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 Greece

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Summary

Greece's GDP (2001 data) is 131 000M EUR. Its Gross Domestic Expenditures on Research and Development (GERD) is 841.47M EUR or 0.64% of its GDP. The government contributes 46.94% and industry 26.69 %, with the rest (21.4%) coming from abroad (GSRT, 2005). The relatively high percentage of foreign funding is due to the influx of contracts mainly through the EU Framework Programme and EU Structural Funds.

Industries specialised in biotechnology applications do not exist in Greece. Public biotechnology research is carried out only by universities and research institutes. Since 2001 – when the Sectoral Programme in Agricultural Biotechnology ended – there has been no research support that is specifically targeted for biotech. However, number 8 of the current '14 Actions for Research and Technology' of the General Secretariat for Research and Technology (GSRT) includes 'particular emphasis on state-of-the-art technologies, such as biotechnology and environmental technology, and promotion of innovation in the ecology sector'.

In the period 2002-2005, Greece had no specific national programme on biotechnology. Funds for biotechnology were sourced from open competition under the Operational Programme 'Competitiveness' (OP 'COM' or EPAN). OP 'COM' is a very large national programme, but only a small proportion of its funds are allocated for research. The general strategic objective of the research part of the programme is to support quality-orientated competitiveness. The programme aims to create high-tech companies though the promotion of new technologies that utilise high-level scientific potential, along with the mobilisation of capital and rational use of modern financial credit instruments. It is envisioned that this will facilitate the development of 'new economy' activities in Greece.

In terms of performance in creating a knowledge base and supporting the availability of human resources, Greek output of biotechnology publications per million capita steadily progressed (from index 38 in 1994-1996 to index 64 in 2002-2004). Its output was nevertheless modest and below EU25 and USA levels. Similarly, Greece's share of biotechnology publications in relation to the total number of publications it produced remained below the EU25 level. However, with regard to biotech publications per public R&D expenditures on biotech for the period of 2002-2004, Greece had an impressive record and far surpassed the EU25 average. Greek biotechnology publications can especially be found in the field of human health biotechnology and generic biotechnology.

Greece's performance in knowledge transmission and application, in terms of patent applications per biotech publication, was relatively low and only slightly improved in the ten years covered by the study. It had zero biotechnology IPOs pMC, and its performance in the market was relatively poor. There were no approved biomedicines in Greece and only 60 field trials were carried out in the ten-year period. This figure is lower than the

EU25 average for the same period and significantly less than the number of USA field trials.

In Greece, public funding of biotechnology is only available through a national policy-directed generic instrument. The OP 'COM' Programme is a response mode programme with open calls for competitive proposals. The recipients of the grants, PROs and SMEs, reflect the government's objective of stimulating partnerships between the public and private sectors. The 50% contribution from the recipient reflects additional contribution from public funding for biotechnology research. This may be in the form of non-policy-directed budget allocations.

Despite the lack of specific biotechnology instruments, the funding for biotechnology research increased dramatically from an average total funding per annum of 3.9M ECU for the period 1994-1998 to 30.06M EUR during 2002-2005. In relative terms, however, the increase of percentage spent on biotechnology within total research funding was less dramatic. The increase rose from 9.26% in the period 1994-1998 to 13.1% between 2002-2005.

The policy goals for both periods remained consistent, particularly in the stimulation of private-public partnerships through, for example, the promotion of high-level industry-oriented research, the support of knowledge flow and the encouragement of business investments in research and development. To qualify for GSRT funding for both periods, research areas had to demonstrate private sector interest and be geared towards potential commercial application in the future.

With regard to future developments, a new general research strategy is anticipated in 2007. The future importance and policy directions of biotechnology for Greece will be defined within the context of this new strategy. Hence, at this stage, it is difficult to predict how biotechnology research and corresponding policy instruments will be addressed by the Greek government. Nevertheless, it is very likely that high technologies (including biotechnology) and cooperation between the public and private sectors will continue to be addressed. It is also very likely that this will be done through a programme similar to the OP 'COM' Programme.

1. Introduction and background

1.1 General introduction

Greece lies in southern Europe at the southern extremity of the Balkan Peninsula. It has a land area of 310 000 km² (Wikipedia, 2005) and a population of about 11 million (Eurostat, 2005).

Greece's GDP (2001 data) is 131 000M EUR. It's Gross Domestic Expenditure on Research and Development (GERD) is 841.47M EUR or 0.64% of its GDP. The distribution is 46.94% from government and 26.69 % from industry (Eurostat, 2005). Aside from the government and public contributions, a substantial percentage of the rest of R&D funding comes from abroad (GSRT, 2005). Greece's public GERD receives a high percentage (21.4%) of its funding from foreign sources. This is due to the influx of contracts mainly through the EU Framework Programme and Structural Funds (EU TrendChart, 2004). Greece is a major beneficiary of EU aid, which amounts to about 2.4% of its GNP (Wikipedia, 2005).

