

BioPolis - Inventory and analysis of national public policies that stimulate research in biotechnology, its exploitation and commercialisation by industry in Europe in the period 2002–2005

National Report of Latvia

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Summary

Latvia became independent from the Soviet Union in 1991 and developed into a Parliamentary Democracy. In 2004 Latvia joined the European Union and the NATO. The Latvian economy is among the least performing ones in the European Union. On a per capita basis its GDP is only about 44% of the EU25 average. However, during recent years the Latvian economy enjoyed one of the highest economic growth rates within the European Union, reaching an average annual growth of 8.1% between 2001 and 2005.

Almost 80% of the Latvian GDP growth is due to the development of the service sector. In particular trade, transport and communication are among the fast growing fields. The biggest manufacturing sector in Latvia is the food industry followed by wood processing. Recently, these two sectors are losing their significance, while at the same time other sectors including the chemical and machine-building industries are growing faster.

The R&D performance of Latvia presently also ranks far below the EU25 average. With an R&D intensity of only 0.39% Latvia is positioned close to the end of the European Member States. A reason for this low R&D intensity is the low contribution of the business sector to total R&D investment (only about 22 % in 2002).

Since the early 1990s a number of policy documents aiming at improving the Latvian innovation system was developed. In 1997 areas of national research priorities were nominated including among others organic chemistry, biomedicine and pharmacy. Recently, these priorities have been updated and life sciences and biotechnology have been identified as key areas of future research. Key actors in the current RTD system in Latvia are the Ministry of Education and Science with its Department of Higher Education and Science, the Ministry of Economy, the independent Latvian Council of Sciences which jointly with the Ministry of Education and Research prepares the draft of the Republic's science budget for each year. Important non-governmental organisations include the Academy of Sciences, the Academy of Agricultural and Forestry Sciences, the Union of Scientists and other scientific societies. On the performing side, five full-fledged universities and 29 other research institutes, universities or centres of excellence are active in research.

In Latvia there is a long tradition in chemical research which is also relevant for biotechnology. In addition, biotechnology has been identified as a national research priority. So far, however, there is no specific biotechnology research programme in Latvia. Rather, there is mainly project funding for various biotechnology activities in the framework of generic measures. An important initiative in biotechnology is the Latvian Genome Programme, which was established in 2001. Similar to the Estonian Genome Programme, the goal of this activity is to establish a genome database of the Latvian population and to compare genomic data with clinical information.

The main biotechnology research actors in Latvia are the Institute of Organic Synthesis, a large institution with a research staff of about 180 people which was established in 1957; the Biomedical Research and Study Centre of the University of Latvia which is the larg-

est institution for molecular and biomedical research in Latvia; the Institute of Microbiology and Biotechnology of the University of Latvia; the August-Kirchenstein-Institute of Microbiology and Virology of the University of Latvia; the Research Institute of Biotechnology and Veterinary Medicine of the Latvian University of Agriculture; and the Institute of Experimental and Clinical Medicine, University of Latvia.

Biotechnology research in Latvia is funded by the Latvian Council of Sciences. The council provides policy-directed funding of biotechnology research in the form of project funding. This funding is not specific for biotechnology. The total budget for biotechnology in 2005 was approximately 160 000 EUR corresponding roughly to 7% of the total budget of the Latvian Council of Sciences for project funding. During the period 2002 to 2005 the council provided about 650 000 EUR for biotechnology projects. Funding of the Latvian Council of Sciences is directed towards public research organisations. The main policy goals are to support high level of biotechnology research and knowledge flow and collaboration among scientific disciplines. In line with the general mission of the council, mainly basic research, applied research and research networks are supported by funding. Projects funded via the council are located mainly in the biotechnology application areas plant biotechnology, health and food biotechnology as well as basic biotechnology.

The participation of Latvian scientists in the 6th Framework Programme of the European Commission is rather limited.

Performance data of the national biotechnology innovation system of Latvia are limited to performance of creating a knowledge base and supporting the availability of human resources. The respective indicators show that the publication output from Latvia in biotechnology is rather low. On the other hand, some publications from Latvia gain high attention in the scientific community as indicated by high citation rates. The focus of scientific activities in Latvia is on health biotechnology and on generic biotechnology.

In summary, the current biotechnology funding landscape in Latvia is characterised by very few funding instruments, limited budgets and no specific biotechnology programme. On the other hand, biotechnology has been set as a national priority for research and some far-reaching initiatives like the Latvian Genome Project have been launched. At the moment it is not clear, whether specific biotechnology funding programmes are being developed in Latvia and if so, when it is intended to implement them.

1. Introduction and background

1.1 General introduction

Latvia became independent from the Soviet Union in 1991 and developed into a Parliamentary Democracy. In 2004 Latvia joined the European Union and the NATO. With a population of 2.32M people (2004) Latvia is the second largest of the three Baltic states behind Lithuania (Eurostat 2005)¹. Direct neighbours of Latvia are Estonia, Russia, Belarus and Lithuania.

The Latvian economy enjoyed one of the highest economic growth rates in recent years within the EU. Between 2001 and 2005 GDP grew on an average of 8.1% annually and reached a growth rate of 10.2% in 2005 (Ministry of Economics of the Republic of Latvia 2006)². Production volume increased by 7.9% in 2004 (European Commission 2005)³ and the employment situation improved continuously in Latvia as indicated by an decreasing unemployment rate from 8.5% in 2004 to 7.4% in 2005 (Ministry of Economics of the Republic of Latvia 2006).

While such relative indicators draw a very favourable picture of the development of the Latvian economy, in absolute figures the Latvian economy is among the least performing ones in the EU. In 2005 the GDP reached 11 800M EUR (Eurostat 2005). On a per capita basis this is only 43.7% of the EU25 average (European Commission 2005). Also labour productivity per person employed is only 43.6% of the EU25 average (European Commission 2005).

Almost 80% of the Latvian GDP growth is due to the development of the service sector. In particular trade, transport and communication are among the fast growing fields (Ministry of Economics of the Republic of Latvia 2006). The manufacturing sector contributes to 12.8% of the GDP. Between 2001 and 2005 the manufacturing output has been growing by 7.6% per year. The biggest manufacturing sector in Latvia is the food industry contributing on average a quarter of the total value added in manufacturing. About 80% of the products manufactured in this sector are consumed on the local market, the remaining is exported mainly to the neighbour countries Estonia, Lithuania and Russia. The second largest industrial sector in Latvia is wood processing, comprising approximately one fifth of the total value added in manufacturing. The largest share of the wood production (about 70%) is exported. The significance of these two sectors in total manufacturing output is declining year by year. At the same time other sectors including the chemical and machine-building industries are growing faster.

The R&D performance of Latvia presently also ranks far below the EU25 average. In 2003 the GERD amounted to 39M EUR corresponding to an R&D intensity (GERD by GDP) of only 0.39%, which ranks Latvia close to the end of the European Member

¹ Eurostat, see: <http://www.eurostat.com>

² Ministry of Economics of the Republic of Latvia (2006): The national economy of Latvia: a macro-economic review. http://www.mfa.gov.lv/data/file/en/plitem_file_13777_no27.pdf

³ European Commission (2005): European Trend Chart on Innovation. Annual Innovation Policy Trends and Appraisal Report. Latvia.

States. Only Cyprus (0.33%) presented a lower R&D intensity rate (Eurostat 2005). One reason for the low R&D intensity of Latvia is the low contribution of the business sector to total R&D investment. In 2002 the share of the business sector was only 21.7% of total research investment (Eurostat 2005). Accordingly, one of the main innovation challenges in Latvia is the mobilisation of a stronger business involvement in innovative development.

