
Financing Papers

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The role of the European Commission in fostering innovation in the life sciences and biotechnology

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Abstract

Life sciences and biotechnology are fundamental to our ability to meet societal, environmental and economic challenges, be it the healthcare needs of a rich but ageing population in Europe, food security and improved healthcare for the ever-growing populations of the developing world, or the need to transform our economies and lifestyles towards more sustainable patterns. The new knowledge offers many opportunities, and competitive challenge obliges us always to seek to use our knowledge and techniques in ever more efficient and effective ways. To derive maximum benefit from recent and continuing progress in the life sciences and biotechnology, Europe has to invest more and better in research and technological development, and support the creation of a skilled and mobile workforce. Academia–industry links, in particular with small research-intensive biotechnology companies, have to be increased. The capital base of these companies has to be strengthened. Proper conditions for the commercialisation of biotechnology innovations are necessary, such as a science-based regulatory framework, and strong, harmonised and affordable intellectual property protection. Basic ethical and other values – including consumer choice – must be respected. The European Commission can play a major role in fostering innovations in the life sciences sector, through its Framework Programmes for Research and Technological Development, as well as through other policy initiatives implementing a coherent EU strategy for biotechnology and life sciences.

INTRODUCTION: CHALLENGE AND OPPORTUNITY

Modern biotechnology has brought major innovations and improvements in healthcare, food production and the management of our environment. The production of human insulin, erythropoietin, vaccines against hepatitis B and rabies, and coagulation factors for haemophilia free of HIV viruses, or the reduction of pesticide use in improved crops with inbuilt resistance, are just a few examples. Recent and continuing rapid progress in the life sciences and biotechnology offers potential solutions for a large number of societal, environmental and economic challenges;

solutions which so far have not been fully developed:

- genomics and proteomics offer the potential of more effective, personalised and preventive medicines, also meeting unmet needs;
- plants improved by genetic engineering offer more effective production of healthier foods, more efficient production of non-food products such as detergents, surfactants and pharmaceuticals, and improved qualities in paper, wood and pulp products;
- biotechnology can reduce pollution

and waste; lead to more sustainable and cost-effective products and processes; save energy, materials and water; create new materials and fuels from waste; and may partly replace conventional industrial production processes, based on traditional chemistry.

The Lisbon objective for Europe: 'most competitive knowledge based economy in the world' by 2010

With a predicted world market potential of €2000bn for 2010, biotechnology and life sciences are clearly important frontier technologies with the potential to contribute significantly to the objective set by Europe's heads of state at the Lisbon summit,¹ ie to make 'Europe the most competitive knowledge based economy in the world and thereby contribute to growth and employment'.

The Lisbon objective is a bold one, and in its reference to the world context immediately invites comparison with the major competitors – particularly the USA. On matters of regulation in biotechnology, it was decided in 1986, after a decade of debate, that such needs as might arise could be addressed within the competencies and terms of existing statutes and agencies (such as the Food and Drug Administration (FDA), US Department of Agriculture (USDA) and Environmental Protection Agency (EPA); a decision that has not handicapped the subsequent development and competitive strength of biotechnology-based commercial developments in the USA. In terms of research, it is notoriously difficult to define biotechnology in a manner permitting it to be measured; but the US\$28bn annual budget of the NIH² has been a major contributor to US strength, even before adding in the contributions of other agencies.

This paper describes the activities of the European Commission, and in particular those in the research and innovation area, aimed at making full use of the potential of biotechnology and life sciences and at fostering the competitiveness of the related European industries. Comparison with the USA is hampered by the difficulty of producing comparable

statistics, but the R&D expenditure gap is strongly in the US's favour. The EU spends some 1.9 per cent of GDP on research; the US, 2.9 per cent. Of the total European (non-defence) research spend, the EU Framework Programme accounts for only some 6 per cent. On biotechnology regulation, the Europeans have been more cautious: with negative effect on research in particular concerning genetically modified (GM) plants. But all these matters are undergoing current change; not least, under the strategic initiatives discussed below.