Greece has a mixed economy with the public sector accounting for about half of the country's GDP. Its gross value added (GVA) (2001 data) is approximately 101 480M EUR. The most important sector is the trade and the service sector, which includes transportation, tourism, communications, trade, banking, and public administration, which accounts for 30.84 % of the GVA. Tourism accounts for the largest portion of foreign exchange earnings. Greece is also an established world leader in shipping (first in terms of ownership of vessels and third by flag registration) (Wikipedia, 2005). Although Greece is generally considered to be an agricultural country, currently agriculture and fisheries only contribute 7.68 % to the country's GVA. Its agricultural products include cotton, olives, tomatoes, tobacco, wheat, beef, dairy products and wine (FAOSTAT, 2004).

Greece has no biotech firms (Boudourides and Kalamaras, 2002).

1.2 Characteristics of national S&T and innovation system

Ancient Greece had a long history of developing science and technology. However, industrial policy in modern Greece, certainly prior to the mid-1980s, was aimed primarily at improving the technological base via technology transfer from elsewhere. During that time, relatively little attention was directed towards the actual development of science and technology. Responsibility for research policy was in the hands of the Ministry of Culture (Kastelli, 2000). The first attempt at introducing a coherent research policy on science and technology started in the mid-1980s when the General Secretariat for Research and Technology (GSRT) was created, under the auspices of the Ministry for Industry, Energy and Natural Resources. The first step involved the creation of a national R&D infrastructure. Two main programmes were adopted: one to fund research activity in industry, the Industrial Research Development Programme (PABE), and an academic

research programme, which subsequently developed into the Programme for the Enhancement of Research Manpower (PENED) (EKT, 2005).

Over the last 20 years, the S&T policy in Greece has evolved towards a more EU-consistent framework of policy tools. The policy of support for the national research sector was implemented through the creation of specialised national programmes, such as the Operational Programme for Research and Technology (EPET I, 1990-1995) and STRIDE (1992-1998), which were funded through EU Structural Funds. The EPET II programme, part of the 2nd Community Support Framework (CSF), was the primary means for implementing national policy on research and technology in the period 1995-2000. The main aims of EPET II were the funding of R&D activity in areas of high economic interest, industrial research and technology transfer, as well as the funding and restructuring of the research facilities and the training and mobility of human resources.

Since 1994, Greek S&T policies have been aimed at the stimulation of the knowledge base and commercialisation of technologies (EPOHITE, 2003). The present system of priorities and objectives concerning science and technology innovation policy in Greece were established in 2000. These systems reflect the structure, measures and financial provisions of the Third Community Support Framework, co-funded by national and structural Third Community funds; mainly from the European Regional Development Fund and Social Fund (EU TrendChart, 2004).

The Operational Programme 'Competitiveness' (OP 'COM' or EPAN) constitutes the central funding mechanism for the development of new economic activities in Greece. Part of OP 'COM' is allocated for the country's R&D. The main priorities of the R&D strategy 2000-2006 remained the same as in 2000: to increase the share of corporate participation in R&D activities and create critical mass in the private sector.

OP 'COM' includes a package of measures which combines incentives for researchers to create new business ventures, to encourage start-up businesses, to support the so-called incubators and technology parks, and maintain excellence in research and technology. The 2001-2004 budget for OP 'COM' amounted to 6 392M EUR. The Structural Funds largely regulated the present innovation policy, mainly expressed and financed through OP 'COM'. This package of measures is underpinned by other administrative measures, which include the creation of the Fund for the Development of the New Economy (TANEO), which is the funding structure for venture capitalists (VCs). Other initiatives are the operational programme 'Information Society' (OPIS) and the programme 'Go-online', which aims to put 50 000 Greek enterprises online (EKT, 2005).

The 2000-2006 national strategic priorities for research and technology (GSRT, Ministry of Development, 2005) were:

