



Overview of industrial biotechnology activities in Europe

Executive summary

EXECUTIVE SUMMARY OF THE OVERVIEW OF INDUSTRIAL BIOTECHNOLOGY ACTIVITIES IN EUROPE

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1. INTRODUCTION

SusChem - the European Technology Platform for Sustainable Chemistry¹ - has developed a "Vision for 2025 and Beyond"² for the development of sustainable chemistry and industrial biotechnology in Europe, followed by a "Strategic Research Agenda"³ giving recommendations on priority R&D topics to be pursued to support the long-term development of this sector.

The implementation of the Strategic Research Agenda started at the EU level with the 7th Framework Programme⁴ and in the Member States and associated countries via their national research programmes, some of them integrated in the "ERA-net for Industrial Biotechnology"⁵. However to develop a competitive Knowledge-Based Bio-economy (KBBE), it was also necessary to understand the barriers to innovation and market access and to develop recommendations to overcome these. This resulted in the "Industrial Biotechnology Policy Agenda for Europe"⁶. This publication was used to prepare the European Commission's Lead Market Initiative for biobased products⁷.

As part of the FP6 specific support action supporting the SusChem - IB Technology Platform, EuropaBio⁸ developed an overview of industrial biotechnology activities in European Member States and associated countries (Croatia, Iceland Norway, Switzerland and Turkey)⁹. Country profiles were prepared with the main objective to obtain a complete picture of the industrial biotechnology situation in terms of research and policy at Member State level. The overview also helped in identifying gaps and best practices in terms of support and promotion of white biotechnology and biobased products.

The first part of the report explains the methodology used to collect the information. The second part of the report is an analysis of what is happening in Member States to support industrial biotechnology research and the introduction to the market of biobased products as well as their commercialization.

¹ <http://www.suschem.org> SusChem brings together a wide spectrum of organisations and individuals looking to boost sustainable chemistry, industrial biotechnology and chemical engineering research, development and innovation in Europe. It seeks to boost chemistry, biotechnology and chemical engineering research, development and innovation in Europe.

² http://www.europabio.org/TPWhite/IB_Vision.pdf

³ http://www.europabio.org/TPWhite/SRA_final_141206.pdf

⁴ <http://cordis.europa.eu/> The Seventh Framework Programme for research and technological development (FP7) is the European Union's chief instrument for funding research over the period 2007 to 2013.

⁵ <http://www.era-ib.net> In the European Research Area network (ERA-NET) "Towards an ERA in Industrial Biotechnology" partners from 12 different countries join forces to reduce fragmentation of national research efforts in the area of Industrial Biotechnology.

⁶ http://www.europabio.org/TPWhite/policy_agenda_web.pdf

⁷ <http://ec.europa.eu/enterprise/leadmarket/leadmarket.htm>

⁸ <http://www.europabio.org> EuropaBio is the European Association for Bioindustries. It has 79 corporate and 5 associate members operating worldwide, 5 Bioregions and 25 national biotechnology associations representing some 1800 small and medium sized enterprises.

⁹ http://www.bio-economy.net/bioeconomy/member_states/index_bioeconomy_member_states.html

2. METHODOLOGY

Information was mainly collected through a survey¹⁰ developed by EuropaBio – the European Association of BioIndustries. This survey addressed research and development (R&D) and policy measures.

The research portion was dedicated to public research funding and pilot and demonstration facilities.

- Public research funding: What kind of public research funding is available for industrial biotechnology and/or biobased products? Is there a specific research programme in this area? If so, what is the yearly budget? Does the Member State take part in the ERA-net IB?
- Pilot and demonstration facilities: Are there any multipurpose, flexible pilot plants in the Member State with the aim to scale-up individual processes? What funding is available? In which areas? Are Member State and/or private investors developing demonstration plants? What funding is available? In which areas?

The second part of the survey mainly addressed policy instruments underlined as key elements in the Lead Market Initiative for biobased products to promote the quick take-up of innovations.

- Policies and regulations: did the Member State develop specific legislation/regulations to support the development and/or market penetration of biobased products? Is there space for improvement?
- Public procurement: Is there a National Action Plan on Green Procurement and are biobased products part of the plan? Did the Member State integrate measurable technical specifications or other characteristics such as biomass content?
- Standardisation, labelling and certification: Is the Member State using standardisation, labelling or certification to overcome perceived uncertainty about product properties and weak market transparency? Is there a national label (eco-labelling, sustainability, etc.) for some biobased products? If so, what are the criteria? Has the industry developed a voluntary certification or labelling scheme (e.g. sustainability, biodegradable, compostable, biobased, etc.)?
- Financing: have measures been developed to support access to finance for biobased products? For investment in demonstration plants? Other initiatives?
- Communication: are there any national communication initiatives in the area of biobased products? Did the Government initiate other communication actions to support biobased products? Did the industry develop other actions?

The survey was sent to several stakeholders active in (industrial) biotechnology:

- National biotechnology associations, members of EuropaBio¹¹
- National delegates of the knowledge-based bio-economy (KBBE) network from the European Commission, DG Research
- National delegates of the competitiveness in biotechnology network from the European Commission, DG Enterprise
- National contact points for the theme Food, Agriculture and Fisheries and Biotechnology in the 7th Framework Programme for Research and Development
- Participants of the roundtables on industrial biotechnology organised by EuropaBio in new Member States and associated countries
- Some national research agencies and institutes
- Other stakeholders.

Information was also found on several websites and in reports.

¹⁰ http://www.bio-economy.net/bioeconomy/member_states/files/master_form_survey.doc

¹¹ http://www.europabio.org/eu_NAC.htm

On the basis of the collected information, draft country profiles were developed by EuropaBio. The draft country profiles were then sent to those who had completed the survey for their approval and corrections.

