

# 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 Romania

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## Summary

Romania has a total land area of 237, 500 km<sup>2</sup> and a population of about 21.7 million. The EU Accession Treaty was signed in early 2005, and Romania is due to join the EU in January 2007. Its gross value added (GVA) is approximately 26.7822B EUR (2002 data). The main economic sectors are industry (contributing 36% to the GVA), services (19.74%) and agriculture (17%).

The country's Gross Domestic Expenditure on Research and Development (GERD) is 183M EUR, which represents 0.38% of its GDP. The public contribution is 48.41%, and industry contributes 41.57% (2002 data). Industries active in the field of biotechnology hardly do exist in Romania.

The Romanian government never had a special policy to develop biotechnology capacity for the country. For instance, the 2001-2004 Government Programme objectives and the Strategy of the Ministry of Education and Research (MER-Research) make no reference to biotechnology. Nevertheless, the Romanian government has a biotechnology programme, BIOTECH, which is one of 14 national RDI programmes.

Biotechnology research is financed through this programme and government grants from the Ministry of Education and Research. In addition, biotechnology research is also eligible for funding in four other national RDI programmes: life and health (VIASAN); agriculture and food (AGRAL); new materials, micro- and nanotechnologies (MATNANTECH); and economic revival through research innovation (RELANSIN). Some funds from the Romanian Academy are also used for biotechnology.

The policy goals of the BIOTECH programme are consistent with stimulating high level biotech research and high industry-oriented and applied research, both of which receive most of the funding. A third and lower funding allocation goes towards transmission of knowledge from academia to industry. The policy goals attempt to address Romania's (almost non-existent) biotech industry.

The BIOTECH programme has a number of application areas. The main emphasis is on industrial biotechnology, followed by health and food biotechnology. In terms of publications, industrial biotechnology ranked low, while generic and health biotechnology performed well. In terms of growth rates, food biotechnology performed best, followed by industrial and health biotechnology. Romania has been highly selective and has only stimulated three biotechnology activities, mostly involving applied research (which is the main recipient of funding).

Over a ten-year period (1994-2004), Romania had not made much progress in biotechnology publications per million capita (index 2 in 1994-1996 to index 5 in 2002-2004). Its modest output was far below EU25 and USA levels. Similarly, the country's share of biotechnology publications (index 22 in 1994-1996 to index 33 in 2002-2004 for Romania) in relation to the total number of publications remained way below EU25

figures. Romanian biotechnology publications can especially be found in the fields of generic biotechnology and human health biotechnology.

In terms of performance in knowledge transmission and applications, specifically biotech patent applications per biotech publications, Romania's output in the ten-year period was not only very limited, but also in decline (index 39 in 1994-1996 to index 11 in 2002-2004). Romania performed far below the EU25 and USA (index 142 to index 115 for the same periods). For biotech patents per million capita, Romania's output was equally insignificant (index 1 in 1994-1996 to index 0 in 2002-2004). In terms of biotech start-ups, there are no data available for Romania.

The National RDI Plan and BIOTECH Programme were extended to 2006. At the time, it remained unclear what future policy and policy instruments for biotechnology would be in place after 2006. The future of biotechnology policy in Romania is expected to be formulated in the next National RDI Plan. Lack of national orientation for biotechnology research was criticised by some of the researchers interviewed.

## **1. Introduction and background**

### **1.1 General introduction**

Romania has a total land area of 237, 500 km<sup>2</sup> and a population of about 21.7 million (Eurostat). It has been a member of NATO since 2004, and is also an acceding country to the European Union. The EU Accession Treaty was signed in early 2005, and Romania is due to join the EU on 1 January 2007 (Wikipedia, 2005).

Since 2000, the economic performance of Romania has been steadily improving, with combined economic growth, disinflation and reduction of the economic deficit. These economic improvements are primarily due to reforms introduced to meet two basic requirements for EU accession: the creation of a functioning market economy and capacity to withstand competitive pressures. Achievements have been made through fiscal consolidation and remarkable performance in trade integration with the EU and global markets (EU TrendChart, 2004). In 2002, Romania's GDP was 48.4M EUR (Eurostat, 2005), representing a 100.1% increase in relation to its 1996 GDP. The private sector has seen robust growth and contributed to 69% of the GDP in 2002 (EU TrendChart, 2004).

Romania's gross value added (GVA) is approximately 26 782M EUR (2002 data). The industry sector (composed of textiles, machinery, metallurgy products and wood processing) contributes 36% to the GVA. The service sector (including trade, transport, post and telecommunications, and tourism) contributes 19.74%, and agriculture (the main crops are maize, wheat and barley, while livestock primarily consists of cows and sheep) contributes 17% to the GVA (Eurostat, 2005). Over half of the Romanian land area is classified as agricultural land, reserved mainly for large scale agriculture (FAOSTAT, 2004).

The country's Gross Domestic Expenditure on Research and Development (GERD) is around 183M EUR (0.38% of its GDP). 2002 data shows a contribution of 48.41%, by the public sector, and 41.57% by industry (Eurostat, 2005).

Industries active in the field of biotechnology hardly exist in Romania. There is only one private company engaged in biotechnology research. This is a subsidiary of Monsanto, which has been collaborating with the Timisoara State University (Agricultural Sciences and State Veterinary Medicine) to develop Romanian potato varieties that are resistant to the Colorado beetle. This variety development is supervised by the Romanian government through the Ministry of Agriculture, Forest and Rural Development (Badea in UNEP/GEF and the Ministry of Environment and Water Management, 2005).

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

Prior to 1989, almost all research activities were highly centralized. First, the National Council for Science and Technology (NCST), in collaboration with the central authorities, defined and approved the priorities of the country's entire research system. This involved multiple-year plans at national and ministry/department levels. Second, the allocation of funds was solely determined by the Ministry of Economics. And third, all research activities were carried out by a country-wide network of so-called 'central institutes'. Essentially, no research was carried out by individual firms. Institutes of the Academy of Sciences of Romania, which had existed prior to communism, were dismembered and subordinated to the Ministry of Education or other central authorities. As a result of the centralized system, the integration between education, research and production was poor to non-existent (EU TrendChart, 2000).

In 1990, shortly after the end of communism in Romania, the NCST and central institutes were abolished. From 1990 to 1999, alternate research re-structuring took place. Research programmes were developed in various R&D institutes within the science department of various ministries such as the Ministry of Education, the Ministry of Research and Technology, the Defence Ministry, the Ministry of Industry and Trade and other authorities. The Romanian Academy was rebuilt and its 34 research institutes were reconstituted on the basis of a fairly rigorous accreditation process. During this period, most activities were characterised by re-organisation, but specific strategies for science and technology remained weak. Moreover, the Romania financial crisis of the late 1990s also had an impact on poor funding for science and technology (ibid).

In 2000, the Romanian government published the 2001-2004 Government Plan. This plan included the government's policy to create a national Research and Development Innovation (RDI) system. The Research Department of the Ministry of Education and Research (MoER) played a central role in the national RDI system. The MoER undertook intense efforts to consolidate the RDI policy framework for Romania.