RESPONSE: STRATEGY FOR THE LIFE SCIENCES AND BIOTECHNOLOGY

The European Commission: A central player in a fragmented situation

Among the several institutions of the EU, the European Commission holds a unique position: it is not merely the executive arm, but is defender of the Treaties, and has the monopoly of political initiative; a huge responsibility. The Commission services comprise 24 Directorates-General, and coordination of actions between them presents the usual complexities of inter-agency or inter-ministerial action in particular when responding to the opportunities and challenges presented by modern biotechnology, with its multifaceted character, multidisciplinary scientific bases and multisectoral applications. The European situation is even more complex, in that responsibility for legislation and policy is divided between the EU institutions and the member states. The European constitutional arrangements have themselves been in continual evolution over the past several decades, not least in the number of countries in the Union, and in the successive changes in the respective powers of the directly elected European Parliament and the Council of Ministers. The result is that in the life sciences and biotechnology, policy

USA decides: no new regulatory statute needed for biotech

USA outspends the EU in research; fragmented, the EU finds it hard to respond

**EU responses:
increasing EU research
programmes, and
strategic reviews**

**Implementation
demands education,
research, ipr, finance —
and inter-service
coherence**

**Year 2002 sees a new
strategy and a 30-point
Action Plan**

makers in any administration face a diversity of opinions and interests.

Historically, a series of disjointed responses

The European Commission, in common with many national administrations around the world, has been wrestling with the policy challenges of biotechnology since the mid-1970s. In 1981 it decided upon the first research programme, the Biomolecular Engineering Programme (BEP), with a modest budget of €15m. In parallel, concerns about the conjectural risks of recombinant DNA led to a cautious Council Recommendation advocating national registration of such work. Two decades later, the research programmes have become larger, the risks remain conjectural and much experience has accumulated, most of it positive. During those decades, public policy responses to the challenges and opportunities presented by modern biotechnology have proliferated, not least in the number of agencies involved. Within the European Commission, strategic reviews started in 1983, and have since then surfaced at irregular intervals every few years. But the subject has climbed up the political agenda, and is thus gaining greater attention in administrations, parliaments and the general public – not all of it welcome, certainly not all of it positive.

The current strategy

The European Commission, conscious of the huge potential of biotechnology for addressing economic and societal challenges, and in the context of the Lisbon strategy, decided in early 2001 that a major and wide-ranging review of the topic was required. Extensive internal work, inter-service debate and external consultation culminated in the formulation of a new strategic response. This was presented in February 2002 as a public communication on 'Life sciences and biotechnology – A strategy for Europe'.³

The strategy consists of two parts: a

discussion of policy orientations, and a 30-point Action Plan to transform policy into action. The policy discussion and the points of the Action Plan address ways of harvesting the potential of biotechnology; how to govern life sciences and biotechnology in a responsible manner; the role of Europe in the world, and its responsibility towards global challenges; and how to implement the strategy and achieve coherence across policies, sectors and actors. The action plan addresses actions for the short, medium and long term, to be carried out by the Commission and member states, in collaboration with relevant stakeholders.

The ability to harvest the potential of biotechnology depends upon the availability of an excellent resource base, which includes access to and investment in a well-educated and mobile workforce (Actions 1 and 2 of the Plan), the generation and exploitation of knowledge through more and better investments into research (Action 3), the exploitation of intellectual property (Action 5) and the strengthening of the capital base of the biotechnology industry (Actions 6 and 7). The strategy emphasises public debate between scientists, industry and civil society in order to raise public interest in the developments of biotechnology and to offer early information about potential benefits and possible risks (Action 13).

Policy coherence at national and EU level

Implementation of the action plan is overseen by a broad inter-service group covering the numerous policy interests involved; a 'First annual progress report and future orientations' document was published in March 2003.⁴ In this report, the European Commission indicated that the risk of diverging policies in member states could seriously hamper the effectiveness and consistency of the EU strategy in this field. This is particularly obvious in the field of GM plants. The number of GM organism (GMO) field trial applications in the EU has dropped by 79 per cent since 1998, from 264

EU field trials diminish sharply; GMO research is cancelled

Since the mid-1980s, multi-year Framework Programmes give coherence and visibility to EU R&D efforts; life sciences gain prominence and deliver results

notifications in 1997, to 56 in 2002.⁵ As a consequence, GMO research has been seriously undermined: according to an Institute for Prospective Technological Studies study on scientific and technological developments in GM plants,⁶ 39 per cent of the respondents have cancelled R&D projects on GMOs over the last four years. The prolonged slowdown in R&D for agricultural GMOs has had widespread consequences: small and medium-sized enterprises (SMEs) have stopped participating in innovative plant biotechnology research and large biotechnology companies have relocated research, field trials and commercialisation of new GMOs outside the EU.