This executive summary is based on information from the country profiles.

3. RESEARCH

Mankind has benefited from biotechnology for a long time, but with the recent progress of new technologies and a much deeper understanding of cell metabolism and materials science, many new opportunities have been identified, and others are continuing to emerge. Modern White Biotechnology is a relatively new discipline, with major areas of knowledge still to be explored. Public support to research as well as the establishment of pilot and demonstration facilities to scale-up individual processes will therefore help in the development of a European biobased economy.

3.1. Public research funding

Specific public research funding for industrial biotechnology is very limited in the Member States of the European Union. Only a few countries are running dedicated industrial biotech research programmes. Some are funded via general biotechnology research programmes or supported via parallel programmes (such as energy, agriculture, etc.) but the large majority of white biotech research projects are still supported through general research funding schemes.

3.1.1. Industrial biotechnology dedicated research programmes

Finland, the *Netherlands*, *Sweden*, the *United Kingdom*, *Lithuania* and *Poland* are the only Member States where dedicated research programmes for industrial biotechnology are running. The two countries where the funds allocated to industrial biotechnology programmes are the highest are Finland and the Netherlands.

In *Finland*, *SymBio - Industrial Biotechnology*¹² from Tekes¹³ (The Finnish Funding Agency for Technology and Innovation) has a budget of €80 million over five years (2006-2011). Both companies and research organisations can take part in the programme. The aims of the programme are to create competitive industrial processes, new products and services using biotechnology; to enhance the environmental friendliness of industrial processes, to create new business opportunities in the fields of industrial production and environmental biotechnology and to boost the transfer of research results into technology and new products.

Also in *Finland*, the *BioRefine*¹⁴ (Tekes) programme has allocated €137 million for 2007-2012 to the development of innovative technologies, products and services based on national strengths and related to biorefineries and the processing of biomass in general for the international market. It also promotes the development and use of second-generation production technology in biofuels for transport.

In the *Netherlands*, the NWO¹⁵ (The Netherlands Organisation for Scientific Research) supports two programmes for a total budget of € 63.6 million. The first, *IBOS - Integration of Biosynthesis and Organic Synthesis*¹⁶ programme (2003 to 2010) has a budget of € 13,6 million (€ 2,27 million from NWO General Board and € 2,27 million from NWO Chemical Sciences, Ministry of Economic Affairs € 4,54 million, chemical and life sciences industry € 4,54 million). The main objective is to integrate state of the art organic chemistry with modern biochemistry and biotechnology. The second programme, *B-Basic - Bio-based Sustainable Industrial Chemistry*¹⁷ (2004-2009) has a total budget of €50 million (Ministry of Economic Affairs €25 million, industrial B-Basic partners

¹² <http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/SymBio/en/etusivu.html>

¹³ <http://www.tekes.fi/eng/>

¹⁴ <http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/BioRefine/en/etusivu.html>

¹⁵ <http://www.nwo.nl>

¹⁶ http://www.nwo.nl/nwohome.nsf/pages/NWOA_6NSGQQ_Eng

¹⁷ <http://www.b-basic.nl/>

€12 million and participating universities and research institutes €13 million). It aims to perform fundamental and applied scientific research in order to provide the chemical industry with an advanced set of tools and concepts by approaching biobased sustainable industrial chemistry in a fully integrated manner, combining functional genomics, intensified bioprocess technology and novel feedstock scenarios. Finally, *CatchBio - Catalysis for Sustainable Chemicals from Biomass*¹⁸ (2007-2015) operates in the field of catalytic biomass conversion. It aims to process the various components present in biomass (cellulose, hemi-cellulose, lignin, proteins and oils) in useful fuels, chemicals and pharmaceuticals. CatchBio is a collaborative programme of universities and industry with a total budget of €29 million; €15 million is subsidized by the Ministry of Economic Affairs.

Other research programmes dedicated to industrial biotechnology in EU Member States can be found in Western and Eastern Europe including *Lithuania* where In October 2006, the government approved the *National Industrial Biotechnology Development programme*. The programme is allocating €8,7 million to research from 2007 to 2010. The objectives of the programme are to develop technologies for obtaining chemicals from biomass; to develop biotechnological products and biodiagnostic methods for industry, agriculture, and healthcare; to explore and to develop biocatalysts and biotechnological processes and to use local materials suitable for industrial biotechnology more effectively and to develop new biomass sources. €1,2 million and €1,7 million were granted in 2007 and 2008 to projects submitted by research institutions together with business entities.

In *Sweden*, Vinnova¹⁹ (The Swedish Governmental Agency for Innovation Systems) has a programme dedicated to industrial biotechnology²⁰ which aims to stimulate research and development and the implementation of industrial biotechnology in various sectors in order to promote more environmentally-friendly processes linked to economic growth. SEK 50 million (around €4,6 million²¹) was granted in the first call as project support in 2008. Vinnova also runs a programme named “VINNVÅXT”²² supporting biorefineries. In June 2008 the agency granted SEK 13 million (around €1,2 million²³) to a project called “The future biorefinery”.

Finally, in the *United Kingdom*, a product development partnership led by Bioscience for Business KTN²⁴ has just been launched. *Integrated biorefining technologies initiative*²⁵ - IBTI is a programme consisting of leading industries, government departments and research councils which will define the research and development and demonstration needs of biorefineries for industrial production. £5 million (around €5,6 million²⁶) will be allocated to support a strategic R&D programme in biorefining research.