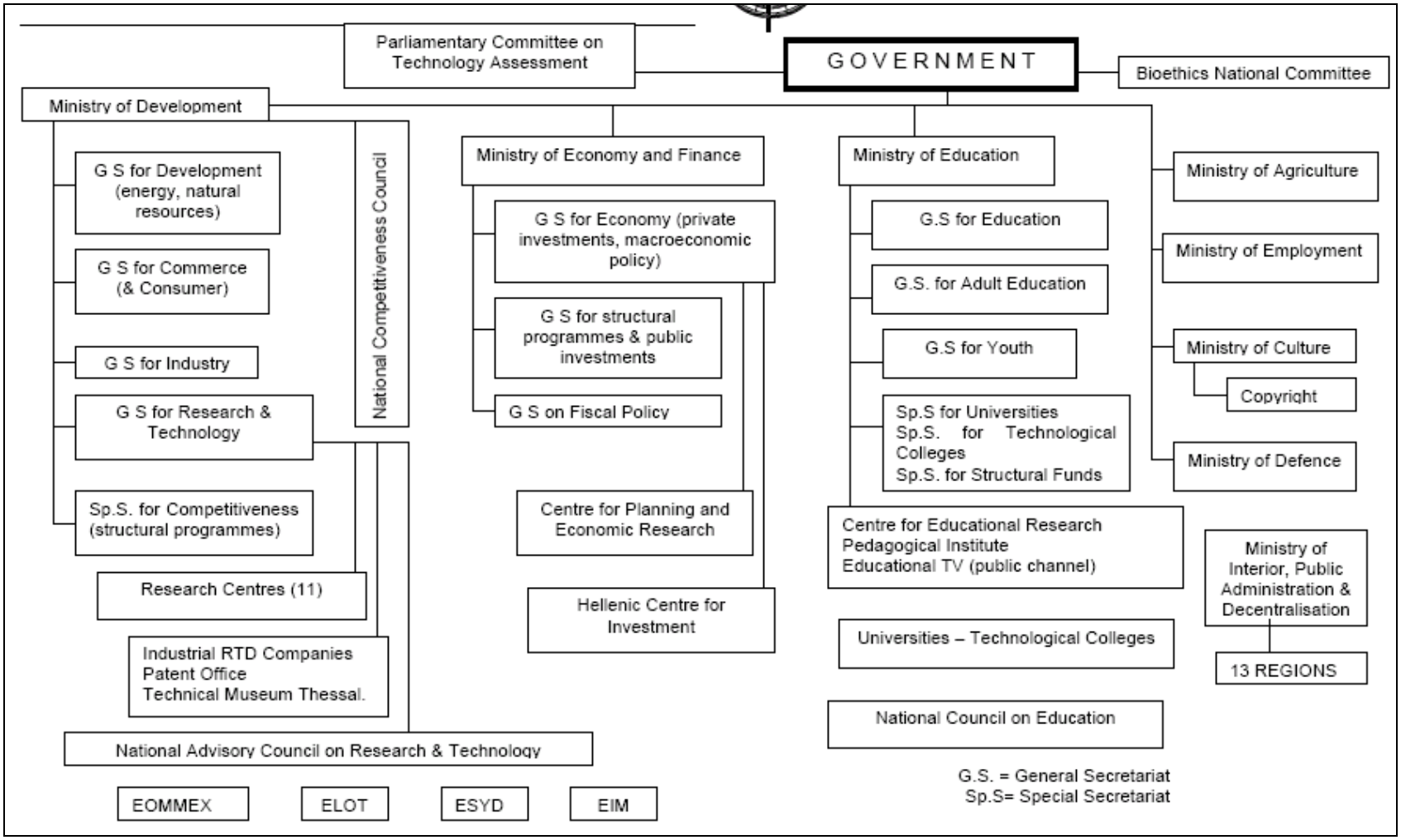
- Increase the demand for new knowledge and research results: e.g., by increasing investments in knowledge-intensive sectors and the reorientation of productive forces towards high added value products and services.

- Reorganisation of the research system and provision of knowledge: e.g. by reorientation of priorities of those research organisations currently under the wing of the GSRT towards economic and social development.
- 'Liberalisation' of the research system and opening it up internationally, e.g. increasing collaboration of Greek research teams from public research foundations and businesses with organisations aboard.
- Development of technological infrastructure for S&T policy: e.g. through ongoing modernisation of electronic networks and procedures to ameliorate access to networks and data bases and improve material infrastructures.

The thematic/sector priorities on S&T policy include: renewable energy; food and hydro culture; knowledge-intensive culture and tourism; health, biomedical, diagnostics and therapeutic methods; new forms of organisations, etc. Although biotechnology is not particularly mentioned in the four priority themes, the Ministry of Development's 14 Actions for Research and Technology include: 'particular emphasis on state-of-the-art technologies, such as biotechnology and environmental technology, promotion of innovation in the ecology sector' (Sioufas, Minister of Development, CORDIS 2005).

Figure 1.1 shows the current actors engaged in research and innovation policy making and implementation. The main organisations involved are: the Ministry of Development (MoD), through its General Secretariat for Research and Technology (GSRT); the Ministry of Economy and Finance (MoEF), through the units for Private Investment, Public Investment and Fiscal Policy; and the Ministry of Education (MoE). The policy instruments they use are legal frameworks and multi-annual programmes (EU TrendChart, 2004).