As in other European Member States biotechnology is considered as an important sector in Latvia. Presently, there are very different estimates of the number of companies that have been set up in recent years. According to an EU source, around 30 biotech companies have been set up recently (European Union 2006). The Latvian Investment and Development Agency lists seven “significant” Latvian biopharma companies. These include service companies providing customised DNA/RNA services, laboratory equipment manufacturers and also manufacturers of pharmaceutical ingredients (Latvian Investment and Development Agency 2005)⁴.

1.2 Characteristics of the national S&T and the innovation system

In the early 1990s many important changes took place in the Latvian innovation system. Among others competitive elements were introduced into funding of R&D. An international evaluation of the status of Latvian science was undertaken in 1992. As a consequence the Latvian Academy of Science which had been founded under the Soviet Regime in 1946 was reorganised and the Latvian Council of Science was created as an independent institution⁵. Within the Ministry of Education and Science the Department of Higher Education and Science was formed as a key actor in the R&D policy-making.

A number of policy documents was elaborated since then. In 1998 a national concept of research and development was formulated by the Ministry of Education and Science and the Latvian Science Council and finally approved by the Cabinet of Ministers in 1998. The national concept comprised a description of the state of research in Latvia, main principles for the development of science and research including the setting of priorities in principle research areas and a working programme for the years 1998 to 2010. In 1997 areas of national research priorities were nominated, including among others organic chemistry, biomedicine and pharmaceuticals. Recently, research priorities have been updated and the following areas have been identified for future research⁶:

- Information technology and telematics
- Life sciences and biotechnology
- New materials and associated technologies
- Environmental protection

⁴ Latvian Investment and Development Agency (2005): Biotechnology and Pharmaceuticals in Latvia.

⁵ www.izm.gov.lv/dokumenti/science/en/04_national/04_02_03.html, accessed. 14th Aug. 2006

⁶ www.izm.gov.lv/dokumenti/science/en/01_introduction/01_01.html, accessed. 14th Aug. 2006

A key policy document is the National Programme for Innovation (2003-2006) approved by the government in 2003 (European Commission 2005). This programme explicitly expresses Latvia's national objectives for innovation. The programme aims at improving the national innovation capacity by

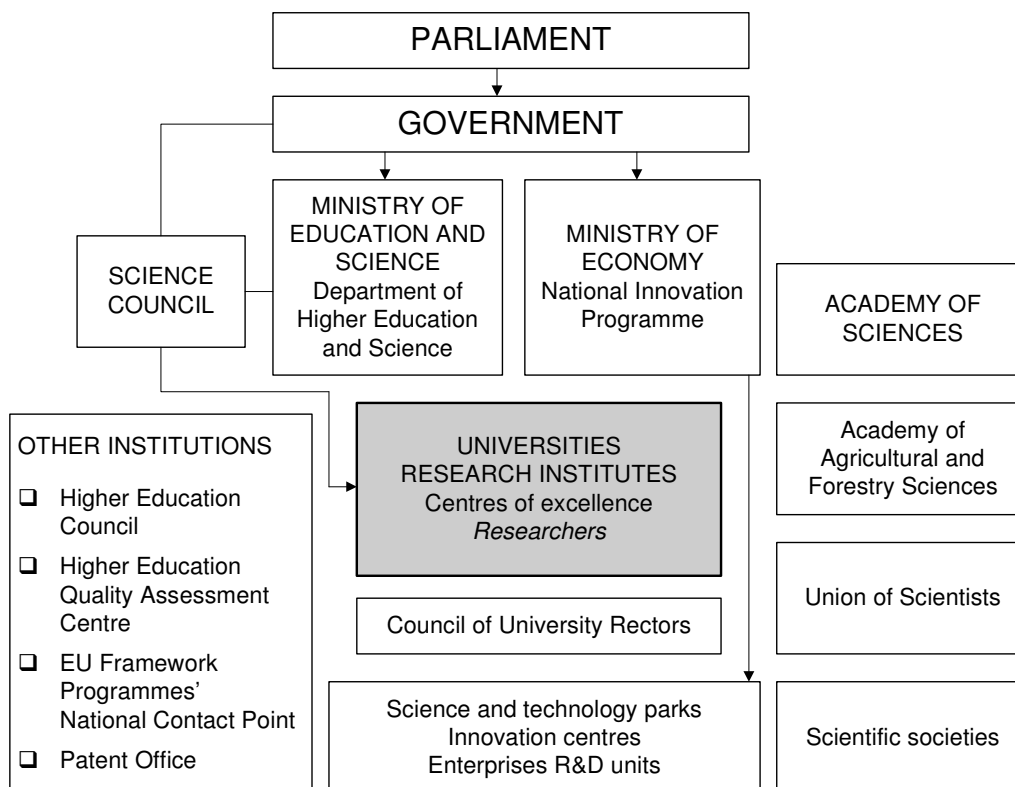
- Developing a harmonised and coordinated innovation-friendly environment,
- Forming a sustainable basis for creation and growth of innovative enterprises,
- Promoting the development of a unique and competitive economic structure.

The main actors in the current RTD system in Latvia are summarised in Chart 1.1 (Bundule 2006)⁷. Accordingly, the key actors at the ministry level are the Ministry of Education and Science with its Department of Higher Education and Science and the Ministry of Economy which is responsible for the National Innovation Programme. The independent Latvian Council of Sciences prepares jointly with the Ministry of Education and Research the draft of the Republic's science budget for each year; it elaborates projects for decisions and laws aimed at development and organisation of science in Latvia. Other institutions include the Higher Education Council, the Higher Education Quality Assessment Centre, an EU Framework Programmes' National Contact Point and a national Patent Office. In addition, non-governmental organisations contribute to the Latvian innovation system. These include in particular the Academy of Sciences, the Academy of Agricultural and Forestry Sciences, the Union of Scientists and scientific societies. On the performing side universities, research institutes and centres of excellence and science and technology parks and innovation centres play an important role.

Latvia has a long research tradition. In 1524 the oldest Library in North-Eastern Europe was founded in Riga, the *Bibliotheca Rigensis*. In 1862 the Riga Politechnical Institute was founded, modelling itself on the ETH Zurich in Switzerland. Famous chemical scientists came from Latvia. In particular, Wilhelm Ostwald, a Riga born chemist was Professor at Riga Politechnic and was awarded the Nobel prize for chemistry in 1909. Paul Walden, another Professor at Riga Politechnic discovered what is known today as the Walden inversion, an important principle of stereochemistry. In 1919 the University of Latvia was founded, in 1939 the Academy of Agriculture. Today research in Latvia is performed in a total of 34 higher education institutions. Among those five are full-fledged universities (University of Latvia, Riga Technical University, Riga Stradins University, Latvia University of Agriculture and Daugavpils University). The others are 15 public specialised universities and university colleges and 14 private higher education institutions. Currently there are about 4,000 researchers in the scientific community in Latvia (European Commission 2005).

⁷ Bundule, M. (2006): Latvian research - integral part of the European research system. Department of Higher Education and Research, Ministry of Education and Science

Figure 1.1: RTD structure in Latvia



Source: BioPolis Research

1.3 National support and framework conditions for biotechnology

As described in the previous section in Latvia there is a long tradition in chemical research which is also relevant for biotechnology. Further, biotechnology has been identified as a national research priority for the period 2002 to 2005. In particular, a focus of biotechnology research should be on biotechnology, biomedicine and organic synthesis with a particular emphasise on gene therapy and new technologies for the synthesis of biological active compounds (Bundule 2006). So far, however, there is no specific biotechnology research programme in Latvia. Rather there is mainly project funding for various biotechnology activities in the framework of generic measures (see section 2).