3.1.2. General programmes supporting biotechnology and side programmes

In several countries, the biotechnology sector (healthcare, agri-food and industrial) has been identified as a key priority in term of R&D and innovation. Biotechnology is seen as an important opportunity for further economic development and job creation. Through funds allocated to these programmes, industrial biotechnology researchers can apply for support. Researchers can also find funding in several research programmes which are related to industrial biotechnology (side programmes) such as agriculture, energy, environment, etc.

¹⁸ <http://www.catchbio.com>

¹⁹ <http://www.vinnova.se>

²⁰ www.vinnova.se/In-English/Activities/Biotechnology

²¹ Mid-December 2008

²² <http://www.vinnova.se/In-English/Activities/Strong-research-and-innovation-environments/VINNVÅXT/>

²³ Mid-December 2008

²⁴ www.biosciencektn.com

²⁵ http://ktn.globalwatchonline.com/epicentric_portal/site/bfb/menuitem.ecb64364566d6990043ae2c68380e1a0/

²⁶ Mid-December 2008

In *Spain*, biotechnology has been identified as one of the five strategic actions (healthcare; energy and climate change; nanoscience and nanotechnology, new materials and new industrial processes; telecommunications and information society; biotechnology) in the Spanish National Plan for R&D&I 2008-2011²⁷. The action plan's budget dedicated to biotechnology for the period 2008-2011 is € 5.7 million, of which one third will be for Industrial Biotechnology.

In *Denmark*, the EUDP program²⁸ - Programme for Energy Technology Development and Demonstration - aims to strengthen development and demonstration within energy technology. The total budget for 2007-2010 is DKK 713 million (around €95,7 million²⁹) of which DKK 200 million (around €26.8 million³⁰) must be spent on second generation biofuels. A specific project on the development of second generation bioethanol is running at the moment with a budget of approximately €3 million³¹.

In the *United Kingdom*, in addition to a specific programme for industrial biotechnology, *The Biotechnology and Biological Sciences Research Council*³² (BBSRC), sponsored through the UK Government's Office of Science and Innovation, invests £336 million (around €376 million³³) a year in biotech. This funds research scientists working in universities and in eight research institutes and funds programmes that promote knowledge transfer, industrial collaboration, business start-ups and intellectual property protection.

In *Estonia*, in the beginning of 2009, the government launched a thematic R&D programme on biotechnology. Biotech was identified as one of the key technologies in the R&D and innovation strategy 2007-2013 "Knowledge-based Estonia"³⁴. Researchers in the field of industrial biotech will be allowed to apply for support.

3.1.3. General support to research and development

Support for industrial biotechnology research projects is also available via general support schemes for R&D. Often this support is granted through open competitive calls to which scientists have to apply. Those support schemes exist in all Member States. They are either centralised (via national research agencies) or spread among many institutions.

As an example, in *Germany*, industrial biotechnology researchers can obtain support from different ministries and funds. Major sources of funding for biotechnology in Germany are:

- The German Federal Ministry of Education and Research (BMBF)³⁵
- The German Federal Ministry of Economy and Technology (BMWi)³⁶
- The German Research Foundation (DFG)³⁷
- The Trust Association for German Science which is composed of several foundations³⁸
- The German Academic Exchange Service (DAAD)³⁹

In *Switzerland*, research support is centralised by the Swiss National Science Foundation (SNSF)⁴⁰ which funds projects for basic research⁴¹. Applications are accepted twice a year

²⁷ http://web.micinn.es/contenido.asp?menu1=1&menu2=0&dir=03_Plan_IDI/00-LIAs

²⁸ <http://www.ens.dk/sw16603.asp>

²⁹ Mid-December

³⁰ Idem

³¹ Ibidem

³² <http://www.bbsrc.ac.uk>

³³ Mid-December

³⁴ <http://www.hm.ee/index.php?popup=download&id=7669>

³⁵ <http://www.bmbf.de/en/index.php>

³⁶ <http://www.bmw.de>

³⁷ <http://www.dfg.de/en/>

³⁸ <http://www.biotechnologie.de/BIO/Navigation/EN/Funding/national.html>

³⁹ <http://www.daad.org/>

⁴⁰ <http://www.snf.ch/E/Pages/default.aspx>

⁴¹ <http://www.snf.ch/E/funding/projects/Pages/default.aspx>

(March and October) and must be submitted directly by researchers. Any researcher working in Switzerland is entitled to participate and researchers are free to choose their research topics. The central criteria for evaluation are the scientific quality, originality and project methodology as well as qualifications and track record of the applicants. Grants are awarded on a competitive basis.

3.1.4. European Research Area network for Industrial Biotechnology (ERA-net IB)

As research is often very fragmented in Europe, the European Union has established ERA-nets (European Research Area networks) with the objective of further enhancing the collaboration between national research agencies and institutions. Under the ERA-net scheme, national and regional authorities identify research programmes they wish to coordinate or open up mutually. ERA-IB⁴² is an ERA-net funded by the European Community's sixth Framework programme. Ten Member States as well as two associated countries are member⁴³ of the ERA-net IB and four (plus one associated country) are observer⁴⁴. Their central objective is to network research activities carried out at the national level in the field of industrial biotechnology to reduce fragmentation of national research efforts in this area and better use scarce resources in the field. A first call was published in 2008.

⁴² <http://www.era-ib.net>

⁴³ Belgium, Croatia, Denmark, France, Germany, Israel, the Netherlands, Poland, Portugal, Romania, Spain and the United Kingdom

⁴⁴ Finland, Italy, Norway, Slovenia and Sweden

3.2. Pilot and demonstration facilities

A database is available on the bioeconomy website (www.bio-economy.net) giving an overview of the existing pilot and demonstration plants in the European Union and associated countries. This database is based on information collected via the survey on industrial biotechnology and complete data already gathered by the knowledge based bio-economy network (KBBE-net).