R&D: THE ROLE OF THE FRAMEWORK PROGRAMMES

The EC Framework Programmes for research and technological development

The concept of a research policy in the EU – apart from the specific exception of nuclear energy research under the 1957 Euratom Treaty – dates from 1974. In the first decade, individual programmes were proposed, discussed and sometimes adopted one by one, responding to current political priorities. By the mid-1980s, it was felt that there should be a more systematic approach to reviewing the role and objectives of the research expenditures, and the concept was launched of setting them within a multi-annual framework – a concept that has progressively gained stronger legal basis with the passing years. Under the EU treaty, the two main objectives of the Framework Programmes are now clearly defined:

- to strengthen the competitiveness of European industry;
- to support the formulation and implementation of other EU policies:

Financing for biotechnology and life sciences research has increased from 5 per cent of the total budget in the 1st Framework Programme (1984–1987) to 18 per cent in the currently running 6th Framework Programme (2002–2006). A number of major achievements have been made during these two decades, including the initiation of the yeast genome project, to which 92 European laboratories and 400 European scientists contributed through EU financing; this resulted in the publication of the full yeast genome in 1997.⁷ This cooperation led to the establishment of the EUROFAN, the first network dedicated to functional analysis of optical reading frames (ORFs).

EU research on enzymes from extremophiles received a strong push under the BIOTECH I programme in 1993, with 33 partners from 10 member states and Iceland, including two major industrial partners. This research has led to the development of improved enzymes for use in various sectors, such as industrial catalysts (paper and starch industry), cosmetics and diagnostics.

The Sixth Framework Programme (FP6), 2002–6: The ‘European Research Area’ and the thematic priorities

FP6, the Sixth Framework Programme for Research, Technological Development and Demonstration Activities, was approved by the European Parliament and the Council of (Research) Ministers of the EU member states in June 2002,⁸ practically in parallel with the adoption of the strategy for the life sciences and biotechnology. It thus forms an important element of that strategy with respect to the needs for education, training and research: items 1, 2 and 3 in the Action Plan. These will encourage and support the creation of a skilled workforce, foster academia–industry collaborations, create centres of excellence, and support or catalyse a

FP6 is adopted in parallel with a new strategy for life sciences and biotech

FP6, although just 6% of the EU R&D effort, should strengthen the 'European Research Area' by coordination of publicly supported research in Europe

critical mass of research projects in Europe.

With a budget of €17.5bn for the years 2002–2006, FP6 represents only some 6 per cent of overall EU public non-defence research expenditure, although it is one of the major funding sources for transnational collaborative research projects. It also aims to contribute to the creation of the 'European Research Area' (ERA) by improving integration and coordination of the publicly supported research activities in Europe, which suffer the inevitable drawbacks of being fragmented among 15 national research programmes, oriented towards diverse national priorities.

The largest part of the budget will be devoted to support for research projects in seven key thematic priorities of exceptional interest and added value for Europe. For the life sciences and biotechnology, priorities of special relevance are those addressing 'Life Sciences, Genomics and Biotechnology for Health' (Number 1), and 'Food Quality and Safety' (Number 5). Other relevant topics, such as biomaterials, nanobiotechnology, industrial biotechnology and bioremediation are covered under other priorities. The first calls for proposals were published in December 2002.

Thematic priority 'Life Sciences, Genomics and Biotechnology for Health'

The thematic priority 'Life Sciences, Genomics and Biotechnology for Health' aims to integrate postgenomic research with more classical approaches in medicine and biotechnology. Multidisciplinary basic research, combining academic and industrial contributions, will aim to exploit the full potential of the genome in support of applications to human health. This will necessitate the involvement of key stakeholders, for example healthcare providers and physicians, policy makers, regulatory authorities, patient associations, as well as experts on ethical matters.

Another part of this priority is targeted at major diseases such as cancer, cardiovascular diseases, diabetes; rare diseases; resistance to antibiotics; and the poverty-related diseases HIV/AIDS, malaria and tuberculosis.