An important initiative in Latvia is the Latvian Genome Programme which was established in 2001 (Pirags and Grens 2002)⁸. The goal of the programme is to establish a genome database of the Latvian population and to compare genomic data with clinical information. The long-term goal is to develop individual therapies based on genetic characteristics of patients. The project is coordinated by the Biomedical Research and Study

⁸ Pirags, Valdis, Grens, Elmars (2002): Latvian Genome Project - unified genome database of the Latvian population. <http://bmc.biomed.lu.lv/gene/print/Latvian%20Genome%20Project-raksts%20Judith%20Sandor.doc>

Centre at the University of Latvia. All in all, the project is planned for a period of ten years. So far, funding comes from the Latvian Council of Science. In addition, it is planned to use EU structural funds in particular for building up the required advanced infrastructure and equipment for sequencing and data processing/storing activities (Antonovs 2005)⁹. Presently it is difficult to assess the current state of the project since there was no documentation available. Most documents focused on detailed descriptions of the planning of the project.

Finally, it is worth mentioning that Latvia is also member of the ScanBalt, which comprises a network of networks in the Scandinavian region focusing on the advancement of biotechnology in that region (www.scanbalt.org).

Information about the public perception of biotechnology in Latvia can be derived from the latest Eurobarometer's survey 64.3 from 2005 (Gaskell et al. 2006)¹⁰, which included for the first time also the new Member States. Among the new Member States Latvia belongs to the more sceptical countries. For example, the optimism about the potential of biotechnology to improve our way of life in the future is rather modest in Latvia. Among the ten new Member States Latvia ranks with an index value of 60 at the sixths place. The most optimistic Member States are Malta (index 81) and Estonia (index 79). In line with this rather sceptical attitude the support for four specific biotechnologies (nanotechnology, pharmacogenetics, gene therapy, GM foods) is also rather low in Latvia. The country ranks at place 22 among the EU25 clearly below the European average. Support is particularly low for GM food where Latvia together with Cyprus and Greece is most sceptical, and also the approval of embryonic stem cell research is comparatively low in Latvia. In contrast to this rather sceptical attitude towards biotechnology confidence and trust in the governance of science is rather high in Latvia. For example, a clear majority which is above the European average favours the governance of science and technology according to the principle of scientific delegation. Such a system is based primarily on scientific evidence about the risks and benefits involved and relies mainly on the advice of experts. Further, the public confidence in the key actors and institutions involved in biotechnology is also rather high in Latvia. This includes confidence in university scientists, scientists and industry, the European Union, the industry in general and the government.

1.4 Main biotechnology research actors in Latvia

In this section the main research organisations involved in biotechnology R&D in Latvia are summarised.

⁹ Antonovs, Aleksandrs (2005): Development of Latvian Genome Database. Shaping Best Practice. Magdeburg, 5th-7th October 2005

¹⁰ Gaskell, George; Allansdottir, Agnes; Allum, Nick; Corchero, Cristina; Fischler, Claude; Hampel, Jürgen et al. (2006) Europeans and Biotechnology in 2005: Patterns and Trends, Eurobarometer 64.3

Institute of Organic Synthesis (IOS)

The Latvian IOS was established in 1957 to perform research in organic chemistry and molecular biology. The IOS comprised 3 laboratories previously belonging to different institutes of the Latvian Academy of Sciences. With the restructuring of the Academy of Sciences following Latvia's independence in 1991 also the IOS changed its organisation. The Department of Molecular Biology was transformed to the Biomedical Centre of Latvian University (see below) and the size of the institute was reduced considerably. Currently, the staff of the IOS numbers about 310 persons including approximately 180 researchers. The institute has developed a number of pharmaceutical preparations and is cooperating intensively with Latvian and international pharmaceutical enterprises.

Biomedical Research and Study Centre, University of Latvia (BMC)

The BMC is the largest institution for molecular and biomedical research in Latvia. In 2001 the BMC had a staff of 42 permanent researchers. The BMC aims to develop and introduce molecular medicine methods and a nation-wide health monitoring approach to Latvia's health care system. In the fields of protein and genome research it is collaborating with international partners from the EU and the USA. There are a number of research contracts with European biotechnology companies. Besides its own research activities the BMC serves as the Latvian Genome Centre for the collection, storage and analysis of genomic material from the Latvian population.

Institute of Microbiology and Biotechnology, University of Latvia

This institute of the University of Latvia is doing biotechnology-relevant research related to microorganisms, to synthesis and conversion of renewables and microbiological processes and to products in the agro-food and the environmental sector. In 2004 it had an academic staff of 38 researchers.

August-Kirchenstein-Institute of Microbiology and Virology, University of Latvia

The institute is working on the production of recombinant proteins and bacterial systems, on plant physiology and microbiology and on various issues of viral infections. In addition, the microbiology of oil products is investigated.

Research Institute of Biotechnology and Veterinary Medicine (SIGRA), Latvian University of Agriculture

The mission of this institute is to contribute to the availability of high quality, non-polluted, safe and healthy animal origin products. This includes research on the improvement of genetic potential of domestic animal in poultry, breeding approaches, optimising production in the meat and dairy sector and the development of vaccination and new treatment measures for infectious and non-infectious diseases.

Institute of Experimental and Clinical Medicine, University of Latvia

In 2006 this institute had an academic staff of 29 researchers. Main research areas are neuroendocrinology, arteriosclerosis, metabolic syndrome, mechanisms of allergic reactions, cancer, cell biology, stem cells and regeneration.

2. Funding of biotechnology R&D, transfer and commercialisation

2.1 Introduction

Data about biotechnology funding in Latvia were collected through desk research (publications, documents, websites of national and regional public funding organisations and/or governmental departments) and a survey under representatives of funding organisations. The website of the funding organisations and their programs and the names of contact persons that participated in the survey can be found in Annex 3 (List of Contact Persons) and Annex 4 (References).

Biotechnology research in Latvia is funded by the Latvian Council of Sciences. This organisation is the main public research funding authority in Latvia and plays an important role as a semi-governmental decision-making body.

2.2 Policy-directed funding of biotechnology research and commercialisation

Policy-directed funding of biotechnology research is given in the form of project funding via the Latvian Council of Sciences. Funding activities of this agency are divided into 14 branches of science. One of these corresponds to biotechnology in the understanding of the BioPolis project. In particular, research concerned with molecular biology, virology, microbiology and biotechnology is funded. In 2005 all in all 679 projects were funded by the Latvian Council of Science, 42 of these projects were concerned with biotechnology. The total budget for project funding of the agency in 2005 was about 2.2M EUR. The biotechnology share of the 2005 budget was approximately 160 000 EUR corresponding roughly to 7% of the total budget. The total biotechnology budget during the period 2002-2005 of the Latvian Council of Science was about 650 000 EUR.

Project funds are granted on the basis of peer evaluation. In case of positive evaluation, the expert commission suggests the level of funding for each project. The council makes the final decision on funding.

The nature of the project is mainly fundamental and applied research. At the moment there is no support for commercialisation of biotechnology in Latvia. In addition to project funding the Council of Science has also developed funding schemes for support of international cooperation, publishing of books and doctoral studies. However, it is not known to which extent such funding is also used for biotechnology-related activities.