In this database, pilot and demonstrations facilities can be selected via different search criteria: country; type (pilot or demonstration) and accessibility (open to all, partly open or closed). Those criteria can be combined while searching. Users can also search pilot and demonstration plants by name or via an open search engine.

4. POLICY

Industrial or white biotechnology has the potential to form the basis of a future EU knowledge-based bioeconomy and make European society both more sustainable and more competitive. But to realise this potential, a number of policy steps must be taken. Public authorities can promote the quick uptake of innovation by implementing a number of “instruments” or policy initiatives. This can include the improvement of the regulatory framework; the integration of biobased products in public procurement programmes; the establishment of standards, labels and certification schemes; the development of financial instruments and support mechanisms to increase investments into research, technology development and innovation, and the elaboration of a communication and information campaign to explain the benefits of biobased products to users.

4.1. Policies and regulations

Markets for biobased products are affected by policies and legislation from a number of different policy areas, in particular agriculture, environment, transport, energy, health, industry and research. Regulation has a clear role to play. Supportive regulation can provide incentives for the biobased product market area but “bad” regulation can impede the development of a dynamic biobased economy and the introduction of new biobased products on the market.

Biomass, industrial biotechnology and the biobased economy in general have been at the centre of several background documents and working groups for the past five years in Europe. However, there are very few strategies or policies dedicated to industrial biotechnology and the biobased economy in Member States. In most of the cases, Member States only have strategies supporting biotechnology as a whole (agri-food, healthcare and industrial) and do not specifically mention biobased products and the biobased economy.

4.1.1. Background documents and working groups on industrial biotechnology and the biobased economy

Some EU Member State Governments have designed background documents on the biobased economy and the use of biomass. Those reports usually address the sustainable production of biomass, the challenges of industrial biotechnology and the opportunities in terms of economic growth and job creation. A number of working groups and technology platforms discussing the future of industrial biotechnology and necessary policy measures have also been created or are being establishment.

In 2005, the *Belgian* Government established the “*Belgian Interdisciplinary Platform for Industrial Biotechnology*” – BIPiB to promote industrial biotechnology in Belgium and to define a long-term strategy for white biotechnology in Belgium. The platform published its report in March 2006⁴⁵ but the recommendations have not yet been implemented.

In *Germany*, the Government published a brochure on white biotechnology - *Weißer Biotechnologie*⁴⁶ as part of its high-tech strategy in 2007. The brochure discusses the opportunities that industrial biotechnology offers and aims at helping establish relevant policies and support measures. This has resulted in several policy initiatives.

In the *Netherlands*, the Government published a vision document on the opportunities that high-grade biomass applications offer to Dutch industry and the need to produce biomass sustainably.

⁴⁵ The BIPiB report is available on: http://www.belspo.be/belspo/home/actua/2006_03_30_BIPiB_en.pdf

⁴⁶ http://www.bmbf.de/pub/weisse_biotechnologie.pdf

This vision document was accompanied with a Policy Agenda⁴⁷ on sustainable biomass (more efficient use of biomass; sustainable biomass production; encouraging the production of green gas and sustainable electricity; market developments).

The Dutch Government also published a vision document on the biobased economy during the energy transition^{48,49} in October 2007. The vision paper identifies challenges and opportunities for the Netherlands and Dutch companies. From the Government's point of view, the development of the biobased economy is driven by the desire to strengthen the economic competitive position of the business sector, to address the problem of climate change, to reduce waste and the distribution of environmentally hazardous substances and to be less dependent on oil.

In the *United Kingdom*, the Department of Trade and Industry - DTI (now BERR⁵⁰) established in October 2004 the Biomass Task Force with the challenge "to assist the Government and the biomass industry in optimising the contribution of biomass energy to renewable energy targets and to sustainable farming and forestry and rural economy objectives". The Task Force concluded that biomass – in its diverse forms – has the potential for contributing strongly to the UK's renewable energy and climate change objectives, and that much of this potential is currently unrealised. In 2006, the Government responded to the task force⁵¹ and provided further details on how the UK intends biomass to contribute to renewable development. The Government asked the Task Force to concentrate on the use of biomass for heat and electricity generation, while taking account of biofuels for transport and other non food uses of crops in so far as cross-cutting issues arose.

The UK Department for Business, Enterprise & Regulatory Reform - BERR has also facilitated an *Innovation and Growth Team on Industrial Biotechnology (IB-IGT)*⁵², an industry led project. It was formed to produce a collective view from the UK chemical and bioscience industries on the challenges of Industrial biotechnology and will report during the second quarter of 2009 with advice on finance, procurement, labeling, life cycle analysis (LCA) and policy issues relating to industrial biotechnology.

In *Italy*, the Government established a Committee for Biosafety, Biotechnology and Life Sciences in 1998⁵³. In 2005, the Committee set up a working group on industrial biotechnology which developed several documents on industrial biotechnology and its potential⁵⁴ for the traditional industry sectors, such as chemistry, textile and food. The working group was reviewed at the end of 2007. It is now comprised of members of the scientific committee of the industrial biotech section of the Italian technology platform for sustainable chemistry and Italian industrial biotech and chemical industries. The working group identifies short term R&D priorities including priorities in the areas of integrated biorefineries for agro-food bio-products and environmental biotech for the remediation of contaminated sites, etc. The working group also aims to promote national policies and regulations that support the biobased economy in general.