Figure 1.1 General overview of the governance system of Greece



Source: European TrendChart on Innovation, *National Report Greece*, 2003/2004

The GSRT is the main actor in innovation-policy implementation through funding schemes and legal instruments. It has been shifting its main focus away from R&D funding towards supporting the exploitation of research results. The MoD and GSRT are assisted by an advisory body in policy making and management of research institutions: the National Council for Research and Technology (NCRT). NCRT advises on national R&D priorities and the appointment of top management in research centres (e.g. the selection of a director).

The MoD is also responsible for industry, energy and natural resources, consumer protection and international (EU) trade. Through the General Secretariat for Industry (GSI), MoD is able to influence SME creation and development of standards. The MoD is also responsible for supervising research units, technological services firms, the Patent Office of Greece, as well as the funding of university and industrial RTD and the assessment of investment applications to MoEF funding (which prioritises incentives for innovative and high-technology ventures).

The MoEF defines Greece's macro-economic policy within the framework of ECOFIN and ECB guidelines and rules, and has overall responsibility for all structural funds in Greece. It manages incentives for private investments, including grants to investors and subsidy interest on loans. The legal framework provides special support to innovative companies and high-technology products and services.

The MoE acts as the think tank for policy elaboration, particularly for tertiary education and lifelong learning. The university systems, under the MoE, are the main operators for R&D. The MoE is responsible for research orientations and priorities and for the supply of fresh knowledge to the market place.

Other public authorities include the Ministries of Agriculture and Food; Public Works and Environment; Transport and Communications; Health and Defence. These bodies have research policies relevant for their respective fields.

1.3 National support and framework conditions for biotechnology

Prior to the early 1980s, biotechnology research did not receive special attention from the state. In the early 1980s, GSRT announced that biotechnology was one of its three priority policy areas. However, no explicit biotechnology programme was identified. The government nevertheless made efforts to set up the necessary infrastructure, and several regulations and laws were established to align Greece with the European Community. This included non-statutory regulation on gene therapy. One of the most important actions was the establishment of the Institute of Molecular Biology and Biotechnology (IMBB) in 1983. Since 1987, IMBB has become one of the seven institutes of the Foundation of Research and Technology (FORTH). The main research areas were insect molecular biology and molecular biology of unicellular organisms. In 1984, Biohellas SA was established as the formal state policy body for biotechnology promotion and development. It was designed to be the intermediary between private and public research

centres (Boudourides and Kalamaras, 2002). Biohellas was authorised to allocate funds for biotechnology research and contribute to shaping biotechnology R&D policy. Its sectoral focus was on health, agriculture and chemical industry. However, Biohellas failed to take off mainly due to incompetent management and lack of funding. It was closed down in the early 1990s (Caloghirou and Zambarlouskos, 2000).

During the period 1994-1998, funding allocation for biotechnology amounted to about 19.7M EUR (Benedictus and Enzing, 1999). In the period 1988-2000, the 'Sectoral Programme in Agricultural Biotechnology' operated with a budget of 2.5M EUR. The aim of the programme was to bolster the activities and infrastructures of technological research and development in the sector of agricultural biotechnology. The programme was administered by GSRT (EPOHITE, 2003).

The period 1994-2001 continued to be characterised by weak state support for biotechnology research. This was due to a combination of the following: a lack of critical mass for biotechnology, especially in the field of industry; a lack of systematic attention to IPR matters; the competition for financial support from industry; and the absence of support for biotechnology from industry (which remains very weak) in Greece.

Since 2001, when the Agricultural Biotechnology Programme finished, state support for biotechnology R&D has been very limited and only restricted to generic R&D programmes.

Regulation
With regard to biosafety, Greece signed and ratified the Cartagena Protocol on biosafety. Greece has a national Biosafety Committee whose members are drawn from academia (specialists in genetic engineering) and representatives from seven ministries. The committee reports to the Ministry of Environment. In addition, the Hellenic Food Control Agency (EFET) is the organisation in charge of biotech food control. It also enforces the EU-wide Traceability and Labelling Regulations. Other than enforcement of regulations, Greece does not conduct biosafety research

With regard to regulation on stem cell research, in Greece the procurement of human embryonic stem cells from supernumerary embryos is allowed by law under certain conditions (Matthiessen-Guyader [ed.], 2004).

In 2000, Greece established a National Bioethics Committee composed of academics, and one of their functions is to participate in public debates. The committee acts as an independent advisory body, subject to the authority of the Greek Prime Minister. It investigates the various aspects of scientific advances (Boudourides and Kalamaras, 2002).