Table 2.1 National and regional public policy-directed biotechnology stimulating instruments during the period 2002-2005

Instrument	Funding organisation	Budget	% of total	Use of DF/SF
National				
<i>Generic</i>				
Project funding	Latvian Council of Science	650.000	100	no

Source: BioPolis Research

2.3 Participation in 6th FP and use of development funds

The participation of Latvian scientists in the 6th Framework Programme of the European Commission is summarised in Table 2.2. Accordingly, in the thematic priority life sciences for health 11 teams from Latvia participated in project teams corresponding to a share of 0.13% of all participants in FP6. There were no coordinators from Latvia in this thematic priority. In nanotechnologies no participation of Latvian scientists took place. In terms of relative contribution, the most significant participation of Latvia in FP6 can be observed in the thematic priority food quality and safety. In this priority one coordinator is from Latvia corresponding to 1.11% of all coordinators and 7 groups from Latvia participated in this priority which is equivalent to a share of 0.44%.

Table 2.2: Involvement of Latvia in biotech parts of the 6th Framework Programme

Sixth Framework Programme ¹	Participations as coordinator	Participations as member of the project team ²
Thematic priority		
1. Life sciences, genomics and biotechnology for health	0	11 (0.13%)
2. Nanotechnologies, section bionanotechnology	0	0
5. Food quality and safety	1 (1.11%)	7 (0.4%)

¹ First and second call, all types of projects

² Persons/groups can participate in more projects, resulting in more participations

Source: BioPolis Research

3. Performance of the national biotechnology innovation system

3.1 Introduction

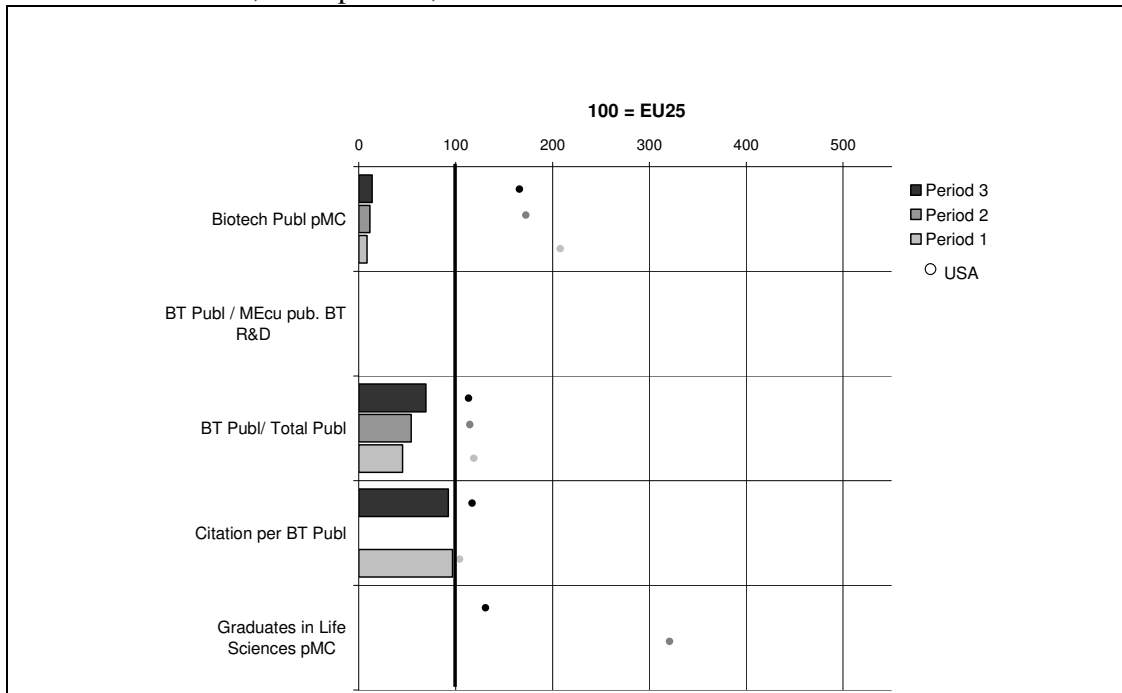
This chapter analyses the performance of the Latvian biotechnology innovation system for two or three time periods depending on data availability, using a range of indicators for scientific and commercialisation performance. Each time period includes several years in order to avoid capturing erratic trends. National trends are benchmarked against the performance of the EU25 Member States and the US. In principle, the presentation of the performance is structured along the four main policy areas which are considered in BioPolis. However, in the case of Latvia, data availability is very poor for indicators measuring the performance in knowledge transmission and application, in industrial development and in market conditions. Accordingly, this chapter will focus on performance in terms of knowledge base and supporting the availability of human resources. Raw data for constructing the various indicators presented in the following charts are provided in Annex 5.

In general, this performance data should be treated with caution. An important indicator for scientific performance is the publications data in the Science Citation Index (SCI). However, the SCI's bias towards English-language journals could distort country comparisons if Latvian scientists have a tendency to publish in journals in languages that are not covered by the SCI. Lack of patent data may reflect failure by the national patent system or in its implementation to meet international standards.

3.2 Performance in creating a knowledge base and supporting the availability of human resources

Indicators illustrating the general trends in performance related to creating a knowledge base and supporting the availability of human resources are presented in Chart 3.1. Period 1 refers to 1994 to 1996, period 2 covers 1998 to 2000 and period 3 corresponds to 2002 to 2004. The absolute numbers of biotechnology publications from Latvia are rather low, ranging from 45 in the first period to 101 in the third period (see Annex 5). Accordingly, the index values of Chart 3.1 should be interpreted with some caution. Yet, data indicate that publication activities in biotechnology from Latvia are far below the European average. However, there is a clear increasing trend over the three periods observed. This also leads to an increasing significance of biotechnology among all publication activities in Latvia as indicated by the increasing share of biotech publications over all publications. The citation indicator reveals an above average performance of Latvia. However, again the low number of publications which are the basis for calculating this indicator should be taken into account. Nevertheless, there seem to be some publications from Latvia which enjoy rather high attention by the scientific community comparable to the EU25 level as indicated by the citation indicator. Data for calculating the human resources indicator (graduates in life sciences per million capita) is not available for Latvia.

Chart 3.1: The biotechnology knowledge base indicators, comparison with EU25 and USA, three periods, index values

