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The origins of the bioeconomy in the European Union[☆]

This article is dedicated to the memory of Dr Stephan Micha (1965–2013), who actively contributed to the development of the Bioeconomy in Germany and in the EU.

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ABSTRACT

This article outlines the context and circumstances that favoured the development of a Bioeconomy Strategy in the European Union (EU) and the role played by the different Framework programmes for Research, Technological Development and Demonstration. Particular attention is given to the biotechnology related programmes and more specifically to the “Cell Factory” Key Action in the 5th Framework Programme (1998–2002). This, together with the parallel development of a Strategy on Biotechnology in 2002, served as a solid foundation for the creation of the, at the time, so-called Knowledge-Based Bio-Economy (KBBE). The KBBE concept emerged in 2005, a couple of years before the launch of the 7th Framework Programme (2007–2013). The experience accumulated over the years and the new societal expectations triggered the EU to launch a Strategy on Bioeconomy in 2012. This article concludes with a brief analysis of the two most important impacts of the EU Strategy on Bioeconomy. One is the Bioeconomy dedicated activity within the Programme Horizon 2020 (2014–2020), and the other the creation of a public-private partnership of bio-based industries. Both the impact of Horizon 2020 on the EU Bioeconomy Strategy and the bio-based industries public-private partnership are analysed in depth in two articles elsewhere in this volume.

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Introduction

The birth of the bioeconomy in the European Union (EU) has been to a large extent the result of chance and necessity. Since 1982, the European Commission (EC) has been in charge of preparing, managing and implementing the EU Framework Programmes in Biotechnology and Life Sciences. Over the years,

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the different research programmes increased in budgetary size, industry participation, number of participants per project, and scientific and technological ambitions of projects, etc. These changes triggered programme managers of the EC to create new managerial instruments to address the increasing size and complexity of the research projects and programmes. Commission staff also needed to take into account the expectations of the Member States' representatives on the programme committees. They managed the programmes in coordination with the EC. Among those instruments that were gradually being developed in the early years were the requirement for transnationality in research projects, the development of the concept of 'European laboratories without walls' [1], the setup of a high-quality method for evaluation of proposals by independent peer-review experts [2], and the development of a number of 'Industry Platforms' associated with some of the most innovative projects [3]. The content of the research programmes was also in permanent evolution to adapt them to tackle the most pressing problems at the forefront of science, technology and society. The overall objectives of EU research programmes were to promote scientific excellence in Europe by bringing together the most dynamic and creative research groups, with the objective of favouring the exploitation of research results for the good of industry and society. When one looks retrospectively, it is easy to realize that the influence of other Community policies, the influence of Member States' representatives at the programme committees and the European socio-economic context of the time, led the orientation of the biotechnology programmes to switch from a more basic and fundamental approach in one programme, towards one more targeted and focussed on a societal or technological programme in the next [4].

The early biotechnology programmes were the managerial and policy frameworks to create solid foundations in European research, such as: European transnationality participation in research projects; an increase in industrial participation, either as partners in projects or as industrial platforms; independent peer-review of proposals; development of solid managerial research tools; and reinforcing excellence in science and promoting industrial exploitation of results. All of the accumulated experience over different Framework Programmes was an essential prerequisite to be able to tackle more ambitious policy initiatives such as the Strategy on Biotechnology in 2002 [5], the concept of the Knowledge-Based Bio-Economy, more commonly known as KBBE [6] and, lastly, the Strategy on Bioeconomy which was adopted in 2012 [7]. As much as 10 years elapsed between the adoption of the Biotechnology Strategy and the Bioeconomy Strategy and 30 years from the first biotechnology programme to the adoption of the Bioeconomy Strategy. This indicates that initiatives like these require not only goodwill but, above all, the development of matching managerial instruments, maturity of sectoral policies and a broad socio-economic consensus. The origin and policy context of these policy initiatives is outlined below. For an insightful analysis of the genesis and evolution of biotechnology research programmes in the EU, see [8].

The "Cell Factory" key action, an early precursor of the bioeconomy

The 5th EU Framework Programme (1998–2002) was a turning point in research policy by creating the so-called Key Actions. It departed from the classical and linear innovation chain, that is to say, from basic to applied research, followed by technological and industrial development and finally ending in industrial exploitation and commercialization. The Key Actions focused on targeted socio-economic needs and on the Community's policy objectives, where European research should make a decisive contribution with innovative products, processes or services.

The "Cell Factory" was one of the six Key Actions identified and its objective was the industrial mastery of the cell as a factory, with the aim of developing new types of drugs, foodstuffs with specific nutritional properties, techniques for biodegradation of recalcitrant compounds, industrial enzymes able to replace less environmentally friendly chemical processes, etc. The overall objective of the Cell Factory, which had a budget of ca. €400 million, was to integrate innovations into living cells (microbial, plant and animal cells) and into their products. Thus, it was expected that they would provide an environment in which results could rapidly be exploited and transformed into products and processes of interest to society. The societal spin-offs were foreseen to be particularly visible in health, the environment, food, agriculture, agro-industries and high value-added products. In contrast with previous Framework Programmes, which were mainly science-driven, the Cell Factory, took a different approach which consisted of putting forward the main socio-economic objectives addressed by the Key Action, together with the anticipated deliverables to society. In order to attain such objectives and deliverables, the Key Action encouraged the mobilisation of any kind of research or technological development, including demonstration activities geared to the maximization of exploitation of research results. In short, from the socio-economic problem, back to basic science and then to exploitation. The challenges that for the first time were addressed in an EU Framework programme by the Cell Factory were:

1. Promoting the development of innovative technologies and mobilising mission-oriented research,
2. Exploitation of results, and
3. Linking the ability to discover to the ability to produce.

These challenges were concomitantly linked to a number of expected deliverables of socio-economic interest. In particular:

1. Improving the diagnostic and therapeutic arsenal for healthcare
2. Improving environmental sustainability, and
3. Improving quality in food, agro-industry and fine chemicals.

Further information on the Cell Factory Key Action objectives, projects, results, exploitation opportunities, etc., can be found in [9,10].

These changes were not cosmetic in Community thinking. They signalled a profound change of paradigm in developing and managing the EU Framework Programmes. At that time the most visible one was the Strategy on Life Sciences and Biotechnology in 2002 [5] adopted towards the end of the Cell Factory. The Biotechnology Strategy marked a turning point for European biotechnology, which went beyond the implementation of the EU Framework Programmes. It triggered structured and interdependent dialogues with industrial, academic and socio-economic stakeholders, where it addressed managerial, policy development, and competitiveness issues, etc. In 2007, on the occasion of the mid-term review of the Biotechnology Strategy, it was mentioned that the latter should make greater efforts to: focus on promoting research and market development for life sciences and biotechnology applications; foster competitiveness by facilitating knowledge transfer and innovation from the science base to industry; encourage informed societal debates on the benefits and risk of life sciences and biotechnology; ensure a sustainable contribution of modern biotechnology to agriculture; and improve the implementation of the legislation and its impact on competitiveness. The communication on the mid-term review also mentioned that the Biotechnology Strategy would provide "an important step towards a competitive and sustainable Knowledge Based Bio-Economy (KBBE)" [11]. Thus, it can be seen that Commission managers and

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