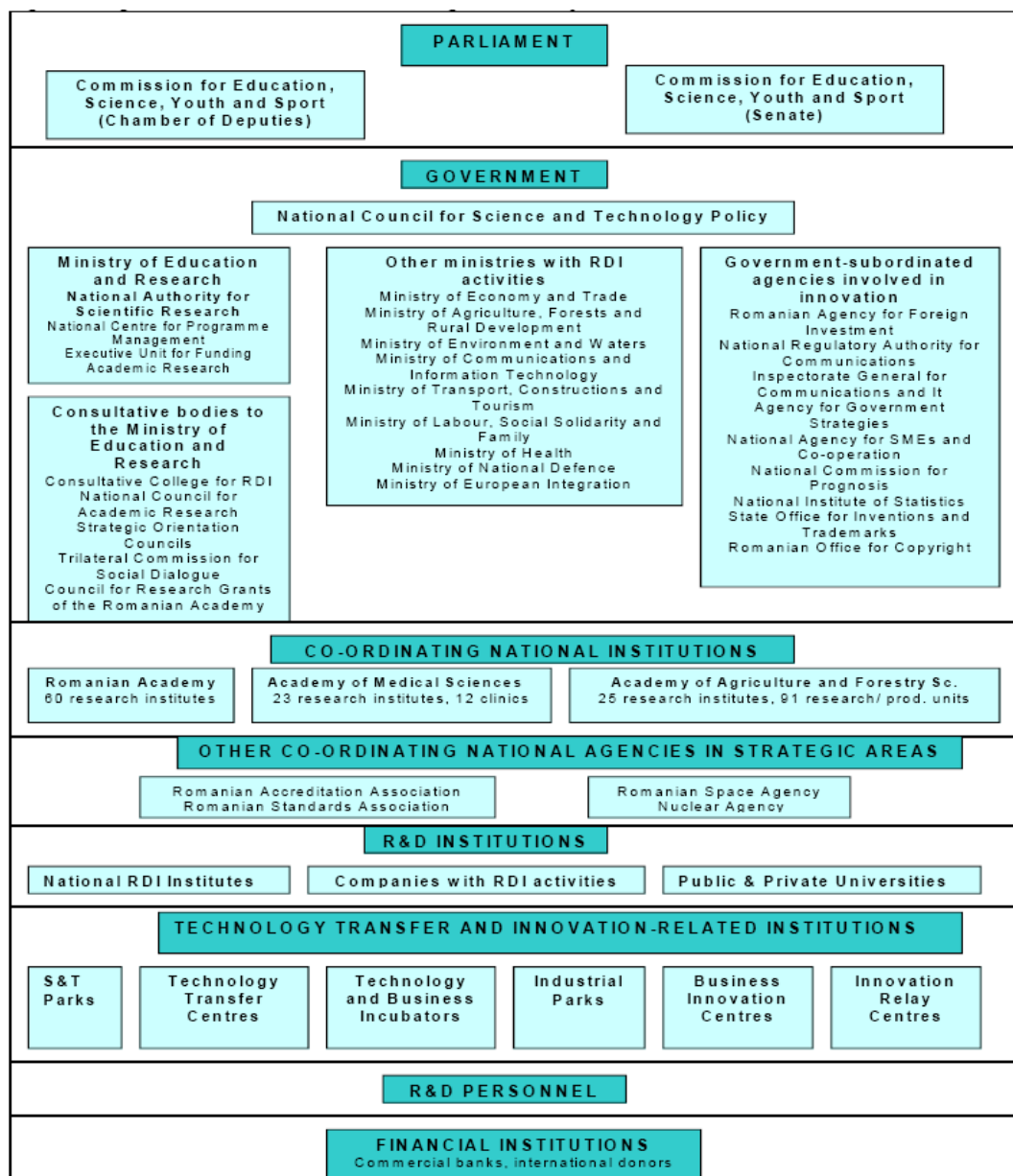
RDI policy measures for the period 2001-2004 included the following (EU TrendChart, 2004):

- R&D management: organising specific R&D programmes with technical assistance provided by the EU PHARE Programme;
- Enhancing R&D competence and efficiency: focusing on research results that are of interest to the economy and society; and correlation of publicly-funded research with medium- and long-term sectoral strategies;
- R&D restructuring and decentralisation: management of RDI programmes assigned by the MER-Research to R&D institutes;
- Generation of S&T knowledge: support for the development of networks of excellence in priority fields;
- Dissemination of S&T knowledge: strengthening the capacity of R&D institutions to disseminate knowledge;
- Development of firms with RDI potential: strengthening the capacity of firms to absorb innovation for economic development.

In 2003, amendments to the National RDI Plan included its extension to 2006. The main RDI objectives were revised to include (ibid):

- Increasing the capacity, quality and competitiveness of the RDI system,
- Increasing the impact of RDI activities on socio-economic development,
- Developing absorption capacity and diffusion of RDI results in the socio-economic environment, and
- Accelerating the alignment of the RDI systems to EU norms.

Figure 1.1 Main R&D and innovation policy actors in Romania: parliament, government institutions and consultative bodies of the MoER



Source: European TrendChart on Innovation, 2006

Figure 1.1 shows the main R&D and innovation policy actors in Romania: parliament, government institutions and the consultative bodies of the MoER (EU TrendChart, 2006).

The Parliament institutions include the Commission for Education, Science and Sport of the two Houses of Parliament.

The National Council for Science and Technology Policy is headed by the Romanian Prime Minister and composed of eight ministers and the President of the Romanian Academy. The council is responsible for higher level coordination of RDI policies in terms of establishing priorities and a legislative framework

The Research Department of the MoER coordinates 18 of the 34 national R&D institutes and implements the government programme in the area of 'scientific research and technological development'. It conducts its mission by elaborating, applying, monitoring and evaluating development and innovation (RDI) policies. The Department is also responsible for establishing an RDI framework that is in line with EU principles, criteria and procedures and for coordinating research with other ministries.

In 2005, by government decision, the function of the Research Department of the MoER was transferred to the National Authority for Scientific Research. The president of the National Authority for Scientific Research has the function of State Secretary in the MoER.

Consultative bodies in the field of science, technology and innovation advising the MoER are:

- The Inter-ministerial Council for Science, Technology and Innovation ensures correlation of RDI policies with other government strategies and programmes;
- The Advisory Board for R&D Innovation includes S&T personalities from R&D institutes, universities and services;
- The Strategic Orientation Council determines and updates priorities of the National RDI Plan;
- The Trilateral Commission for Social Dialogue provides the constitutional framework for consultation with social partners, such as patrons and unions;
- The Council for Research Grants of the Romanian Academy includes representatives of the Romanian Academy research divisions.

Public R&D research expenditure is channelled through the Ministry of Education and Research and the Romanian Academy. RDI programmes coordinated by MER-Research are (ibid):

- The National RDI Plan (14 programmes),
- Programmes for scientific research grants,
- Core research programmes,
- Sectoral R&D Plans,
- Other programmes (scientific literature, exhibitions and events), and
- The 2004 INFRATECH Programme.

The Romanian Academy is structured into 14 scientific divisions specialised in technical sciences, basic sciences and socio-human sciences. Research programmes coordinated by the Romanian Academy include (ibid):

- Priority and fundamental national projects that address complex scientific and cultural issues with impact at the national level;
- Grant programmes for scientific research undertaken by the Romanian Academy.