Thematic priority 'Food Quality and Safety'

The thematic priority 'Food Quality and Safety' addresses key aspects of food quality, safety and consumer concerns along the food chain by adopting a 'total food chain' approach. Topics include the epidemiology of food-related diseases, the impact of food on health, traceability, safer production and processing methods, the impact of animal feed on health, and environmental health risks.

New instruments: Integrated Projects and Networks of Excellence

FP6 introduces two new instruments: Integrated Projects and Networks of Excellence. About two-thirds of the budget will be spent through these instruments, which are intended to create European research projects and centres of excellence of a critical mass that can stimulate innovations.

The **Integrated Project** is an instrument to support objective-driven research, where the primary deliverable is new knowledge. It should aim at either increasing Europe's competitiveness, or addressing major needs in society; its main task is to deliver knowledge for new products, processes and services. Integrated Projects will need to integrate a research component, technological development and demonstration components, innovation-related activities (protection of intellectual property, take-up activities including assessment, trial and validation of new technologies) and training activities, in particular those oriented towards potential users, such as SMEs. A single project may span the whole research spectrum, ie from basic to applied research, combining different disciplines and technologies. The

New priorities integrate genomics and classical approaches for health, and adopt a 'total food chain' approach for food quality, safety and consumer concerns

New research instruments aim at critical mass to stimulate innovations

Overcoming fragmentation, building European leadership

minimum number of participants would be at least three partners from three different member states. Duration would be typically three to five years, and the Commission contribution as a grant to the total budget of the project can be up to several tens of millions of Euros.

Networks of Excellence aim to overcome the fragmentation of European research by bringing together the critical mass of resources and expertise needed to provide European leadership in a particular field. Training, in particular involving or targeted towards SMEs, is an important project component, to help spread excellence beyond the boundaries of its partnership.

Integration of small and medium-sized enterprises

Biotechnology and life science companies play an important role in exploring and exploiting the results of publicly funded academic research. In the USA, which has a more mature and developed biotechnology industry than Europe, biotechnology companies are contributing to about half the innovations in the pharma sector. Although the number of biotechnology companies in the EU has doubled in the last five years and the EU now has more biotechnology companies than the USA, the industry is less developed in terms of employment, research spending and turnover. Creating stronger links between the EU biotechnology industry and academic and industrial research on a large scale, as well as enabling SMEs to be integrated in large projects for specific activities and for a determined duration, are therefore important objectives in order to strengthen innovation capability.

The European Parliament, when deciding upon FP6, recognising the importance of SMEs for innovation and growth in Europe, requested that 15 per cent of the total budget allocated to the thematic priorities be spent on them. In the thematic priorities relevant to the life sciences, whose total budget is €2.94bn

(€2255m for priority 1 and €685m for priority 5), this translates into more than €100m per annum for the next four years – almost double what was spent on SMEs in FP5 (1998–2002).

The size of the new instruments, such as the Integrated Project, will make it likely that only the larger SMEs will be able to manage and coordinate such a project. However, the increased administrative and financial flexibility will make it possible to integrate SMEs at any stage of the project, either directly at the start or through competitive calls at a later stage, when first results become available for purposes of demonstration and take-up. The possibility of financing clinical trials up to phase II can make FP6 particularly attractive to SMEs developing or complementing their pipelines.

Regulations concerning ownership of and access to intellectual property (IP), whether generated within the project ('knowledge') and/or brought into the project by the partners ('pre-existing know-how') are more flexible than in previous programmes. As a specific novelty in FP6, access to relevant 'pre-existing know-how' can be refused, which is particularly important for small, developing companies with a core IP portfolio. Life science and biotechnology companies can therefore play diverse roles: as technology providers and research performers, service providers or technology users. They may also be involved in exploitation, dissemination or training activities.

The Commission is co-financing specific support measures to promote participation and ease integration of SMEs in the framework programme. One of these is co-ordinated by EuropaBio, the European biotechnology industry association.⁹ The Commission is also supporting the organisation of congresses, seminars and workshops or other activities aimed at, for example, the promotion of SME participation or the development of research or innovation strategies and operational support and dissemination to

More flexible rules concerning IP

Increasing the role of SMEs and strengthening links between academic and industrial centres

Reversing the brain drain with attractive grants and tech transfer fellowships

'Technology Platforms' to combine know-how, industry, regulators and financiers in a coherent vision and strategy

Research is one part of the strategy, linking up with the financial community

research in member states and other participating countries.