In July 2006, *Lithuania* established a National Biotechnology Platform (LNBP) under the leadership of the national biotechnology association. The platform brings together 13 academic partners and 15 industrial partners. One of its two priorities is *industrial biotechnology and agro-biotechnology*. The objectives in this area are to reduce the dependence of Lithuania upon the imports of non-renewable raw materials via a more efficient utilisation of the available agricultural and forestry resources, reduction of environmental pollution and the "green-house" effect, and the expansion of the share of modern technologies in the Lithuanian economy. The platform is deeply

⁴⁷ <http://appz.ez.nl/publicaties/pdfs/04EP06.pdf>

⁴⁸ http://www.minlnv.nl/cdlpub/servlet/CDLServlet?p_file_id=21862

⁴⁹ http://www.minlnv.nl/cdlpub/servlet/CDLServlet?p_file_id=14937

⁵⁰ <http://www.berr.gov.uk/>

⁵¹ <http://www.berr.gov.uk/files/file28197.pdf>

⁵² www.berr.gov.uk/whatwedo/sectors/biotech/IBIGT/page44395.html

⁵³ <http://www.governo.it/biotecnologie/>

⁵⁴ <http://www.governo.it/biotecnologie/documenti.html> (cf. 2006)

involved in drafting a long-term strategy for the development of the industrial biotechnology and pharmaceutical products sectors in Lithuania.

Other countries have also established technology platforms dedicated to biotechnology (e.g., Poland); national technology platforms in the framework of the European technology platform for sustainable chemistry⁵⁵ (United Kingdom, Germany, Spain) or are in the process of creating such networks. For example, Turkish white biotech actors are looking to establish a national platform for the KBBE.

4.1.2. Strategies and policies dedicated to industrial biotechnology

Poland and the United Kingdom are the only countries in the European Union and in associated countries⁵⁶ where a strategy for industrial biotechnology has been decided at the Government level.

In March 2008, the Polish Ministry of Science and Higher Education adopted the “Action plan: towards the development of industrial biotechnology in Poland”⁵⁷. The action plan addresses mainly two types of activities: R&D activities and system activities (policy). Regarding policy aspects, the action plan aims to improve legal regulations and to initiate legislative and administrative activities to further support the biobased economy.

In the United Kingdom, DEFRA⁵⁸ and DTI (now BERR⁵⁹) published a “*A strategy for non-food crops and uses - creating value from renewable materials*”⁶⁰ in 2004. The Strategy action plan covers areas such as tackling climate change, funding more scientific research and increasing the use of sustainable products. In November 2006 the Strategy Project Board published its report⁶¹ on the delivery of the first two years of the Strategy and in May 2007, the Government responded⁶² to this evaluation by refocusing the action plan for developing the strategy though the end of 2009. The Government noted that bioenergy has seen most progress over the last two years. He noted that to achieve a low carbon economy, the development of biorefineries to provide a sustainable manufacturing base for energy, fuels, biomaterials and chemicals is central.

4.1.3. Support to biotechnology in general

Several EU Member States have developed global strategies and policies supporting biotechnology as a whole.

In *Germany*, the High-Tech Strategy for Germany⁶³ was developed in 2007 through a joint effort by all federal government departments. The strategy aims to create a climate where ideas can be “ignited” and where research results can be translated into products, processes and services. The High-Tech Strategy defines 17 key sectors, of which biotechnology is one, where Germany wants to create lead markets with the objective of improving the cooperation between science and industry as well as accelerating direct application of research findings.

⁵⁵ <http://www.suschem.org/>

⁵⁶ Iceland, Norway, Switzerland, Croatia, Turkey and Israel

⁵⁷ [http://www.bio-](http://www.bio-economy.net/bioeconomy/member_states/poland/files/workshop_files/IB_in_poland_stanislaw_bielecki.pdf)

[economy.net/bioeconomy/member_states/poland/files/workshop_files/IB_in_poland_stanislaw_bielecki.pdf](http://www.bio-economy.net/bioeconomy/member_states/poland/files/workshop_files/IB_in_poland_stanislaw_bielecki.pdf)

⁵⁸ <http://www.defra.gov.uk>

⁵⁹ <http://www.berr.gov.uk>

⁶⁰ [http://www.defra.gov.uk/farm/crops/industrial/pdf/nfc-](http://www.defra.gov.uk/farm/crops/industrial/pdf/nfc-strategy.pdf#search=%22%22nfc%22%20%22non%20food%20crops%22%22)
[strategy.pdf#search=%22%22nfc%22%20%22non%20food%20crops%22%22](http://www.defra.gov.uk/farm/crops/industrial/pdf/nfc-strategy.pdf#search=%22%22nfc%22%20%22non%20food%20crops%22%22)

⁶¹ <http://www.defra.gov.uk/farm/crops/industrial/pdf/nfc-progress-0611.pdf>

⁶² <http://www.defra.gov.uk/environment/climatechange/uk/energy/renewablefuel/pdf/nonfoodstrat-2yearreview.pdf>

⁶³ http://www.bmbf.de/pub/bmbf_hts_lang_eng.pdf

In *Estonia*, the Government defined biomedicine as one of the three key areas for the country's economy in the "the Estonian Strategy for Research and Development 2002-2006". The document covering 2007-2013 has extended the status of "strategic key technology" to biotechnology in general. The aim of the current strategy document is to increase R&D investments to 3.0% of GDP.

4.2. Public procurement

“Public procurement” spending represents 16% of EU GDP, but reaches 40% of spending on construction and almost 100% on defence, civil security and emergency operations. Mobilising public authorities to act as 'launching customers' by promoting the use of public procurement practices supportive for innovation is therefore a frequent point in action plans⁶⁴ aiming at strengthening a sector.