Public opinion
In Greece, public opinion on biotechnology is influenced on the one hand by 'a population which does not perceive science as being of immediate importance to their lives' (Siotis in 'Educating the European Public for Biotechnology. The Position in

Greece', 2000), and on the other hand, a negative public opinion of GM crops. Boudourides and Kalamaras (2002) state that the Greek public is much more sensitive to food than to environmental issues: Greeks do not want GM products on their plates. NGOs such as Greenpeace and the E.K.Poi.Zo (Union of Consumers for Quality of Life) conducted a highly publicised campaign to keep Greece a 'GM-Free Zone'.

A survey conducted by the Eurobarometer showed that only 53% of Greek respondents said they believe that biotechnology and genetic engineering will have a positive effect on their way of life in the coming 20 years. Greece ranked one of the lowest countries among the EU25 in this regard. However, Greek respondents were more positive about medicines and new medical technologies (97%) and high-tech agriculture (74%). With regard to specific applications, among the EU25 Greece stood out as one of the countries who were strongly against cloning human stems cells. Moreover, they were also strongly against human cloning enabling a couple with a genetic disorder to have a child. This attitude is likely to be reflected by Greece having a very strong stand on protecting the dignity of any unborn human life. Greece also showed less tolerance to GM crops and growing meat from cell cultures. However, Greek respondents were more tolerant towards animal cloning for research in human diseases and the use of GM bacteria for cleaning up the environment.

Table 1.1 Response outlining the extent of Greek approval of the application of new technologies

Question	Never	Only in exceptional circum-stances	Only if highly regulated and controlled	In all circum-stances	DNK
Animal cloning for research in human diseases	34	23	30	9	
Human cloning so couples can have a baby despite genetic disorder	62	17	12	6	
Cloning human stem cells from embryos for organ transplant	39	21	25	9	6
Growing meat from cell cultures to avoid slaughter of animals	74	6	8	4	7
Developing GM crops to increase variety of regionally grown food	54	13	19	7	7
Developing GM bacteria for cleaning up environmental catastrophes	28	23	28	12	9

DNK: Do Not Know
Source: Eurobarometer, 2005

1.4 The main biotech policy and research actors in Greece

Greece has no specific policies for biotechnology and also no policy-making bodies specialised in biotechnology. Public biotechnology research is carried out by research institutes and universities.

The main public research bodies in Greece engaged in biotechnology research are the six research institutes supervised by GSRT, the National Agricultural Research Foundation (NAGREF) and the Genetic Molecular Biotechnology Department of the Hellenic Centre for Marine Research.

The six GSRT-supervised research institutes are:

- The National Centre for Scientific Research 'DEMOKRITOS'
- Biomedical Research Centre 'Alexander Fleming'
- Foundation for Research and Technology Hellas (FORTH)
- Hellenic Pasteur Institute
- The National Hellenic Research Foundation
- Centre for Research and Technology (CERTH)

The National Centre for Scientific Research 'Demokritos' performs research in ten areas. The areas chosen aim to promote the development of high, added value, new knowledge and technologies; expand the possibilities of exploiting the centre's products and services for the socioeconomic development of the country; and explore the possibilities and conditions likely to foster the development of new high technology production units. Area 9 is 'Biomolecules, Natural Products & Biotechnology'. The centre's scientific activities are carried out by eight institutes, including the Institute of Biology.

The Biomedical Sciences Research Centre 'Alexander Fleming' conducts research in immunology, molecular biology and genetics. The centre is composed of two high-level institutes: the Institute of Immunology and the Institute of Molecular Biology and Genetics. The institutes work in the fields of cellular immunology, disease modelling, transgenic and conditional mutagenesis in mice, transcriptional and post-transcriptional regulation of gene expression, inter- and intra-cellular signalling and functional genomics.
The centre runs its own animal house unit and has established transgenic animal models for rheumatoid arthritis, inflammatory bowel disease and multiple sclerosis. These models have served as a basis for multiple collaborations with the international biopharmaceutical industry in the evaluation of novel therapeutic compounds, or as tools for collaborative R&D. In addition, the centre runs a core facility for proteomics and gene expression profiling that has established several collaborative projects with academic partners in Greece and abroad. The facility also provides services to local and international biotechnology and pharmaceutical companies.

The Foundation for Research and Technology Hellas (FORTH), through its Institute of Molecular Biology and Biotechnology (IMBB), conducts research in the areas of

biotechnology of recombinant proteins (e.g. biopharmaceuticals, industrial enzymes), protein and membrane-based biosensors and bionanotechnology of transport devices and motors. In addition, FORTH's Institute of Chemical Engineering and High Temperature Chemical Processes (ICE-HT) conducts research in systems analysis and engineering, nanotechnology and materials science, surface characterisation, metabolic engineering, fermentation technology, quantitative systems biology and biotechnology to pursue integrated projects for the development of analytical and computational techniques and tools for the analysis of biological systems.