Under the Romanian Network for Innovation and Technology Transfer, there are five functional S&T parks, six technology transfer centres, and two business incubators. There are also technology information centres, over 50 business innovation centres, industrial liaison offices and innovation relay centres (EU TrendChart, 2004).

Romania's accession negotiations with the EU began in 2000. Pre-accession assistance to Romania was substantial and included provisions for EU Framework Programmes. Romania committed itself to increasing its capacity to implement and administer research and technology development activities, and to increasing its personnel for Framework Programme activities (EU, 2004).

### **1.3 National support and framework conditions for biotechnology**

The Romanian government never had a special policy to develop biotechnology capacity for the country. The 2001-2004 Government Programme objectives (see Section 1.2.) and related strategy of the Research Department of the MoER did not make any specific reference to biotechnology. This lack of government attention to biotechnology is mentioned in a workshop report entitled 'The evaluation of Romanian modern biotechnology research capacity' (the workshop was organized by UNEP/GEF and the Romanian Ministry of Environment and Water Management). The report highlights the fact that no policy documents of the Research Department of the MoER in the period 1992-2004 made any reference to biotechnology. The Romanian Academy also had not addressed the need to develop biotechnology (UNEP/GEF and the Romanian Ministry of Environment and Water, 2005).

Despite this lack of attention to biotechnology in policy documents, the Romanian government has a biotechnology programme: BIOTECH is one of 14 programmes of the National RDI Plan.

#### *Regulation*

Romania is becoming active in the field of biosafety, partly due to the fact that genetically-modified plants (soybean-tolerant roundup herbicides) are commercially grown in Romania by the Monsanto and Pioneer Hi-Bred Company.

The workshop on "the evaluation of Romanian modern biotechnology research capacity" concluded that a general strategy on modern biotechnology and biosafety, particularly with regard to the use of genetically-modified organisms, still needed to be elaborated. There is a system for regulating genetically-modified organisms and facilities do exist for

obtaining GMOs that have economic significance. Romania also has the necessary scientific competencies (human resources) for research monitoring activities, but does not have certified laboratories to analyse the genetically-modified organisms. Through the support of the State Institute for Variety Testing and Registration, Romania has the capacity and competency to test and register genetically-modified plant varieties and hybrids, but both still need to be further developed (ibid).

Biosafety research monitors major environmental concerns related to each crop trait combination. This research is conducted by universities and research institutes, in collaboration with private companies seeking approval for the release of their transgenic plants (ibid).

*Public opinion*

With regard to public opinion vis-à-vis biotechnology, a survey conducted by the Eurobarometer (2005) showed that 65% of Romanian respondents believe that biotechnology and genetic engineering will have a positive effect on their way of life in the next 20 years. Romanian respondents are especially optimistic about high-tech agriculture (73% positive), and medicines and new medical technology (95%). Romanian respondents are wary of specific cloning applications, particularly human cloning and growing meat from stem cells. They are less opposed to animal cloning for research into human diseases, and the cloning of human stems cells from embryos for organ transplants. Similarly, there is less opposition to developing GM crops and GM bacteria for cleaning up the environment.

Table 1.1 Romanian approval rating of new technology applications (%)

<b>Topics for Consideration</b>	<b>Never</b>	<b>Only in exceptional circumstances</b>	<b>Only if highly regulated and controlled</b>	<b>In all circumstances</b>	<b>DNK*</b>
Animal cloning for research into human diseases	27	18	29	13	12
Human cloning so couples can have a baby despite a genetic disorder	57	13	12	6	13
Cloning human stem cells from embryos for organ transplants	23	19	29	9	20
Growing meat from cell cultures to avoid the slaughter of animals	58	8	14	8	12
Developing GM crops to increase the variety of regionally-grown foods	29	17	28	12	15
Developing GM bacteria for cleaning up environmental catastrophes	17	19	28	20	15

\*DNK: Do not know

Source: Eurobarometer, 2005

The Eurobarometer survey shows that Romanians are more inclined to using the genetic data of the population to study genetic causes of human diseases. However, they are much less in favour of genetic testing to produce a child that could act as a bone marrow donor.

That GMOs are an issue is clearly illustrated by the fact that, in the period 2000-2004, at least four different research projects on the social impact of GMOs were conducted in Romania (UNEP/GEF and the Romanian Ministry of Environment and Water, 2005):

- GMO-food and bio-pollution certification, conducted by the Romanian Chamber of Trade and industry with funding by the EU Leonardo project
- Centre for broadcasting information regarding GMOs, conducted by the Food Bio-resources Institute with funding from BIOTECH
- Public consultation regarding GMOs consumers rights, conducted by the Romanian Centre for Small and Medium Enterprises with funding from PHARE
- Euro-competency, Information transfer, Recommendations for young specialists in bio-sciences and Euro-bio-competency, conducted by Romanian society for Biotechnology and Bioengineering, Chemical Research Institute, Poly-technical University and the University of Agricultural Sciences and Veterinary Medicine Bucharest. This was funded by the EU Leonardo project.

#### **1.4 Main biotech policy and research actors**

Romania still has to develop a policy on biotechnology, so there are no specific biotechnology policy-making actors as yet.

Biotechnology research in Romania is largely related to micro-organisms and plants and biomedical research. A survey of Romanian modern biotechnology showed that the field of transgenic research is mainly focused on genetic modification of micro-organisms and obtaining transgenic plants. Work with animals is restricted to embryo transfer and clinical testing of laboratory animals, mainly in cell cultures. These research activities are carried out by universities and states institutes, and are restricted to laboratory testing only.

The most important biotechnology research actors include the following (UNEP/GEF and the Ministry of Environment and Water Management, 2005):

- The Genetics Institute of the University of Bucharest (Faculty of Biology) conducts research on the plant genome for the purpose of increasing the biosynthesis capacity of secondary metabolites.
- The Institute of Biology of the Romanian Academy is conducting a study of chimaera gene expression involved in embryogenesis.

- The University of Agricultural Sciences and Veterinary Medicine of Banat-Timișoara does research on: the transfer and stability of transgene expression in vegetative and sex lineage for *Solanum* species; the agronomic, economic and ecologic impact of cultivating plants obtained through modern biotechnology in Romania; and the promotion and extension of non-polluting sustainable and efficient technologies for potato cultivation. Furthermore, the University's Department of Genetic Engineering and Breeding conducts laboratory research on genetically-modified bacteria: *Agrobacterium tumefaciens* and *Agrobacterium rhizogenes*.
- The Faculty of Biology of the Babeș-Bolyai University Cluj conducts research on: potato plants resistant to biotic factors; viruses and insects; manipulation of the repairing system for increasing plant homologous recombination mechanisms; and the use of biotechnological methods (somatic hybridization and genetic transformation) in potato breeding.
- The Centre for Experimental Cellular Biology and Plant Genetics of the Institute of Biology in Bucharest (IBB) conducts laboratory research on genetically-modified bacteria: *Agrobacterium tumefaciens* and *Agrobacterium rhizogenes*.