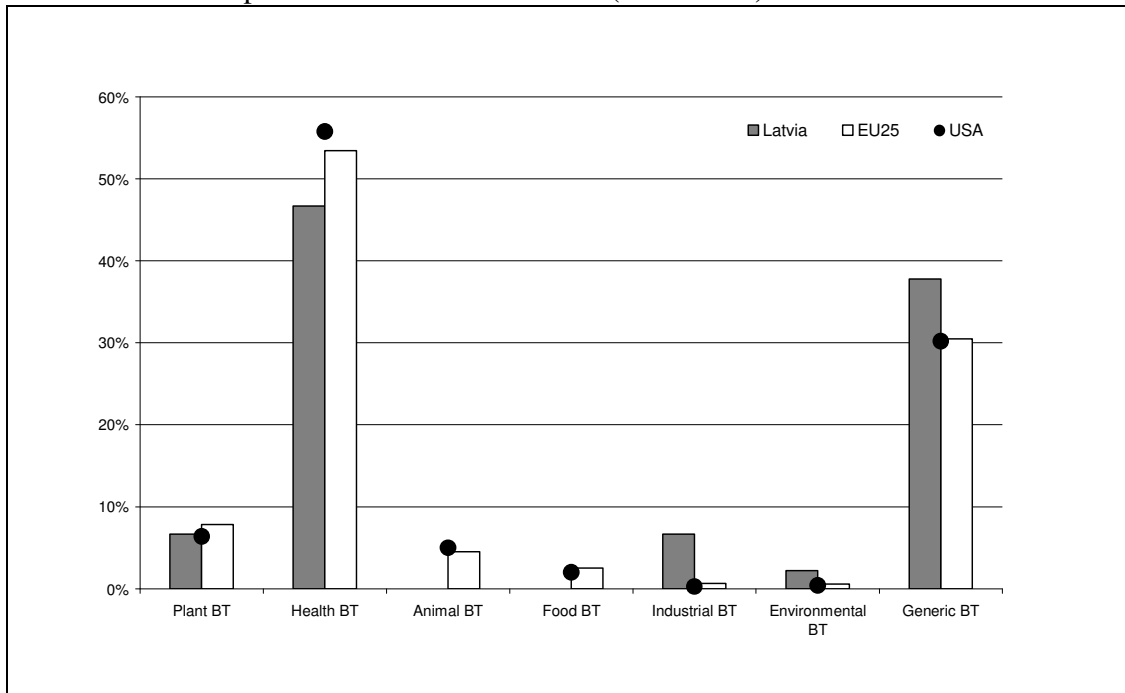


Source: BioPolis Research

For capturing the thematic orientation within biotechnology research activities in Latvia the following Charts 3.2.1 to 3.3 provide an analysis of publication activities by biotechnology area. Again, this information should be interpreted with some caution since it is based only on a very low absolute number of publications. Accordingly, just some general trends are worth being mentioned.

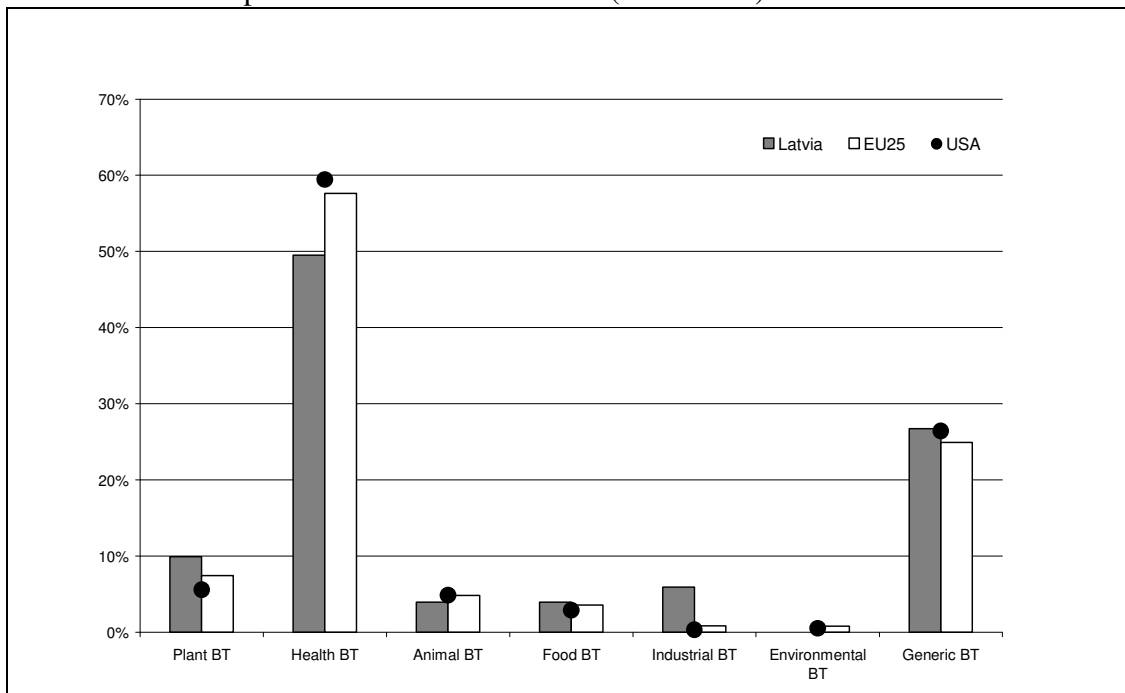
As in Europe as a whole the focus of Latvian publications is on health biotechnology (Chart 3.2.1). In addition, generic biotechnologies are important in Latvia. Between the two periods 1994/96 and 2002/04 the following main changes took place in Latvia: plant biotechnology gained more attention and also publication activities in health biotechnology increased. All other trends cannot be interpreted due to low absolute figures.

Chart 3.2.1: Share of subfields (in %) of total biotechnology publication for Latvia in comparison with EU25 and USA (1994-1996)



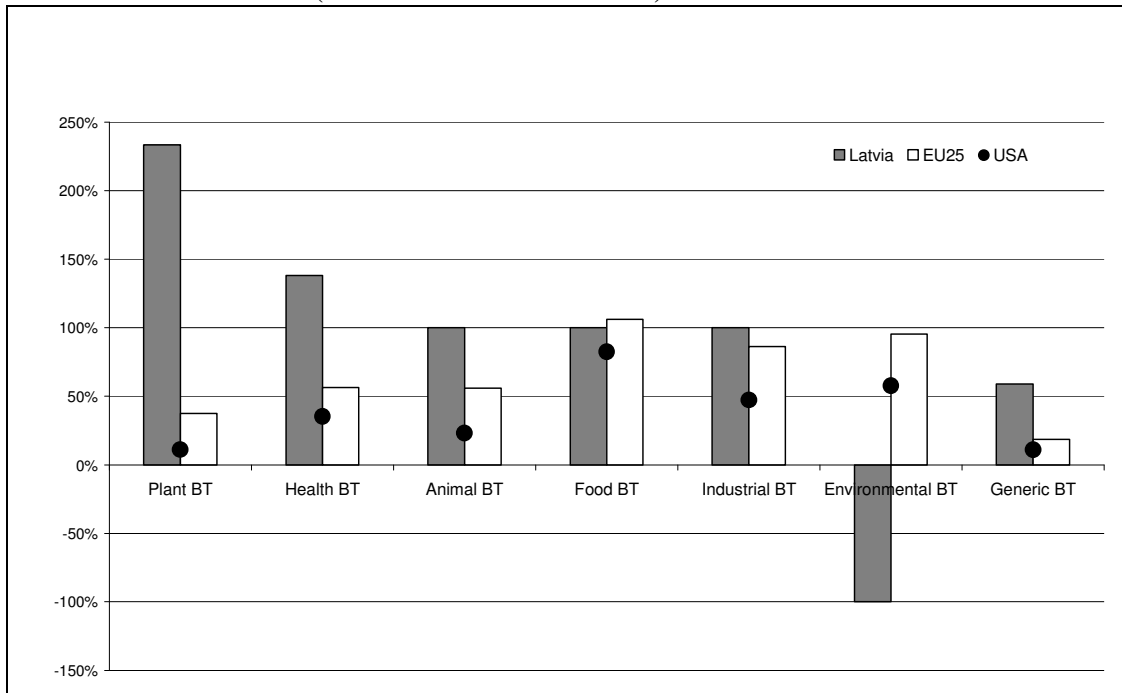
Source: BioPolis Research

Chart 3.2.2: Share of subfields (in %) of total biotechnology publication for Latvia in comparison with EU25 and USA (2002-2004)



Source: BioPolis Research

Chart 3.3: Biotechnology subfields growth rates for Latvia in comparison with EU25 and USA (1994-1996 and 2002-2004)



Source: BioPolis Research

3.3 Performance in knowledge transmission and application

Between 1994 and 2003 only ten biotechnology patents were applied for from Latvia. Accordingly, a discussion of performance in knowledge transmission based on patent indicators is not possible. Further, there is also no information available on biotechnology start-ups from Latvia.

