D; good position of some firms; relevant policy issues

Source: Fraunhofer ISI; * “biotechnologically produced” means at least one major step in the production process is a biotechnological step; includes combinations of different production technologies.

4 Next steps in the value chain analysis

The value chain analyses in WP 2 will be conducted by document research, indicator generation and expert interviews on the basis of the following template:

- Description of the value chain (including actor groups, applications)
- Scientific and technological developments in IB as well as competition with existing and alternative solutions
- Potentials in terms of economic impact and addressing societal and environmental goals
- Framework conditions
- Position of Europe (patents, publications, markets and market trends, production capacities, actors, strengths and weaknesses in international competition + advantages/disadvantages)
- Geographical distribution in Europe.

In WP 4, three workshops (each covering two value chains) will be conducted to elaborate the future scenarios for the value chains.