In terms of biomedical research, a number of initiatives concerned the transfer and expression of various genes of medical significance. All these studies were realized using *E.coli* as host for recombinant DNA molecules. This type of research was conducted by the Pasteur Institute in Bucharest, the St. S. Nicolau Institute of Virology, the Institute of Biology and Cellular Pathology N. Simionescu, and the Institute of Biochemistry of the Romanian Academy. In addition, the Cantacuzino Institute, which is the main technical and scientific medical unit of the Ministry of Health, is involved in developing and applying programmes aimed at preventing and controlling infectious diseases. Its research includes: the production, by means of genetic engineering, of enzymes of biomedical interest; testing clones for gene expression and biosynthesis of the desired enzyme; the isolation and identification of the action mechanism, at cellular or molecular level, of some compounds isolated from bacterial or plant extracts by antibacterial, immuno-stimulant or anti-inflammatory action; the identification of new molecular markers useful for diagnosis; the epidemiology of infectious diseases of viral or bacterial ethiology; *etc.* (ibid).

Lastly, research programmes carried out by the St. S. Nicolau Institute of Virology include: genetic engineering and antiviral chemotherapy (e.g. cloning and expression of the L1 major capsid protein of the human papillomavirus 18 in mouse cells); studies on viral gene transfer in eukaryotes by lipofection; and preliminary experimental models for gene therapy (ibid).

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

### **2.1 Introduction**

This report reviews the funding of biotechnology research and commercialisation. In the report we make a distinction between policy-directed funding and non-policy-directed funding of biotechnology.

Policy-directed funding includes funding directed by explicit policy decisions about specific instruments, such as R&D programmes, programmes encouraging collaboration, industrial research grants, support for centres of excellence, support for commercialisation of research, support for start-ups, programmes encouraging mobility of researchers, programmes with open calls, *etc.* This policy-directed funding can include biotechnology-specific policy instruments and generic policy instruments. Biotechnology-specific policy instruments are instruments specifically set up to stimulate biotechnology. Generic policy instruments are not linked to a specific technology, but in principle stimulate all technologies, including biotechnology. The BioPolis project only considers those generic instruments that make a reference to (the stimulation of) biotechnology activities in the policy of the funding organisation running the programme, or that of the ministry/government department itself.

Non-policy-directed funding of research is linked structural government support for scientific education, research and research infrastructure. This type of funding is mainly given through block grants to universities and (government) research institutes and the open-call system of research councils. Research councils, research institutes and government research institutes develop their own programmes through which biotechnology may be supported. The BioPolis project only considers funds allocated through block grants to (government) research institutes and through the open-call system of research councils.

This chapter describes the funding of biotechnology research through policy and non-policy-directed instruments, and of biotechnology commercialisation through policy-directed instruments. Although there is a biotechnology programme in Romania, the fact that biotechnology is not addressed in R&D policy documents means that, according to the criteria set in the BioPolis study, there are no policy-directed instruments being used at present. For this reason, the funding of biotechnology in Romania is qualified non-policy-directed funding, and is presented in Section 2.2. So far, public funds from the government are the only source of funding for biotechnology research; there are no charity organisations in Romania that finance biotechnology-related research. Section 2.3 provides a short overview of European funding of biotechnology research in Romania through the 6<sup>th</sup> Framework Programme.

## 2.2 Non-policy-directed funding of biotechnology research

Generally, biotechnology research is financed through government grants to several research programmes within the MoER (see Section 1.2).

The BIOTECH programme is one of 14 national RDI programmes. Biotechnology research is also eligible for funding within four other national RDI programmes (Ispas in UNEP/GEF and the Romanian Ministry of Environment and Water Management, 2005):

- Life and health (VIASAN),
- Agriculture and food (AGRAL),
- New materials, micro- and nanotechnologies (MATNANTECH),
- Economic revival through research innovation (RELANSIN).

In addition, funds from the Romanian Academy are also used for biotechnology research.

Topics funded include genomics, biotechnology applied to medicine, agriculture, and food quality and safety.

Table 2.1 provides an overview of funding organisations providing non-directed funding of biotechnology. Unfortunately, except for the BIOTECH programme, data on the biotechnology component of the national budget is not available<sup>1</sup>.

Table 2.1 Non-policy-directed funding of biotechnology research in the period 2002-2005 (in M EUR)

Funding organisation	Public research institutions / Response mode programmes	Biotech part of the Budget (M EUR)
Ministry of Education and Research	BIOTECH	12.11*
Ministry of Education and Research	VIASAN	NDA**
Ministry of Education and Research	AGRAL	NDA
Ministry of Education and Research	RELANSIN	NDA
Ministry of Education and Research	MATNANTECH	NDA
Romanian Academy	NDA	NDA

\* 2005 Exchange rates

\*\* NDA: No Data Available

Source: BioPolis Research

<sup>1</sup> The National Centre for Programme Management (CNMP) of the Ministry of Education and Research and the Romanian Academy were both requested to provide data. However, CNMP only provided data for the BIOTECH programme. There had been no response from other CNMP programmes, nor from the Romanian Academy.

### 2.2.1 Instrument of the Ministry of Education and Research

The BIOTECH Programme is the only programme of the RDI that is exclusively focused on biotechnology. National RDI programmes run from 2001 to 2006. The BIOTECH Programme is intended to develop and promote modern biotechnologies, products and services for technology transfer to various sectors such as agriculture, the food and drinks industry, pharmaceuticals, *etc.* The funds of the programme are spread over many different application areas. Research funded by this programme includes the study of human, animal and plant genomes to discover and understand genetic information and genetic manipulation with beneficial effects in the development process and metabolisms. It also includes the survey, protection and conservation of the national gene pool; the development of a national system for conserving and cultivating micro-organisms; and the identification, development and good use of genetic diversity of plants and animals. In addition, the programme looks into uses of DNA recombinant techniques for obtaining new bio-products that are relevant to the agro-food and medical-pharmaceutical industries. Lastly, the programme includes the identification and use of re-generable biological resources and wastes (Ispas in UNEP/GEF and the Ministry of Environment and Water Management, 2005).

The BIOTECH Programme is structured into seven modules:

- Biotechnological methods used to procure active biological products,
- Modern genetic techniques with implications for biotechnology,
- Biotechnology used for environment protection and retrieval,
- Biotechnological and bioinformatics equipment,
- Control of bio-products and bio-processes, and the prevention of risks derived from their procurement, production and use,
- Organisation of modern infrastructures to create facilities for services in biotechnology,
- Biotechnological methods to combat bio-terrorism.

The BIOTECH Programme aims to stimulate high level biotech research and industry-oriented applied research. These policy goals receive 45% of the funding each. The policy goal knowledge transmission from academia to industry receives 10% of the funding and is stimulated by supporting collaborative research between industry and public research organisations. Public research organisations, SME's and large firms can participate in the programme and up to 80% of the project costs is funded by the programme.

The aim of the Life and Health (VIASAN) Programme is to conduct basic, strategic and applied research in view of better prevention and treatment of human diseases, especially those that have a high impact on the population. Three of its six sub-programmes are used to fund biotechnology research. These sub-programmes are: genomics and proteomics, allocated 16.43% of the VIASAN budget; cellular immunology and organ/tissue transplant, allocated 21.10% of the budget; neuroscience, allocated 11.54% of the budget; and cellular and molecular medicine, allocated 25.8% of the budget (EU TrendChart, 2005; Ispas in UNEP/GEF and the Ministry of Environment and Water Management,

2005). Data on the total budget were not available and could not be provided by the MoER.