Human capital and mobility

Europe suffers from a continuing brain drain and the lack of specialised workforce. The Third European Report on Science & Technology Indicators published in March 2003¹⁰ shows that three-quarters of European scientists who receive a US PhD degree decide to remain there; a figure that rose from 49 per cent in 1990 to 73 per cent in 1999. To work against this trend, the budget for human capital and mobility grants of FP6 has been almost doubled from the FP5 value of €858m to €1580m.¹¹ Specific grants to attract high-class researchers to the EU, and technology transfer fellowships that allow companies to host fellows for periods of 4 to 24 months, have been introduced. The latter are particularly attractive for SMEs, not least because the administrative management for this type of instrument is significantly lower than for research projects.

OTHER MEASURES

This paper has focused on the strategic and competitive challenges of modern biotechnology largely from the perspective of research, while recognising that research cannot be conducted in a vacuum but has to form part of a coherent strategy. We have not gone item by item through the 30 points of the Action Plan – the figure itself is one measure of the complexity and the multiplicity of policy interests involved – but we present below two examples of other important elements of strategy.

Strengthening the capital base of the biotechnology industry

In 1997, the European Commission and the European Association of Security Dealers (EASD) set up a 'Biotechnology and Finance Forum' (BFF), with the aim of developing links between the scientific and industrial community on the one hand and the financial community on the other, thereby promoting the

development of the European biotechnology industry. The BFF currently includes representatives of all major stakeholders such as EuropaBio, the European Federation of Biotechnology (EFB), the European Venture Capital Association (EVCA) and the European Investment Bank and Fund (EIB/EIF). A specific working group comprising experts from industry and finance was set up in September 2002 to analyse the financial situation of the EU biotechnology industry.¹² The group estimated that there is a shortage of around €1bn for investments into the EU biotechnology sector in 2003, which will most probably affect young companies disproportionately, as VC investors tend to concentrate on more matured portfolio companies. Recommendations for financial instruments have been proposed to react to this funding crisis, the implementation of which is currently being investigated together with the EIB, EIF and their national counterparts.

Technology platforms

The Commission is currently encouraging the creation of 'Technology Platforms' focused on specific issues, opportunities or technologies which need a combination of technological know-how, industrial interest, and the participation of regulators and financial institutions to develop a strategic agenda. One example under current discussion is a platform for 'Plant Genomics and Biotechnology'. Strategic technology platforms are a tool to develop a coherent strategy for research and innovation, engaging the interest and commitment of all stakeholders through effective public-private partnership. The goal is to develop a shared, long-term vision for the development of specific areas of life sciences and biotechnology which address specific challenges, and a strategy to achieve this vision via action plans to deliver on agreed targets and optimise benefits for all parties. Research plans form crucial parts of such strategies.

The Commission will promote the

establishment of such platforms. The new instruments of the Framework Programme, specific support actions or the ERA-NET activities¹³ may be used to initiate them, or can be integral parts of them.

CONCLUSIONS

The European Commission is currently supporting a range of initiatives to support research and innovation in the life sciences and biotechnology. The Sixth Framework Programme offers specific opportunities for industry-academia research collaboration, with special emphasis on stronger integration of small life sciences and biotechnology companies into research at European level. FP6 is part of a comprehensive strategy for the development of biotechnology and the life sciences in Europe, in response to societal, health, environmental and economic challenges.

Although the Commission has an important role to play in fostering life sciences innovations through action at European level, its strategy paper has also highlighted the importance of a policy approach coherent with action at national and regional levels for the development of biotechnology. The Spring 2003 European Council, aware of deficiencies in this area, has urged member states and the Commission to pursue actively the agreed roadmap and rapidly finalise and implement necessary regulation. It has also called for the strengthening of the European Research and Innovation Area by creating European technology platforms.

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Europe is getting its act together to meet the social, health, environmental and economic challenges

The European Commission will work with the member countries, strengthening the European Research and Innovation Area through new initiatives, including technology platforms

13. FP6 includes a specific programme 'Integrating and Strengthening the European Research Area' from which a new initiative – the ERA-NET Scheme – will be financed, with the

objective of strengthening coordination and cooperation of national and regional programmes (URL: www.cordis.lu/coordination/era-net.htm).