Green public procurements are encouraged⁶⁵ by the European Commission to support the introduction of greener products and promote more sustainable modes of production and consumption. According to a study of 2005⁶⁶ seven EU Member States (Austria, Denmark, Finland, Germany, Netherlands, Sweden and UK) are implementing more elements of green public procurement than the twenty other Member States. Since then, some other Member States, such as Italy, are discussing the introduction of environmental criteria in their system. However, if they are making efforts to green their public procurement scheme, no Member State has included biobased products or integrated measurable technical specifications or other characteristics such as biomass content.

The only initiative attempting to introduce biobased products in public procurement comes from *France*. The French Environment Agency - ADEME has published in July 2005 a guidebook on bio-products⁶⁷. The aim is to help public organisations to include more biomass-based products in their purchasing policies. The guidebook gives buyers information and concrete data about green issues. It presents the 10 main bioproduct applications: biofuels, wood heating, packaging, inks for printing, lubricating oils, building materials, agricultural films, cleaning agents, phytosanitary products, and road-surfacing. Each section includes an overview of the existing market in France and Europe, and of the legal context. The advantages of the vegetal alternatives are summarised, along with the existing commercial offer (suppliers, manufacturers, distributors). Some significant showcases illustrate the possible applications for the French authorities, at local and regional level.

⁶⁴ http://ec.europa.eu/enterprise/leadmarket/doc/com_07_en.pdf

⁶⁵ http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lq=en&type_doc=COMfinal&an_doc=2005&nu_doc=658

⁶⁶ http://ec.europa.eu/environment/gpp/pdf/Stateofplaysurvey2005_en.pdf

⁶⁷ www.bourgogne.pref.gouv.fr/online-media/bourgogne/guide_bioprod_collectivite.pdf

4.3. Standardisation, labelling and certification

A bioplastic is still a plastic and consumers do not see the difference compared to traditional plastics. Standardisation, labelling and certification schemes help in overcoming the perceived uncertainty about product properties and weak market transparency.

Standardisation and certification schemes for biobased products do not exist in EU Member States and associated countries. Regarding labelling systems, several initiatives were launched at European and national level to mention the green aspect of product. However, none are especially designed for biobased products.

4.3.1. At the European level

At the European level, the major labelling system is the community eco-label⁶⁸ which aims to promote products with a reduced environmental impact compared with other products in the same product group. This label also provides consumers with accurate and scientifically based information and guidance on products. It is delivered for a 3 to 4 years period. Biobased products, if they are “cleaner” than other products in the same group, can apply for the eco-label. However, the label does not specify the biobased characteristics of the product.

4.3.2. At national level

In *Germany*, companies can apply for “*Der Blaue Engel*”⁶⁹ which was created in 1978 on the initiative of the Federal Minister of the Interior and approved by the Ministers of the Environment of the national Government and the federal states. It was designed as an instrument of environmental policy which would promote the positive features of products and services by labelling them on a voluntary basis. It sets the standard for eco-friendly products and services selected by an independent jury. However, the label does not communicate specific biobased properties or qualities. Like the community eco-label, it rewards eco-friendlier products compared to similar products in the same group.

In *Norway, Iceland, Sweden, Finland and Denmark*, the *Swan label* applies⁷⁰. This label has been introduced by the Nordic Council of Ministers with the objective to promote more sustainable consumption. In this voluntary system, the applicant agrees to follow a certain set of criteria, outlined by the Nordic ecolabelling system in cooperation with stakeholders. These criteria include environmental, quality and health arguments. The criteria levels promote the most environmentally friendly products and services and take into account factors such as free trade and proportionality (cost vs. benefits). However, the label does not communicate specific biobased properties or qualities.

In *France*, the *NF Environment label*⁷¹ is awarded to products that have a reduced impact on the environment as comparable products while offering equivalent performance. It is a voluntary certification mark created in 1991 as the official French ecological certification. To receive the NF Environment label, the product must comply with specific environmental criteria. These criteria are the result of negotiations between representatives of manufacturers, consumers, environmental protection and distributor associations and public authorities. However, the label does not communicate specific biobased properties or qualities.

⁶⁸ http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Regulation&an_doc=2000&u_doc=1980

⁶⁹ <http://www.blauer-engel.de/en/index.php>

⁷⁰ <http://www.svanen.nu>

⁷¹ <http://www.marque-nf.com>

In *Lithuania*, the “Water lily” label was designed to mark eco-friendly non-food products. However, its use is rather limited and use of the label does not communicate specific biobased properties or qualities.

4.4. Financing

To develop the markets for biobased products, more investment into research, technology development and innovation is needed, as well as financial support for large scale demonstration plants. Pilot infrastructure to demonstrate the technologies and to test new feed-stocks and pre-treatment processes already exist to some extent but need to be complemented by larger scale demonstrators to verify scale-up of processes.

Very few initiatives have been developed by Member States specifically for industrial biotechnology and biobased products. Some Member States have implemented support programmes for the development of new biobased products and bio-processes. However, financing is also available via other support instruments such as the national innovation agencies or programmes targeted at biotechnology in general.

4.4.1. Programmes dedicated to industrial biotechnology

In Germany, the most prominent current funding program in the field of IB is called *BioIndustrie 2021*⁷² and runs from 2006 to 2011 with a budget of €60 million. Additional funding from industrial partners will supplement the total funding volume for research and development projects to more than €150 million. The objective is to bring ideas and research results in the field of white biotechnology from universities and research institutes more quickly to the market. These funds will be channelled mainly through the new BioIndustrie 2021 cluster competition organised by the Federal Ministry of Research and Education (BMBF) which began in the fall of 2006.

The definitive goal of the BioIndustrie 2021 competition⁷³ is to consolidate essential institutions and disciplines (e.g. process engineering, machine and equipment construction, process and control engineering, analytics) into interdisciplinary project teams at an early stage. Strategic clusters that integrate all parties in a network structure are expected to emerge within the framework of the competition. Included in this vision are research institutions, private companies, venture capitalists and banks, which will be cooperating to define their core competencies, develop forms of financing and strategies for future markets, and implement appropriate projects in their common interests.