The Programme for Agriculture and Food (AGRAL) has as its goal to provide solutions, methods, technologies and equipment for the sustainable development of the agro-food industry, food safety, quality of life and rural development in Romania. AGRAL has nine components, seven of which have funds for biotechnology research. These seven components are the following (EU TrendChart, 2005; Ispas in UNEP/GEF and the Ministry of Environment and Water Management, 2005):

- genotypes and performant technological systems for cereals (GESICA), allocated 15.3% of the AGRAL budget,
- evaluation, protection, improvement and use of natural resources in accordance with the principles of sustainable agriculture (RESNAT), allocated 15.9% of the budget,
- competitive viticulture products and sustainable development of viticulture agro-systems (POLEVIT), allocated 22.7 % of the budget,
- animal breeding systems and sanitary veterinary protection (ZOOMED), allocated 18.1% of the budget,
- food resources and technologies, products, nutrition and food safety (INDAL), allocated 10.2% of the budget,
- modern and efficient systems of organisation, commercialisation and management in agriculture and the food industry (ECOMA), allocated 5.9% of the budget,
- application systems and equipment used in agriculture and the food industry (SIMAGRO), allocated 9.4% of the budget.

Data on the total budget were not available and could not be provided by the MoER.

The Programme for Economic Revival through Research Innovation (RELANSIN) aims to support Romania's economic revival and the competitiveness of its key players by implementing RDI projects that improve the performance and quality of products, technologies and services. It has 18 sub-programmes, one of which focuses on biotechnology (RELANSIN Biotechnology) and accounts for 0.35% of the programme budget (EU TrendChart, 2005). Data on the total budget were not available and could not be provided by the MoER.

The Programme for New Materials, Micro- and Nanotechnologies (MATNANTECH) has a total budget of 6.53M EUR (Nanoforum, 2004). This programme is mainly concerned with the development of new materials such as alloys, ceramics, metallurgy, *etc.* It also carries out some research on new biomaterials for specific applications and biomimetric microsystems and life interface microstructures (EU TrendChart, 2004).

### **2.2.2 Instrument of the Romanian Academy of Science**

In addition to the National RDI programmes of the MoER, some funds from the Romanian Academy are used for biotechnology research, including by its Institute of Biology. There is no data available on the actual amount and nature of biotechnology

funding from the Romanian Academy. As an indication, the Institute of Biology received 0.14M EUR for biotechnology research in the period 2002-2005.

### 2.3 Participation in 6<sup>th</sup> Framework Programme and use of development funds

Table 2.2 shows the involvement of Romania in the EU's 6th Framework Programme. Romania participates in 20 projects from Theme 1 'life sciences, genomics and biotechnology for health' and in 11 projects from Theme 5 'food quality and safety'. Romania does not operate as a project coordinator in the FP6.

Table 2.2 Involvement of Romania in biotechnology/life sciences programmes of the 6<sup>th</sup> Framework Programme

<b>6th Framework Programme<sup>1</sup></b>	<b>Participations as coordinator</b>	<b>Participation as member of the project team<sup>2</sup></b>
Thematic priority		
1. Life sciences, genomics and biotechnology for health	0	20
2. Nanotechnologies (section bio-nanotechnology)	0	0
5. Food quality and safety	0	11

<sup>1</sup> First and second call, all types of projects.

<sup>2</sup> Persons/groups can participate in more than one project.

Source: BioPolis research

### **3. Performance of the national biotechnology innovation system**

#### **3.1 Introduction**

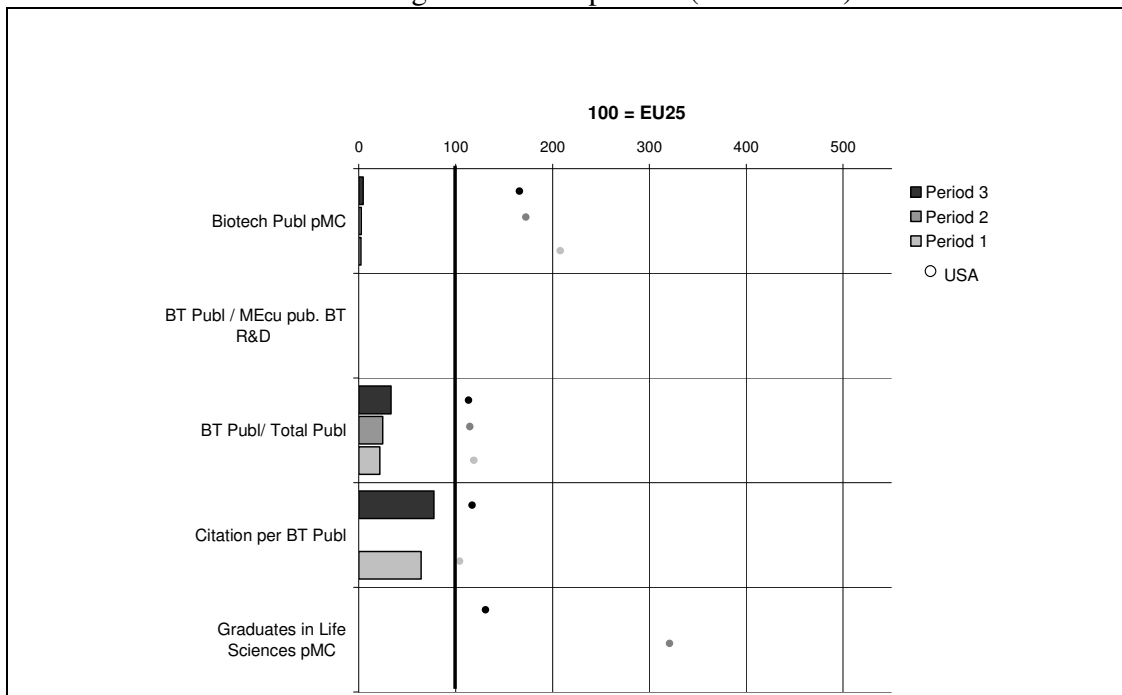
This chapter analyses the performance of the Romanian biotechnology innovation system for two or three time periods (depending on data availability), as shown by a range of indicators for scientific and commercialisation performance. Each time period includes several years to avoid capturing erratic trends. National trends are benchmarked against the performance of EU25 member states and the USA.

The presentation of the performance is structured along four main policy areas being considered in the BioPolis project. For each policy area, a comparison of different indicators by country is shown.

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

In the ten-year period covered by this report, Romania had not made much progress in its output of biotechnology publications per million capita (from index 2 in 1994-1996 to index 5 in 2002-2004 - see Chart 3.1). Romania's output was modest and far below EU25 (index = 100) and USA publication levels (index 166 in 2002-2004). Similarly, Romania's share of biotechnology publications in relation to the total number of publications (index 22 in 1994-1996 to index 33 in 2002-2004) remained far below EU25 levels. When considering the number of citations per biotechnology publication, Romania showed improved performance (index 65 in 1994-1996 to index 77 in 2002-2004), but still below the USA levels (index 104 in 1994-1996 and index 117 for 2002-2004) and EU25 levels for both periods. In terms of the number of PhD graduates per million capita, no data are available for Romania.