The Hellenic Pasteur Institute has a long tradition in leading biomedical research and public health services. The study of infectious diseases and immunology and neurobiology are the main focuses of the institute's research activities. The institute is active in the production of recombinant proteins in heterologous systems (bacteria, yeast, protozoa and mammalian cells with the help of viral vectors, such as retroviruses and adenoviruses), the production of monoclonal and polyclonal antibodies with classical technology and phage display, and the isolation, genetic manipulation and differentiation of neural stem cells.

The National Hellenic Research Foundation (NHRF) is a multidisciplinary research centre. One of NHRF's six research institutes is the Institute of Biological Research and Biotechnology (IBRB). IBRB works in three research areas: the biological mechanisms of carcinogenesis, ageing and other degenerative diseases; environmental carcinogenesis and genetic toxicology and enzyme technology; and biocatalysis with applications of biological and biotechnological interest. A common aim of the research in these three areas is the understanding of the mechanisms of interaction between the genome and the environment as a basis for elucidating the environmental dimension of human disease and ageing, in order to model and develop chemo-protective agents and to identify natural products with such characteristics. A second aim, in accordance with GSRT policies, is product development and technology transfer to industry and institutions.

The Centre for Research and Technology Hellas is a non-profit government research centre with the mission of carrying out basic and applied research with special emphasis on the exploitation of research results. One of its institutes is the Institute of Agrobiotechnology (IN.A). IN.A. is responsible for carrying out basic and applied research in the field of biotechnology with applications in the agricultural sector. Areas of research include genetic improvement of all kinds of plants, development and exploitation of new biodiagnostic methods, and exploitation of new technologies for the production and control of plant materials, biomass, food and beverages. Special emphasis is given to the reproduction of plants for pharmaceutical purposes. The institute works on the utilisation of biotechnologies in the production and testing of seeds and propagation material, the development and application of biodiagnostic technologies in plants and other organisms. Additionally the institute works in the following areas: utilisation of Greece's rich biodiversity, applications of biotechnology in food production and testing, plant by-product processing, production of novel materials, diagnostic kits, etc.

Aside from these six national research centres, which are supervised by GSRT, other relevant research institutes include the National Agricultural Research Foundation (NAGREF) and the Genetic Molecular Biotechnology Department of the Hellenic Centre for Marine Research. NAGREF is the principal national organisation involved in agricultural research. Its research and technological activities are in the fields of agriculture, livestock, fisheries, agricultural products technology, and environment protection through the use of biotechnological approaches. For example, research in transgenic tobacco and melon plants aimed at improving the organoleptic and nutritious properties; increase of disease resistance of cucumber with the isolation of specific genes through the application of genetic engineering techniques; and the study of the ethical and social issues arising from the applications of biotechnology in the agrofood sector. In addition, NAGREF's Forest Research Institute conducts research in forest genetics, breeding and biotechnology.

The Genetics Molecular Biotechnology Department of the Hellenic Centre for Marine Research introduced the use of molecular genetic markers for the analysis of natural and cultivated populations of marine species in Greece. Its main research orientations are directed towards the study of genetic variation and the stock structure of wild populations of commercially important fish species; the production of superior broodstock for aquaculture species by means of genetic improvement for fitness characteristics; and the better understanding of the physiological bases of traits such as reproduction, fertility and sex determination.

Biotechnology research is also conducted by universities. Currently, three universities are confirmed to be active in biotechnology research. They are the Agricultural University of Athens, which is engaged in plant breeding and bioremediation; the University of Patras (see FORTH/ICE-HT) and the Ioannina Biomedical Research Institute (IBRI) of the University of Ioannina (see NHRF). IBRI also collaborates with FORTH and works in the field of molecular medicine, biomedical technology and molecular epidemiology.

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

2.1 Introduction

This part of the report reviews the funding of biotechnology research and commercialisation. In the report a distinction is made 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 that have been specifically set up to stimulate biotechnology. Generic policy instruments are instruments that are not dedicated to a specific technology, but which 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 to 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 given through block grants to (government) research institutes and the open-call system of research councils.

Data were collected through desk research (publications, documents, websites of national and regional public funding organisations and/or governmental departments), a survey conducted by representatives of funding organisations that manage the generic and biotech-specific programmes, interviews with representatives of organisations that are involved in non-policy-directed and policy-directed funding. Websites of the funding organisations and their programmes and the names of contact persons who participated in the survey and/or who were interviewed can be found in Annex 3 (List of contact persons) and Annex 4 (References).