In *the Netherlands*, the Government has developed several programmes supporting innovation and development in industrial biotechnology.

- The *Innovatieve BioBrandstoffen (IBB) regulation*⁷⁴ is a subsidy program for the development of innovative biofuels. The program supports investments in demonstration plants.
- *The Unieke Kansen Regulation (UKR)*⁷⁵ supports demonstration programs in the field of energy transition, including biofuels, biobased materials etc.
- *The Small Business Innovation Research Program*⁷⁶ (SBIR) is a programme for entrepreneurs developing products or services for societal issues. Contracts are awarded in a three-phase competition: feasibility, research phase and commercialisation. The unique feature of the SBIR programme is that the contracting authority fully funds the first two phases, whilst the resulting intellectual property remains with the company. In 2006, one of the themes was biobased product.

⁷² <http://www.bmbf.de/de/6955.php>

⁷³ <http://www.biotechnologie.de/bio/generator/Navigation/English/funding-and-grants.did=71310.html>

⁷⁴ <http://www.senternovem.nl/Biobrandstoffen/>

⁷⁵ http://overheidsloket.overheid.nl/index.php?p=product&product_id=900166

⁷⁶ http://www.senternovem.nl/english/products_services/encouraging_innovation/small_business_innovation_research_sbir_programme.asp

In the *United Kingdom*, finance and investment will be a workstream for the BERR's recently launched Industrial Biotechnology Innovation and Growth Team (IB-IGT)⁷⁷. The *Bioscience for Business KTN*⁷⁸ is the UK's knowledge transfer network (KTN) in making sustainable use of renewable bio-resources. The Bioscience for Business KTN operates across white, green and blue biotechnology and is designed to meet the challenge of integrating rapid developments in the biosciences with the necessary equipment and process advances, including biocatalytic manufacturing processes to achieve industrial excellence.

4.4.2. General biotechnology programmes and other initiatives

In *Germany* the Federal Ministry for Education and Research (BMBF) is supporting the high-risk development of young biotech companies through the *BioChancePlus*⁷⁹ financial instrument. The BMBF programme makes €100 million available via project funds. Together with a further €150 million in private capital, its objective is to encourage in particular cooperation and networking between companies. The aid is specifically aimed at helping spin-offs and start-ups to prepare themselves for the purpose of bringing new biotech products to market.

With the *GO-Bio*⁸⁰ programme biotech research teams with a good business plan can qualify for support from the BMBF. The fund is making €150 million available over the next ten years and should help researchers to take their ideas from the laboratory to the marketplace.

The *High-Tech Strategy for Germany* allocates €430 million⁸¹ to biotechnology for the period 2006-2009. The Biotechnologie 2021 cluster competition and the BioChance Plus are two programmes benefiting from those funds.

In *Switzerland*, the Swiss Confederation's innovation promotion agency (CTI)⁸² has one initiative targeted to life sciences. The CIT budget for the "Life science R&D programmes" (biotech & medtech) is CHF 60 million (around €39 million)⁸³. Around half of the budget is assumed by the Swiss Confederation, the remaining part is brought together by business partners. The initiative supports applied research and development projects in industrial biotechnology involving both universities and industry.

In *France* the *OSEO*⁸⁴ agency (created in 2005, by bringing together the French innovation agency and the SME development bank) is currently supporting three major projects in the field of industrial biotechnology and biorefinery: BioHub⁸⁵ (€42 million); Osiris (€31,2 million) and Futuro⁸⁶ (€29 million) a second generation bioethanol research and development project.

The *French* Government is also supporting a cluster dedicated to biomass valorisation: *Industrie et Agro-Ressources* (IAR)⁸⁷. The cluster gathers together stakeholders from research, higher education, industry & agriculture in the Champagne-Ardenne and Picardy regions around a shared goal: the value-added non-food exploitation of plant biomass. It is active in the field of bioenergy, biomolecules, biomaterials and food ingredients.

In *Belgium*, the Institute for the promotion of Innovation by Science and Technology in Flanders⁸⁸ (IWT) is supporting several initiatives via its *Thematic Innovation Stimulation*⁸⁹ (TIS) instrument.

⁷⁷ <http://www.berr.gov.uk/whatwedo/sectors/chemicals/ibigt/page44395.html>

⁷⁸ www.biosciencektn.com

⁷⁹ <http://www.bmbf.de/en/986.php>

⁸⁰ <http://www.go-bio.de/>

⁸¹ <http://www.hightech-strategie.de/en/36.php>

⁸² <http://www.bbt.admin.ch>

⁸³ Mid-December

⁸⁴ OSEO was born in 2005, by bringing together ANVAR (French innovation agency) and BDPME (SME development bank). Its mission is to provide assistance and financial support to French SMEs and VSEs in the most decisive phases of their life cycle: start up, innovation, development, business transfer / buy out. By sharing the risk, it facilitates the access of SMEs to financing by banking partners and equity capital investors.

⁸⁵ <http://www.biohub.fr/>

⁸⁶ <http://www.iar-pole.com/index02.php?page=actualite#futuro>

⁸⁷ <http://www.iar-pole.com>

⁸⁸ http://www.iwt.be/iwt_engels/general.html

Currently, two associations (Essenscia Vlaanderen⁹⁰ and FlandersBio⁹¹) and the Ghent Bio-Energy Valley⁹² are supported through the instrument. Projects are financed for a 4 years period by the institute.