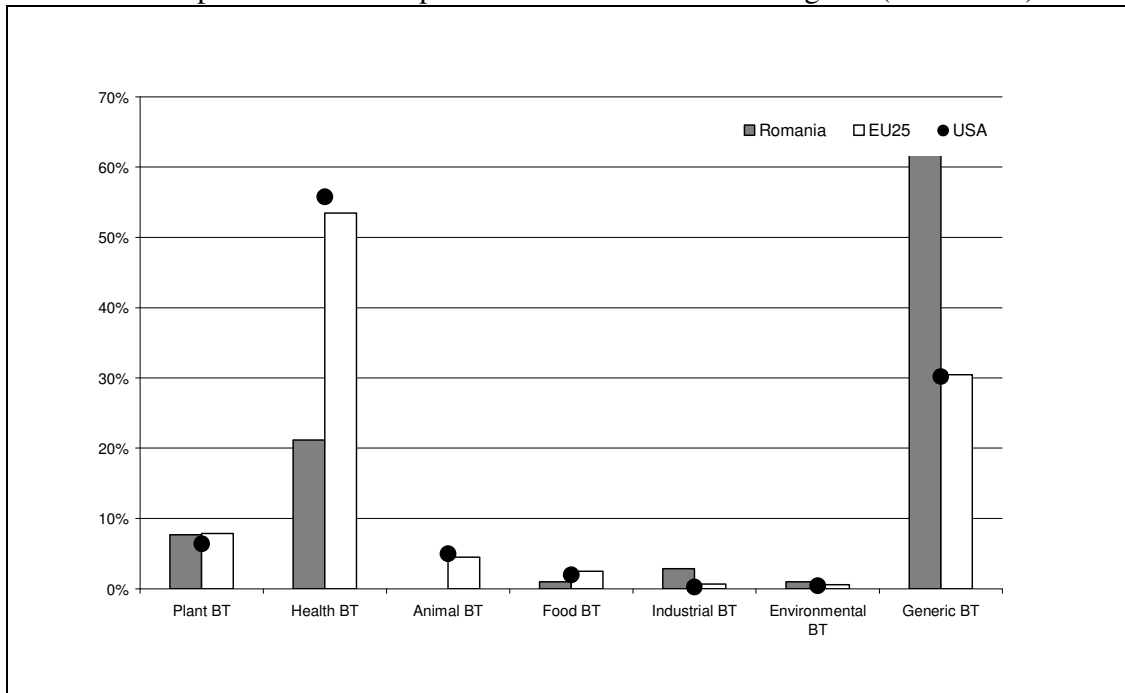
Chart 3.1 Romania biotechnology knowledge base indicators: comparison with EU25 and USA figures in three periods (index value)



Source: BioPolis Research  
Data: Science Citation Index

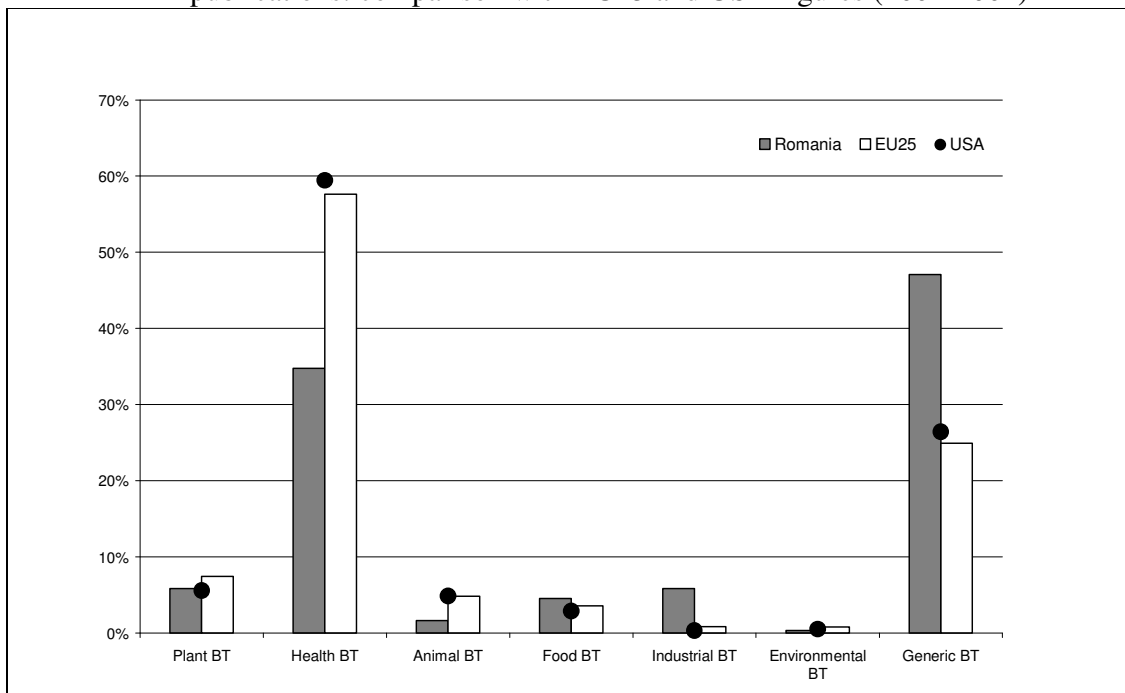
Romanian biotechnology publications can especially be found in the fields of generic biotechnology and human health biotechnology. This is consistent with findings from 1994-1996 and 2002-2004. If one compares both periods, the share of generic biotechnology publications remained prominent, although it decreased from 66% to 47%. The share of human health biotechnology publications came in second place, increasing from 21% to 35% over the ten-year period. Charts 3.2.1 and 3.2.2 show how biotechnology publications were spread over various research fields in Romania, the USA and EU25 in 1994-1996 and 2002-2004.

Chart 3.2.1 Share of biotechnology subfields, as a percentage of total biotechnology publications: comparison with EU25 and USA figures (1994-1996)



Source: BioPolis Research  
Data: Science Citation Index

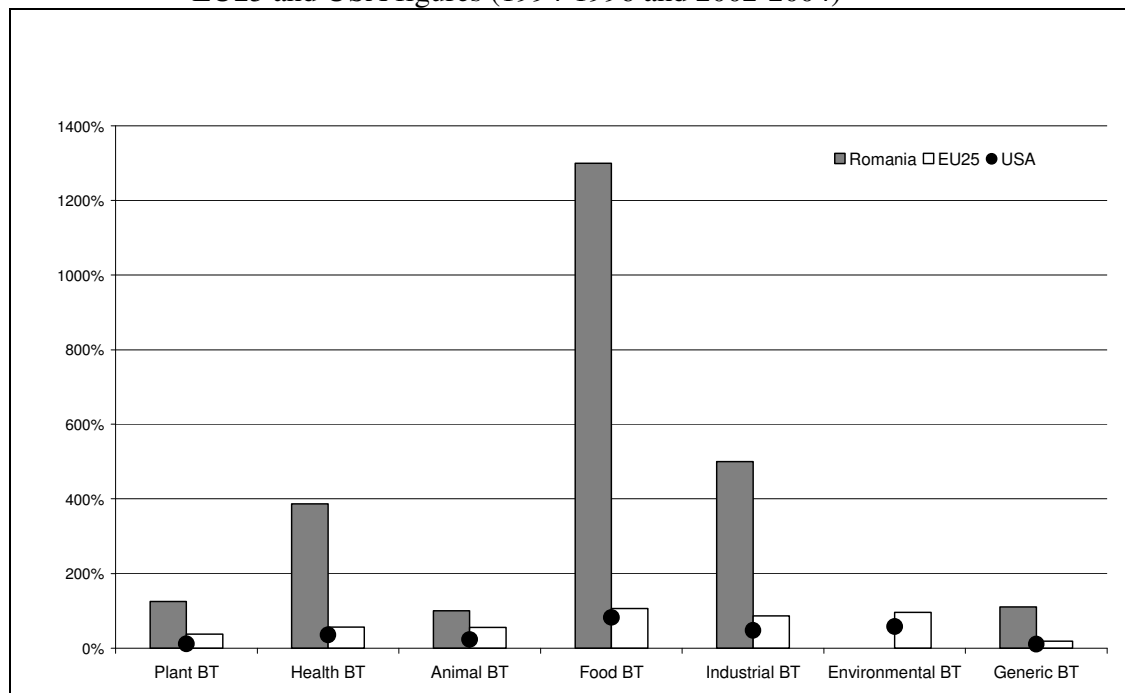
Chart 3.2.2 Share of biotechnology subfields, as a percentage of total biotechnology publications: comparison with EU25 and USA figures (2002-2004)