4. Conclusions

4.1 Introduction

The following tables summarise biotechnology funding observed in Latvia during the period 2002 to 2005. Tables 4.3 through 4.5 provide overviews of the policy goals, the biotechnology application areas and the activities covered by biotechnology relevant policy instruments. The presented data deliver useful indications of priorities and promotion styles. However, the aggregated budgets for each of the categories should be interpreted with due caution since in most cases the reported budget shares had to be based on informed approximations of the programme officers of the funding agencies. In addition, in some cases rough estimates had to be made by the project team.

4.2 Public funding of biotechnology through policy instruments

Table 4.1 Public funding of biotechnology through non-directed, generic and specific instruments for the period 2002-2005 (in M EUR)

	2002	2003	2004	2005	Total
RESEARCH	0.163	0.163	0.163	0.163	0.650
2a. Policy-directed Generic					
National					
GRAND TOTALS	0.163	0.163	0.163	0.163	0.650

Source: BioPolis Research

As already indicated in section 2 there is only generic policy-directed funding of biotechnology in Latvia during the period covered. At average 163 000 EUR per year were devoted to the funding of biotechnology research projects. No information was available on funding instruments and budgets supporting the commercialisation of biotechnology.

4.3 Specific features of the instruments

The project funding provided by the Latvian Council of Science is directed towards public research organisations (Table 4.2). Firms are not among the target group of these funding activities. There is no financial contribution required by funding recipients.

Table 4.2 Participants/recipients and co-financing requirements of policy-directed programs that fund biotech activities in the period 2002-2005

Instrument	Funding agency	Participants/Recipients			Financial contribution required (%)	
		PROs	SMEs	LFs	Recipients	Other public authorities
National						
<i>Generic</i>						
Project funding	Latvian Council of Science	✓				

Source: BioPolis Research

4.4 Policy goals

In line with the mission of the Latvian Council of Science - advancement, evaluation, financing and coordination of scientific research in Latvia - the main policy goals covered by funding provided by the council are the support of high level of biotechnology research and the facilitation of knowledge flow and collaboration among scientific disciplines. We estimate that most of the budget aims at supporting high level of biotechnology research (Table 4.3).

Table 4.3 Coverage of policy goals and funding by goal by policy-directed instruments in the period 2002-2005 (in M EUR)

	1*	2	3	4	5	6	7	8	9	10
National										
<i>Generic</i>										
Project funding	0.52		0.13							

*

- | | |
|---|---|
| 1 High level of biotechnology research | 6 The adoption of biotechnology for new industrial applications |
| 2 High level of industry-oriented (and applied) research | 7 Firm creation |
| 3 Knowledge flow and collaboration among scientific disciplines | 8 Social acceptance of biotechnology |
| 4 Availability of human resources | 9 Business investment in R&D |
| 5 Transmission of knowledge from academia to industry and its application to industrial resources | 10 Bio-safety, Risk assessment |

Source: BioPolis Research

4.5 Biotechnology research application areas

The main biotechnology application area supported by funding of the Latvian Council of Science are plant biotechnology, health biotechnology, food biotechnology and basic biotechnology (Table 4.4). While the emphasis on health biotechnology and generic biotechnology reflects more or less funding patterns also found in other countries, the focus on food biotechnology may be related to the high significance of the food industry in Latvia which comprises the biggest manufacturing sector in the country (compare section 1.1).

Table 4.4 Coverage of biotech application areas and funding through policy-directed instruments by biotech application area for the period 2002-2005 (in M EUR)

	Biotech application areas							
	1*	2	3	4	5	6	7	8
National								
<i>Generic</i>								
Project funding	0.163			0.163	0.163		0.163	

*

- | | | |
|-------------------------------|----------------------------|---|
| 1 Plant biotechnology | 4 Health biotechnology | 7 Basic biotechnology |
| 2 Animal biotechnology | 5 Food biotechnology | 8 Ethical, legal, social aspects of biotechnology |
| 3 Environmental biotechnology | 6 Industrial biotechnology | |
- Source: BioPolis Research

4.6 Stimulation of biotechnology activities through the instruments

Considering the various biotechnology activities supported through funding of the Latvian Council of Science not surprisingly reveals that basic research, applied research and the support of research networks are the main activities being promoted.

Table 4.5 Coverage and funding of biotech activities in the period 2002-2005 through policy-directed instruments (in M EUR)

	Biotech activities									
	1*	2	3	4	5	6	7	8	9	10
National										
<i>Generic</i>										
Project funding	0.325	0.195		0.130						

*

Many different types of activities are supported by biotech instruments:

- | | |
|---|---|
| 1 Basic research | 6 Biotechnology training |
| 2 Applied research | 7 Mobility of researchers between academia and industry |
| 3 Centres of excellence | 8 Collaborative research between industry |
| 4 Research network | 9 Set up research institute/centre of industrial interest |
| 5 Mobility of researchers among disciplines | 10 Technology transfer office |

5. Future developments

The current biotechnology funding landscape in Latvia is characterised by very few funding instruments (basically there is just one generic instrument), limited budgets and no specific biotechnology programme. On the other hand, biotechnology has been set as a national priority for research and some far reaching initiatives like the Latvian Genome Project have been launched. Another national programme which has some relevance for the future development of biotechnology is the “Support for the Modernisation of the Scientific Infrastructure in State Research Institutions” Programme. Among others this programme should contribute to establishing an international competitive infrastructure for the Latvian Genome Database. At the moment it is not clear whether specific biotechnology funding programmes are being developed in Latvia, and if so when it is intended to implement them. Experience with other comparable countries indicates that in particular in early stages of biotechnology such specific instruments are superior to just generic instruments (Reiss et al. 2004)¹¹. Another question which will be answered in the future is the perspective of the Latvian Genome Project. Comparable initiatives in other countries such as Estonia faced severe difficulties in terms of financing. It will be interesting to observe whether Latvia will succeed in avoiding or solving such problems.

¹¹ Reiss, T.; Hinze, S.; Dominguez Lacasa, I.; Mangematin, V.; Enzing, C.; van der Giessen, A.; Kern, S.; Senker, J.; Calvert, J.; Nesta, L.; Patel, P.: (2004): Efficiency of innovation policies in high technology sectors in Europe (EPOHITE). Final Report from STRATA Accompanying Measures. Brussels: European Commission

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Annex 3 List of contact persons

Name, first name	Institution	Contact date(s)
Bürka, Astrida	Ministry of Economics of Latvia	July 7th, 2006; August 10th, 2006

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Annex 5 Performance

Introduction

This Annex includes the data that was used to develop the indicators discussed in Chapter 3. Chapter 3 describes four sets of indicators used to measure the performance of the national biotechnology system of innovation, in terms of:

1. Creating a knowledge base and supporting the availability of human resources: Charts 3.1, 3.2.1, 3.2.2 and 3.3
2. Knowledge transmission and application: Chart 3.4
3. Industrial development: Chart 3.5
4. Market conditions: Chart 3.6

The indicators aim to capture trends in performance and compare the national situation with that of a reference region. To present trends in performance, most indicators are provided for three or two different time periods, depending on data availability. To avoid capturing erratic trends, each time period includes several years, again depending on data availability. Information on which years have been captured for each period and comments concerning the index used can be found in the last two columns of Table A5.1.