In Greece, our definition of non-policy-directed funding does not generally include biotechnology research. For GSRT, there are no other funding instruments for research other than the OP ‘COM’ Programme. The block grants from the respective ministries, e.g. the Ministry of Agriculture and the Ministry of Health, are in most cases mainly used for staff salaries of the sectoral research institutions. Sometimes it is also used for technical infrastructures (e.g. DNA sequencing facility) as well as training and

scholarship programmes. Research organisations, including universities, can only conduct research through project grants and not through block funding (information source: prof. Tsaftaris). For that reason this chapter will only deal with the policy-directed instruments (Section 2.2). Charities can also play an important role in funding biotechnology research in some countries. However, there are no charity organisations in Greece financing biotechnology-related research. The final section of this chapter provides a short overview of the European funding of biotechnology research in Greece through the 6th Framework Programme.

2.2 Policy-directed instruments

This section provides an overview of the national policy-directed instruments supporting biotechnology research, transfer and commercialisation during the period 2002-2005. There are no biotech-dedicated programmes; biotechnology activities are only funded through the generic programmes described below.

Table 2.1 National public policy-directed biotechnology-stimulating instruments during the period 2002 – 2005 (M EUR)

Instrument	Funding organisation	Biotech part of the budget	Use of DF/SF
Generic			
Operational Programme 'Competitiveness' (OP'COM' or EPAN)	General Secretariat for Research and Technology	90.18	55.46

Source: BioPolis Research

The majority of funds for biotechnology research, technology transfer, commercialisation and other activities are sourced through open competition under the Operational Programme 'Competitiveness' (OP 'COM' or EPAN).

EPAN is a substantial national programme, but only a small proportion of its funds is allocated to research. The general strategic objective of the research part of the programme is to support competitiveness. The programme's main aims are to create high-tech companies though the promotion of new technologies that utilise high-level scientific potential, along with the mobilisation of capital and the rational use of modern financial credit instruments. It is envisioned that this will facilitate the development of 'new economy' activities in Greece. For this purpose, the programme facilitates the full use of venture and high-risk capital (especially for new enterprises) to improve the links between education, training and business needs.

The management of the EPAN programme is carried out by GSRT, with about 150 personnel representing all educational levels and specialties. GSRT also works with external collaborators, the members of the National Advisory Council for Research and Technology and other experts from Greece and aboard.

The programmes of the EPAN programme include:

- PRAXE Programme for the Exploitation of Research Results (76M EUR).
- ELEFTHO Programme for the creation of S&T parks and incubators (85M EUR).
- Programme for the Development of Industrial Research and Technology (PAVET) (52M EUR).
- Programme for Demonstration Projects (PEPER) (54M EUR).
- HERON Programme for the support of employment of research staff in enterprises (75M EUR).
- TECHNOLOGY BROKERAGE Programme for the support of intermediary technology transfer organizations (5.9M EUR).
- AKMON Programme for the development of research centres with the participation of users (30M EUR).
- Liaison Offices in Research Centres and Higher Educational Institutes for the exploitation of research results and the matching of researchers with potential sponsors (30M EUR).
- International Cooperation in Industrial Research (21.5M EUR).
- Bilateral and International S&T Collaboration Programme with bodies from technologically developed countries and international organisations (15M EUR).
- European Union Framework Programme and development of the European Research Area (ERA).
- Development of Excellence in the Research Centres supervised by GSRT (10.3M EUR).
- Concerted Programmes in selected economic, scientific, cultural and environmental fields (164M EUR).
- Foresight Programme for the selection of research and technology policy directions in Greece (1.5 M EUR).
- PENED Programme for the Support of Researchers for training young researchers (60M EUR).
- ENTER Programme for the Integration of Foreign Researchers for attracting notable researchers from abroad and integrating them into the national research system for a specific time period (7M EUR).
- TECHNO LEARNING Programme for the familiarisation of pupils and teachers with science and technology issues (3.9M EUR).
- HERMES Programme for increasing public awareness in science and technology.
- Programme for improving awareness on patents and their use.

Up until the present time, the EPAN programme has been set up in response mode and open call for competitive proposals. In principle it is open to all science and technology including biotechnology in relation to plants, animal, health or food, industrial biotechnology and basic biotechnology.

2.3 Participation in 6th Framework Programme

Greece is an active participant in the 6th Framework Programme, especially in the 'Life Sciences, Genomics and Biotechnology for Health' (Thematic Priority 1) part of the

programme; it participates in 82 (of the 8 537) projects and coordinates 11 (of the 759) projects. Greek researchers also participate as members of the project team in Thematic Priority 5 on 'Food Quality and Safety' and in the NanoBiotech section of Thematic Priority 2 on Nanotechnologies.