Source: BioPolis Research  
Data: Science Citation Index

In terms of the growth rate of biotechnology publications in various subfields, between 1994-1996 and 2002-2004, publications in food biotechnology grew by 1300%. Other significant growth rates were in industrial biotechnology (500%), health biotechnology (386%), plant biotechnology (125%), generic biotechnology (110%) and animal biotechnology (100%). Due to their relatively low starting point, Romanian growth rates in these subfields surpassed USA and EU25 levels (Chart 3.3). By contrast, Romania had a 0% growth rate in the environment biotechnology subfield, whereas the USA and EU25 both had substantial growth rates in this subfield.

Chart 3.3 Growth rates of biotechnology publications in Romania: comparison with EU25 and USA figures (1994-1996 and 2002-2004)

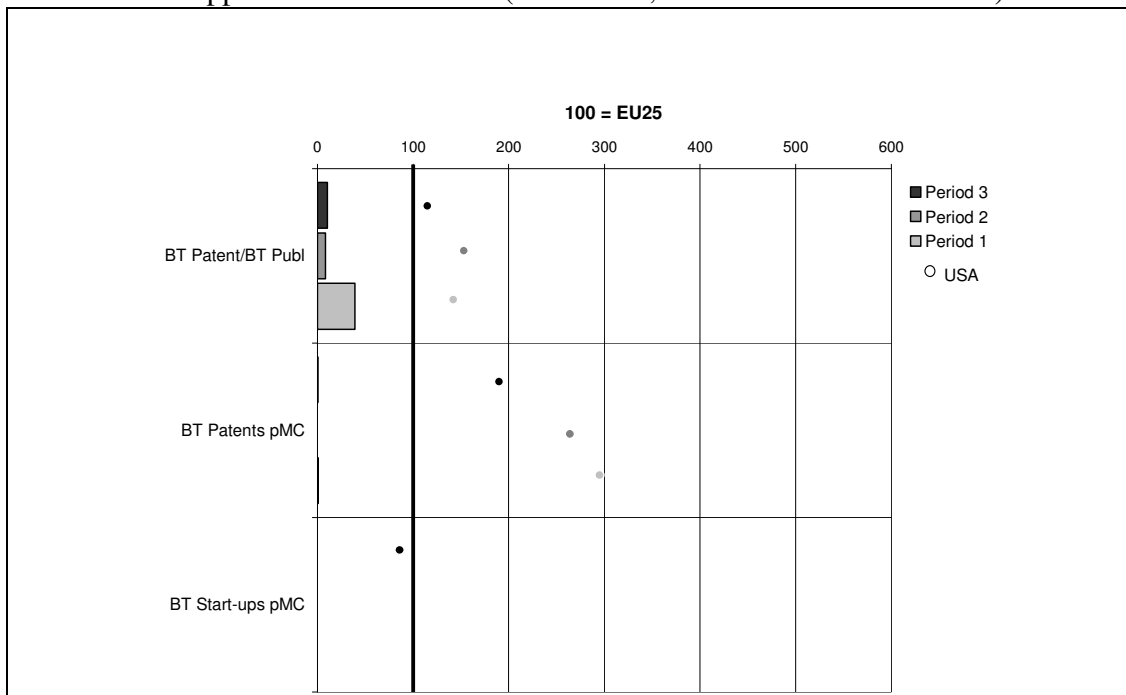


Source: BioPolis Research  
Data: Science Citation Index

### 3.3 Performance in knowledge transmission and application

In terms of biotech patent applications per biotech publications, Romania's output in the ten-year period was not only very limited, but also declined (index 39 in 1994-1996 to index 11 in 2002-2004). Romania performed far below EU25 and USA levels (index 142 to index 115 for the same periods). With regard to biotech patents per million capita, the Romanian output was equally insignificant (index 1 in 1994-1996 to index 0 in 2002-2004). In terms of biotech start-ups, there are no data available for Romania.

Chart 3.4 Performance indicators for biotechnology knowledge transmission and applications in Romania (1994-1996, 1998-2000 and 2002-2004)



Source: BioPolis Research  
Data: Science Citation Index

### 3.4 Industrial development

To date, indicators for industrial development, as measured by the number of biotechnology companies pMC, biotech Initial Public Offerings pMC and Venture Capital invested in biotechnology companies EUR pC, do not record any achievements for Romania (2005 data). This is consistent with the information provided in Section 1.1, which suggests that there are currently no industries specialised in biotechnology in Romania.

### 3.5 Market conditions

To date, indicators for market conditions, as measured by the number of field trials and approved biomedicines, do not record any achievements for Romania. It is only recently that field trials have been allowed in Romania (2005 data).

## 4. Conclusions

### 4.1 Introduction

This concluding chapter presents a summary of Romania's funding of biotechnology, which includes one non-directed policy instrument, namely the BIOTECH Programme. If policy-directed funding would have been available, this chapter would have presented more details including policy goals addressed, research application areas funded and activities stimulated through this type of funding. Regrettably, the MoER and the Romanian Academy could not provide sufficient data to enable the BioPolis study to present a more complete picture of biotech funding and other related aspects of the programmes. Therefore, the information in this chapter is limited to a summary of the funding available for biotechnology. In Chapter 2 more details about the non-policy directed BIOTECH Programme are presented.

### 4.2 Public funding of biotechnology through policy instruments

In Romania, public funding of biotechnology research is, according to our own definition, only available through non-policy-directed funding. Table 4.1 summarises the findings.

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

	2002	2003	2004	2005	Total
<b>RESEARCH</b>					
<b>1. Non-policy-directed</b>					
BIOTECH Programme	1.32	2.98	4.50	3.31	12.11
<b>2. Policy-directed, Biotech-specific</b>	-	-	-	-	-
<b>COMMERCIALISATION</b>	-	-	-	-	-
<b>GRAND TOTAL</b>	NDA	NDA	NDA	NDA	NDA

Source: BioPolis Research  
NDA: No Data Available

## **5. Future developments**

The BIOTECH Programme has been extended to 2006. Beyond 2006, the policy and corresponding instruments for biotechnology remain unclear. Meanwhile, the current National RDI Plan has been extended to 2006 as well. The future of biotechnology research in Romania will largely depend on how the next National RDI Plan will be defined.