Table A5.1. Performance indicators, charts, comments and time periods

-	Indicator	- Chart	- Comments	- Time periods
Ind. 1	Biotech publications per million capita (pMC)	3.1	Index: Reference Region EU25 =100 and US data for comparison	- (1) 1994-1996, (2) 1998-2000, (3) 2002-2004
Ind. 2	Biotech publications per BT public R&D expenditure	3.1	Only for those countries included in the inventory Index: Reference Region EU25 =100	BT Pub. 2002-2004 / Total Pub. Expenditure 1994-1998 M Ecu
Ind. 3	BT patents / BT publications	3.4	Index: Reference Region EU25 =100 and US data for comparison	- (1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 4	BT publications / Total pub.	3.1	Index: Reference Region EU25 =100 and US data for comparison	- (1) 1994-1996 (2) 1998-2000 (3) 2002-2004
Ind. 5	Citations to BT publications	3.1	Index: Reference Region EU25 =100 and US data for comparison Small country effect	- (1) 1994-1998 (3) 2000-2004
Ind. 6	Graduates in life	3.1	Index: Reference	- (2) 1998

-	Indicator	Chart	Comments	Time periods
	sciences pMC		Region EU17 =100 and US data for comparison	(3) 2002
Ind. 7	BT publications in subfields, as % of total BT publications	3.2.1	Data in % EU25 and US data for comparison	1994-1996
		3.2.2		2002-2004
Ind. 8	Growth rate of BT publications in subfields	3.3	EU25 and US data for comparison Small field effect	- Growth rate between 1994-96 (period 1) and 2002-04 (period 3)
Ind. 9	Biotech patent applications pMC	3.4	EU25 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 10	Number of biotechnology companies pMC	3.5	European (data available) and US data for comparison	(2) 2001 (3) 2004
Ind. 11	Number of biotech start-ups pMC	3.4	European (data available) and US data for comparison	(3) 2001-2003 (only one period)
Ind. 12	Number of biotech IPOs pMC	3.5	European (data available) and US data for comparison	(3) 2002-2005
Ind. 13	Venture capital in € pC	3.5	European (data available) and US data for comparison	(2) 2002 (3) 2004
Ind. 14	BT acceptance index	No Chart - Discussed in text of chapter 3	Source: BT Policy Benchmarking 2005. The biotechnology acceptance index is a composite index and draws on questions Q.12, Q.13.1 and Q14.01 and Q14.09 of the Eurobarometer 58.0	- 2002
Ind. 15	Eurobarometer 225	No Chart - discussed in text of chapter 3	See section 3.3 and sections 3.4.1, 3.4.2, and 3.4.3 of the Special Eurobarometer 225 ¹²	- 2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100	1995-2002

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http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_225_report_en.pdf

-	Indicator	- Chart	- Comments	- Time periods
			US data for comparison	
Ind. 17	Field trials	3.6	Source: Biotechnology Innovation Scoreboard 2002 Index: Reference Region EU15 =100 US data for comparison	- 1996-2001

The following methodological issues are related to some of the indicators:

- Indicator 3 (Patent BT / Publications BT) replaces the indicator *BT publications basic research/ BT publications applied research*. Results of the EPOHITE project have shown that the original indicator does not differ significantly in the case of old EU member states. This might be the result of methodological problems associated with the indicator, since the definition of basic and applied research is based on a journal classification made by SCI. The explanatory power of this indicator is therefore questionable.
- To calculate the citation rate first the publications for the period 1994-1996 (set 1) were searched and all the publications in 1994-1998 that cited any publications in set 1 (set 2). Citation rate has been calculated by (number of publications in set 2) / (number of publications in set 1). However, many of the articles in set 2 cited not only one article in set 1 and these duplicated citations are not taken into account in our calculation. For example, if there are 2 articles in set 1 and they each has one citation but cited by the same article, there is only 1 article in set 2. The citation rate for the 2 articles in set 1 is 0.5 instead of 1. This depreciation is more obvious in countries with more publications such as USA and EU25 since the possibility to cite multiple articles in set 1 is large. Accordingly the citation rates of USA and EU25 are a bit underestimated.
- The indicator ‘Citations to BT publications’ seems to have a ‘small country effect’ bias. Small countries show a relatively large citation rate. A possible explanation might be that, as far as number of publications is concerned, larger countries usually have a larger ‘middle quality’ share of research results (in terms of impact) while smaller countries usually have a ‘low in number but good in quality’ publications impact. This can be explained by the concentration of resources allocated to selected research groups in small countries. Small countries may concentrate resources in outstanding research units. Accordingly, fewer publications may have greater impact.
- The EU25=100 index is applicable in the indicator ‘Graduates in life sciences pMC’ since data was only available for 17 member states.
- For those countries starting from zero in period 1 (1994/1996), the growth rate of BT publications in subfields was set to 100% if the number of publications in period 3 (2002-2004) was larger than zero. On the other hand, if the country reduced the number of publications to zero in the period 2002-2004, the growth

rate was -100%. Given that a relative growth rate was used, small fields tended to have relatively larger growth rates.

- To benchmark each country we chose EU25 (or EU15 if data was not fully available) as the reference region. In those cases where data for EU25 or EU15 were not available, the reference corresponds to the sum of national data available. Moreover, to ease the presentation of indicators with different scales in a given chart, an index value was used.

Raw data for the Charts in chapter 3

Raw data for Chart 3.1. BT publications per million capita (pMC): absolute and indexed values

	BT publications			Population (million)		
	94-96	98-00	02-04	1996	2000	2004
EU25	97521	128716	145646	447	451	457
Latvia	45	78	101	2	2	2
USA	119802	135508	154402	264	276	292
	BT publications/pMC			Index EU25=100		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	218	285	319	100	100	100
Latvia	18	33	44	8	11	14
USA	454	492	529	208	172	166

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Population data: EUROSTAT and OECD

Raw data for Chart 3.1. BT publications per BT public R&D expenditure

	BT publications	Non-policy-directed funding	Policy-directed funding		Total public spending on BT (M Ecu)	BT publications/M Ecu BT public expenditure	Index
			Biotech specific	Generic			
	2002-2004	1994-1998	1994-1998	1994-1998	1994-1998	2002-2004/1994-1998	
EU25	145646				n.a.		
Latvia	101				n.a.		n.a.
USA	154402				n.a.		n.a.

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

BT public expenditures in research: Inventory Project, Table 3.4 Executive Summary

Raw data for Chart 3.1. BT publications, as share of total publications: absolute and indexed values

	BT publications			Total publications		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	97521	128716	145646	860652	1024327	1117392
Latvia	45	78	101	877	1146	1116
USA	119802	135508	154402	889506	941191	1045894
	Share of BT publication			Index EU25=100		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	11%	13%	13%	100	100	100
Latvia	5%	7%	9%	45	54	69
USA	13%	14%	15%	119	115	113

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.1. Citations to BT publications: absolute and indexed values

	Citations to BT publications		Index EU25=100	
	94-98	00-04	94-98	00-04
EU25	6.14	7.28	100	100
Latvia	5.93	6.72	97	92
USA	6.39	8.54	104	117

Source: BioPolis Research

Citations data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.1. Graduates in life sciences pMC: absolute and indexed values

	Graduates in Life Sciences		Population (million)	
	1998 / 1999	2002	1998 / 1999	2002
EU17	46859**	81316	552**	431
Latvia	n.a.	n.a.	2	2
USA	75253*	70950	276*	288
	Graduates pMC		Index EU17=100	
	1998 / 1999	2002	1998 / 1999	2002
EU17	91**	189	100	100
Latvia	n.a.	n.a.	n.a.	n.a.
USA	273*	246	321	131