In *Finland*, VTT⁹³ and universities receive their basic financing for pilot and demonstration plants from the state budget as they are governmental bodies. Other investments for pilot-scale equipment and other test beds are normally financed from two sources: from the research institutes' own budget (institutional money) and from the Finnish Funding Agency for technology and Innovation (Tekes), which grants money for such investments and related R&D work on the basis of competition. The R&D projects concerned are non-profit, pre-competitive projects that are supposed to benefit the society at large. Companies may also participate in such jointly funded projects (as financier and/or through R&D input).

In *Italy*, a global funding programme to support industry, "*Industria 2015*"⁹⁴, was launched by the Government in 2007 with an overall budget of around €500 million. The programme funds 3 years R&D projects from small and large companies, interested in scaling up promising processes notably in the area of biofuels production, fine chemical and biomaterial production, as well as agro-food byproducts and waste valorization. It plans to co-finance projects up to 50% (up to 75% in the case of demonstration activities) of their costs. Approximately 10% of the calls for proposal are in the industrial biotechnology area.

Finally, in new *Member States*, structural funds represent an important opportunity to allocate funds to pilot and demonstration facilities which may help researchers and enterprises to scale up process and prove the commercial viability of their products.

⁸⁹ http://www.iwt.be/downloads/publicaties/brochure/fiche_vistis_eng.pdf

⁹⁰ <http://www.essenscia.be/EN/essenscia/essenscia+vlaanderen/page.aspx/1250>

⁹¹ <http://www.flandersbio.be/home.asp>

⁹² <http://www.gbev.be/>

⁹³ www.vtt.fi

⁹⁴ <http://www.industria2015.ipi.it/>

4.5. Communication

Industrial biotechnology is an emergent technology and biobased products are quite unknown. Often, decisions makers are not aware of benefits, challenges and opportunities that biobased products represent. It is important to communicate the benefits of biobased products to users, industry sectors which could beneficiate from them and the public at large, in order to get buy-in from all relevant societal groups and market actors. To this purpose, national communication campaigns headed by either industry or the Government are important.

Currently, very few communication campaigns and events on industrial biotech have been set up. Industrial biotechnology actors (researchers and industry) are generally only represented by their biotechnology national associations.

4.5.1. Communication actions on industrial biotechnology

In *Germany*, the chemical industry together with their trade associations VCI⁹⁵/DIB⁹⁶, DECHEMA⁹⁷/VBU⁹⁸, BIO Deutschland⁹⁹, research institutions and the chemical union have created a platform called *Plattform Weiße Biotechnologie – DPWB*¹⁰⁰. It aims to communicate the general benefits of biotech product groups and improvements regarding regulation, market incentives, research, etc. to the general public and to politicians.

In the framework of the Innoempresa programme¹⁰¹, Asebio, the *Spanish* biotechnology association, developed a communication campaign "*La biotecnología como vector de competitividad en sectores maduros*"^{102,103}. This initiative intends to present the different applications and benefits of biotechnology in our daily life as well as in different industrial sector.

In the *United Kingdom*, the National Non-Food Crops Centre¹⁰⁴ (NNFCC) is developing a communications strategy for non-food crops to provide information to the consumer to influence behaviour and support beneficial choices and to industry on new commercial opportunities. The Bioscience for Business Knowledge Transfer Network¹⁰⁵ (BfB KTN) is also promoting a number of events and "webinars" to raise awareness and to bring together researchers and commercial bodies. The Chemistry Innovation KTN¹⁰⁶ is working to promote IB in collaboration with BfB KTN as well.

In May 2008, a Biotechnology week was jointly organized by the *Portuguese* Institute for the Medium and Small Enterprises and Innovation¹⁰⁷ (IAPMEI), the University of Minho and the MIT-Portugal Programme. One day was dedicated to industrial biotechnology (seminar organised by APBio¹⁰⁸, IAPMEI and E-Unlimited¹⁰⁹). The main objectives of this seminar were to increase general awareness of industrial biotechnology and its current and potential benefits; to show to national policy makers EU-wide best practices and their positive effects on developing and supporting sustainable bio-economy and to present the opportunities of industrial biotechnology

⁹⁵ <http://www.vci.de/>

⁹⁶ <http://www.dib.org/>

⁹⁷ <http://www.dechema.de/>

⁹⁸ <http://www.v-b-u.org/>

⁹⁹ <http://www.biodeutschland.org/>

¹⁰⁰ <http://www.weisse-biotechnologie.de/>

¹⁰¹ <http://www.ipyme.org/IPYME/en-US/InnoEmpresa>

¹⁰² <http://www.asebio.com/inno/index.cfm>

¹⁰³ http://www.europabio.org/Education/edu_what.htm

¹⁰⁴ <http://www.nnfcc.co.uk/metadot/index.pl>

¹⁰⁵ <http://www.biosciencektn.com>

¹⁰⁶ www.chemistryinnovation.co.uk

¹⁰⁷ www.iapmei.pt

¹⁰⁸ <http://www.apbio.pt/>

¹⁰⁹ www.e-unlimited.com

to national companies that could largely benefit from it, particularly from the chemical, pulp and paper, forestry, energy, textile, food and drink sectors.

4.5.2. National biotechnology associations

Biotechnology associations representing industry are present in nearly all Member States. It is often the only communication channel that industrial biotechnology actors have used to be represented at national level.

Slovakia is the only country having a specific national association¹¹⁰ for the industrial biotechnology sector. Usually, national biotech association include a white biotech group gathering together all actors.

Other usual ways for industrial biotech actors to be represented are national biotechnology platforms and national platforms of the European technology platform - SusChem¹¹¹.

¹¹⁰ <http://www.slovbiotech.sk>

¹¹¹ <http://www.suschem.org/>