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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

	<b>Indicator</b>	<b>Chart</b>	<b>Comments</b>	<b>Time periods</b>
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

	<b>Indicator</b>	<b>Chart</b>	<b>Comments</b>	<b>Time periods</b>
Ind. 6	Graduates in life sciences pMC	3.1	Index: Reference Region EU17 =100 and US data for comparison	(2) 1998 (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 <sup>2</sup>	2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100 US data for comparison	1995-2002

<sup>2</sup> [http://europa.eu.int/comm/public\\_opinion/archives/ebs/ebs\\_225\\_report\\_en.pdf](http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_225_report_en.pdf)

	<b>Indicator</b>	<b>Chart</b>	<b>Comments</b>	<b>Time periods</b>
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
Romania	101	176	315	23	22	22
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
Romania	4	8	15	2	3	5
USA	454	492	529	208	172	166

Source: BioPolis Research

Publications: SCI

Population: 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 (Mecu)	BT publications/ Mecu 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.		
Romania	315				n.a.		n.a.
USA	154402				n.a.		n.a.

Source: BioPolis Research

Publications: SCI

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
Romania	101	176	315	4128	5690	7293
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
Romania	2%	3%	4%	22	25	33
USA	13%	14%	15%	119	115	113

Source: BioPolis Research  
Publications: SCI

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
Romania	3.96	5.64	65	77
USA	6.39	8.54	104	117

Source: BioPolis Research  
Citations: SCI

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
Romania	n.a.	n.a.	23*	22
USA	75253*	70950	276*	288
	Graduates pMC		Index EU17=100	
	1998 / 1999	2002	1998 / 1999	2002
EU17	85**	189	100	100
Romania	n.a.	n.a.	n.a.	n.a.
USA	273*	246	321	131

Index EU17=100 for 1998 is actually EU16, because no data was available for Portugal

\* data for 1998; \*\* data for 1999

Source: BioPolis Research  
OECD Education Database  
Population source for US OECD

Raw data for Chart 3.2.1 BT publications in subfields, as share of total 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%
Romania	100%	8%	21%	0%	1%	3%	1%	66%
USA	100%	6%	56%	5%	2%	0%	0%	30%

Source: BioPolis Research  
Publications: SCI

Raw data for Chart 3.2.2 BT publications in subfields, as share 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%
Romania	100%	6%	35%	2%	5%	6%	0%	47%
USA	100%	6%	59%	5%	3%	0%	1%	26%

Source: BioPolis Research  
Publications: SCI

Raw data for Chart 3.2.1 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
Romania	104	8	22	0	1	3	1	69
USA	111686	7118	62274	5580	2230	296	459	33729

Source: BioPolis Research  
Publications: SCI

Raw data for Chart 3.2.2 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
Romania	308	18	107	5	14	18	1	145
USA	141680	7910	84234	6872	4070	436	724	37434

Source: BioPolis Research  
Publications: SCI

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%
Romania	125%	386%	100%	1300%	500%	0%	110%
USA	11%	35%	23%	83%	47%	58%	11%

Note: For those countries starting from 0 in period 94/96, the growth rate was set to 100% no matter how large the number in period 2002/2004 is. On the other hand, if the country reduces the number of publications to 0 in period 2002/2004, the growth rate is -100%.

Source: BioPolis Research  
Publications: SCI

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
Romania	2	1	2	23	22	22
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
Romania	0	0	0	1	0	0
USA	33	52	42	295	264	190

Source: BioPolis Research  
Publications: SCI  
Patents: 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
Romania	2	1	2	101	176	263
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
Romania	0.02	0.01	0.01	39	8	11
USA	0.07	0.11	0.08	142	153	115

Source: BioPolis Research  
Publications SCI  
Patents Questel Orbit

Raw data for Chart 3.5. Number of BT companies pMC for the period 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
Romania	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
Romania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
USA	5.11045	5.112158	5.06553	4.95054	99	99	116	99

Note: EU Available is the result of the sum of available EU member states

Source: BioPolis Research

Biotech companies: E&Y Beyond Borders 2002, 2003, 2004, 2005; 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 (EU 15 - Cyprus - Greece + Norway + Switzerland)	523	132	367051	
Romania	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 (EU 15 - Cyprus - Greece + Norway + Switzerland)	1.4	100	0.36	100
Romania	n.a.	n.a.	n.a.	n.a.
USA	1.2	86	0.29	79

Source: BioPolis Research  
Start-ups: EuropaBio

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

	BT IPO	Population T				
	2002-2005	2002	2003	2004	2005	2002-2005
EU Available	29	452927	454869	457154	461593	456636
Romania	0	21834	21773	21711	21659	21744
USA	52	287941	290789	291685		290138
	IPO /pMC	Index				
	2002-2005	2002-2005				
EU Available	0.00	100				
Romania	0.00	0				
USA	0.00	282				

Note: EU Available is the result of the sum of available EU member states  
IPO data: Ernst and Young 2002-2005, London Stock Exchange, Frankfurt Stock Exchange, Euronext, Nasdaq, Burrell & Company  
Source: BioPolis Research

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

	Venture capital in biotechnology companies M€			Population in T		
	2002	2003	2004	2002	2003	2004
Europe	1100	920	2800			
EU Available	890	883	1111	315584	319663	325131
Romania	n.a.	n.a.	n.a.			
USA	2288	2498	2855	287941	290789	291685
	Venture capital in €/pC			Index		
	2002	2003	2004	2002	2003	2004
Europe						
EU Available	2.8	2.8	3.4	100	100	100
Romania	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
Romania	n.a.	n.a.	n.a.	n.a.
USA	115	289	0.40	387

Note: EU 15 is the result of the sum of the first 15 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
Romania	n.a.		n.a.	n.a.
USA	6745	278	24	688

Note: EU 15 is the result of the sum of the first 15 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)
EU - 15*	100.29	16828
Romania	n.a.	n.a.

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

AGRAL	Programme for Agriculture and Food
ECOMA	Modern and efficient systems of organisation, commercialisation and management in agriculture and the food industry (sub-programme of AGRAL)
GESICA	Genotypes and performant technological systems for cereals (sub-programme of AGRAL)
IBB	Institute of Biology Bucharest
INDAL	Food Resources and Technologies (sub-programme of AGRAL)
MATNANTECH	Programme for New Materials, Micro- and Nanotechnologies
MoER	Ministry of Education and Research
RDI	Research and Development Innovation
NCST	National Council for Science and Technology
POLEVIT	Competitive viticulture products and sustainable development of viticulture agro-systems (sub-programme of AGRAL)
RESNAT	Evaluation, protection, improvement and use of natural resources (sub-programme of AGRAL)
RELANSIN	Programme for Economic revival through Research Innovation
SIMAGRO	Application systems and equipment in agriculture and food the industry (sub-programme of AGRAL)
VIASAN	Programme for Life and Health
ZOOMED	Animal breeding systems and sanitary veterinary protection (sub-programme of AGRAL)

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