Index EU17=100 for 1998 is EU-16, because for Portugal no data available

* data for 1998; ** data for 1999

Source: BioPolis Research

Graduates data OECD Education Database

Population source for US is the OECD

Raw data for Chart 3.2.1. BT publications in subfields, as share of total number of BT publications for the period 1994-1996

	1994-1996							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Latvia	100%	7%	47%	0%	0%	7%	2%	38%
USA	100%	6%	56%	5%	2%	0%	0%	30%

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.2.2. BT publications in subfields, as share of total number of BT publications for the period 2002-2004

	2002-2004							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	100%	7%	58%	5%	4%	1%	1%	25%
Latvia	100%	10%	50%	4%	4%	6%	0%	27%
USA	100%	6%	59%	5%	3%	0%	1%	26%

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.3. BT publications in subfields for the period 1994-1996

	1994-1996							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	97217	7629	51944	4375	2434	624	576	29635
Latvia	45	3	21	0	0	3	1	17
USA	111686	7118	62274	5580	2230	296	459	33729

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.3. BT publications in subfields for the period 2002-2004

	2002-2004							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	140984	10494	81220	6821	5017	1162	1126	35144
Latvia	101	10	50	4	4	6	0	27
USA	141680	7910	84234	6872	4070	436	724	37434

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.3. Growth rate of BT publications in subfields between 1994-96 and 2002-04

	1994-1996/2002-2004						
	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	38%	56%	56%	106%	86%	95%	19%
Latvia	233%	138%	100%	100%	100%	100%	59%
USA	11%	35%	23%	83%	47%	58%	11%

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Raw data for Chart 3.4. BT Patents pMC: absolute and indexed values

	BT Patents			Population (million)		
	94-96	98-00	01-03	1996	2000	2003
EU25	4924	8921	10119	447	451	455
Latvia	1	5	4	2	2	2
USA	8590	14396	12348	264	276	292*
	BT Patents/pMC			Index		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	11	20	22	100	100	100
Latvia	0	2	2	4	11	8
USA	33	52	42	295	264	190

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

Raw data for Chart 3.4. BT Patents per BT publications: absolute and indexed values

	BT patents			BT publications		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	4924	8921	10119	97521	128716	140219
Latvia	1	5	4	45	78	98
USA	8590	14396	12348	119802	135508	148853
	BT patents/ BT publications			Index EU25=100		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	0.05	0.07	0.07	100	100	100
Latvia	0.02	0.06	0.04	44	92	57
USA	0.07	0.11	0.08	142	153	115

Source: BioPolis Research

Publication data: Science Citation Index (through online database vendor STN International)

Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

Raw data for Chart 3.5. Number of BT companies pMC for years 2001 – 2004: absolute and indexed values

	BT companies				Population in T			
	2001	2002	2003	2004	2001	2002	2003	2004
Europe	1879	1878	1861	1815	452016	452641	454580	456863
EU Available	1643	1650	1782	1605	319337	319484	408602	322210
Latvia	n.a.	n.a.	n.a.	n.a.				
USA	1457	1472	1473	1444	285102	287941	290789	291685
	BT companies pMC				Index			
	2001	2002	2003	2004	2001	2002	2003	2004
Europe								
EU Available	5	5	4	5	100	100	100	100
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
USA	5.1045	5.12158	5.6553	4.5054	99	99	116	99

Note: EU Available is the result of the sum of available EU Member States

Source: BioPolis Research

Biotech companies data: Ernst and Young 2002-2004, EuropaBio

Raw data for Chart 3.5. BT start-ups pMC for the period 2001-2003 and year 2003: absolute and indexed values

	BT start-ups		Population in T	
	2001-2003	2003	2003	
Europe (EU15 - Cyprus - Greece + Norway + Switzerland)	523	132	367051	
Latvia	n.a.	n.a.		
USA	355	83	290789	
	Biotech start-up/pMC	Index	Biotech start-up/pMC	Index
	2001-2003	2001-2003	2003	2003
Europe (EU15 - Cyprus - Greece + Norway + Switzerland)	1.4	100	0,36	100
Latvia	n.a.	n.a.	n.a.	n.a.
USA	1.2	86	0.29	79

Source: BioPolis Research

Start-ups data: EuropaBio

Raw data for Chart 3.5. Number of BT IPO's pMC: absolute and indexed values

	BT IPO	Population T				
	2002-2005	2002	2003	2004	2005	2002-2005
EU Available	29	452927	454869	457154	461593	456636
Latvia	0	2346	2332	2319	2306	2326
USA	52	287941	290789	291685		290138
	IPO /pMC	Index				
	2002-2005	2002-2005				
EU Available	0.00	100				
Latvia	0.00	0				
USA	0.00	282				

Note: EU Available is the result of the sum of available EU Member States

Source: BioPolis Research

IPO data: Ernst and Young 2002-2006, London Stock Exchange, Frankfurt Stock Exchange, Euronext, Nasdaq, Burril & Company

Raw data for Chart 3.5. Venture capital pC: absolute and indexed values

	Venture capital in biotechnology companies M EUR			Population in T		
	2002	2002	2002	2002	2003	2004
Europe	1100	920	2800			
EU Available	890	883	1111	315584	319663	325131
Latvia	n.a.	n.a.	n.a.			
USA	2288	2498	2855	287941	290789	291685
	Venture capital in EUR/pC			Index		
	2002	2003	2004	2002	2003	2004
Europe						
EU Available	2,8	2,8	3,4	100	100	100
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
USA	8	9	10	282	311	286

Source: BioPolis Research

VC data: E&Y Beyond Borders 2002, 2003, 2004, 2005

Raw data for Chart 3.6. Number of Biomedicines pMC

	Biomedicines	Population (Million)	Biomedicines / pMC	Index
	1995-2002	2002		1995-2002
EU15	39	378	0,10	100
Latvia	n.a.	n.a.	n.a.	n.a.
USA	115	289	0,40	387

Note: EU15 is the result of the sum of the 15 old EU Member States

Source: BioPolis Research

Number of medicines: Benchmarking of public biotechnology policy 2005

Raw data for Chart 3.6. Number of field trials pMC

	Field trials	Population in M	Field trials pMC	Index
	1996-2001	2001	1996-2001	1996-2001
EU15	1334	379	4	100
Latvia	n.a.	n.a.	n.a.	n.a.
USA	6745	278	24	688

Note: EU15 is the result of the sum of the 15 old EU Member States

Source: BioPolis Research

Field trials: Biotechnology Innovation Scoreboard 2002

Raw data for biotechnology acceptance. Data are mentioned in the text of Chapter 3.

BT acceptance index 2002		
	Index average	N (sample size)
EU15*	100.29	16828
Latvia		

*Weighted Average according to the weight "W13" of the Eurobarometer 58.2, which considers population differences among countries and corrects for inconsistencies in the national samples

Source: BioPolis Research

BT acceptance index: Benchmarking of public biotechnology policy 2005

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Frankfurt Stock Exchange	http://deutsche-boerse.com/
Euronext	http://www.euronext.com/
Nasdaq	http://www.nasdaq.com/
Burril & Company	http://www.burrillandco.com/
EuropaBio	http://www.europabio.org/
EUROSTAT	http://epp.eurostat.cec.eu.int/
OECD Education Database	http://www.oecd.org/
OECD Statistics	http://www.oecd.org/
STN International	http://www.stn-international.de/
Questel Orbit	http://www.questel.orbit.com/index.htm

Annex 6 Abbreviations

GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
IOS	Institute of Organic Synthesis
BUC	Biomedical Research and Study Centre, University of Latvia

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