Table 2.2 Greece involvement in 6th Framework Programme

6th Framework Programme[1] Thematic priority	**Participations as coordinator**	**Participations as member of the project team**[2]
1. Life sciences, genomics and biotechnology for health	11 (1.45%)	82 (0.96%)
2. Nanotechnologies, section bionanotechnology	0	2 (1.89%)
5. Food quality and safety	0	28 (1.75%)

[1] First and second call, all types of projects.
[2] Persons/groups can participate in more projects, resulting in more participation.

3. Performance of the national biotechnology innovation system

3.1 Introduction

This chapter analyses the performance of the Greek 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 the EU25 member states and the USA.

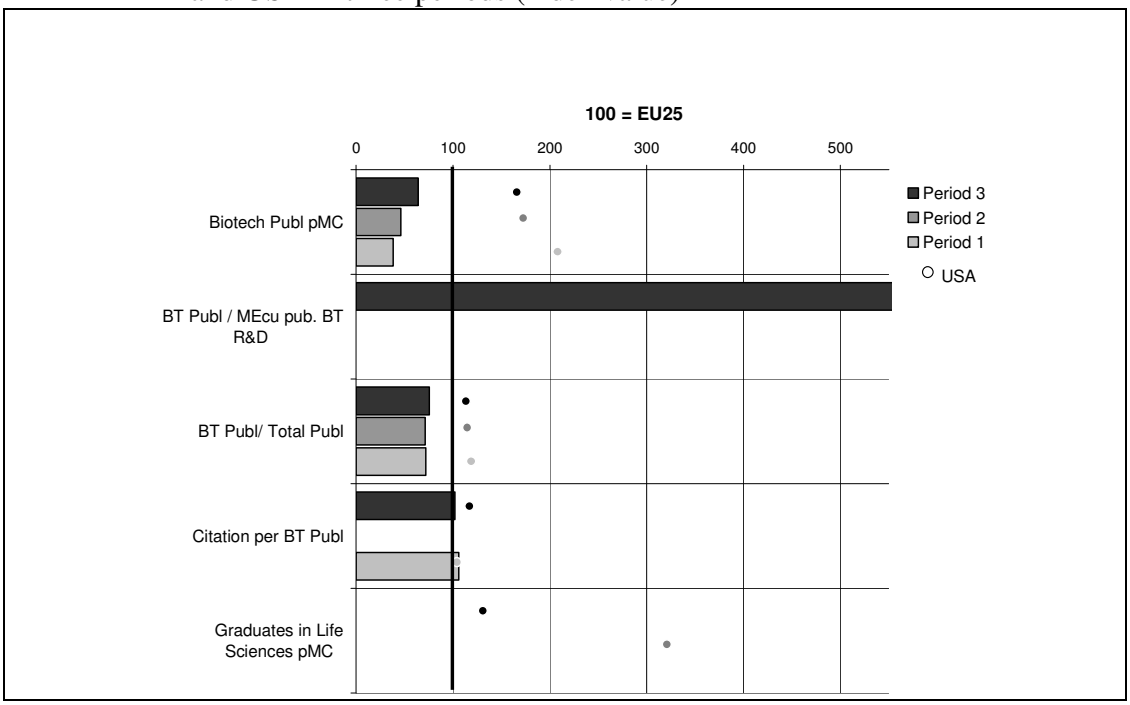
The presentation of Greece's performance is structured along four main policy areas considered in BioPolis. For each policy area, comparisons are made with the EU25 and the USA. For each area, data are shown of a number of different indicators for Greece, the USA and EU25. The values of EU25 have been chosen as a reference in each indicator. The absolute figures used to calculate the values for the indicators presented and the sources for the data can be found in Annex 5. In principle, for each indicator data are presented for three periods. The periods chosen can vary considerably between the indicators; Table A.5.1 presents for each indicator the specific years for each period.

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

Considered over a ten-year period, Greek output of biotechnology publications per million capita steadily progressed (from index 38 in 1994-1996 to index 64 in 2002-2004, see Chart 3.1.). However, its output was modest and below EU25 (index = 100) and USA publication levels (index 166 in 2002-2004). Similarly, the share of Greece's biotechnology publications in relation to the total number of publications it produced remained below the EU25 level (index 72 in 1994-1996 to index 75 in 2002-2004 for Greece). In terms of biotech publications per public R&D expenditures on biotech, for the period of 2002-2004, Greece had an impressive record of 710, and performed significantly higher than the EU25.

When considering the number of citations per biotechnology publication, Greece (index 106 in 1994-1996 to index 102 in 2002-2004) performed slightlyabove the EU25 level, but below the USA (index 104 in 1994-1996 and index 117 for 2002-2004). With regard to the number of graduates in life sciences per million capita, there is no available data for Greece.

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

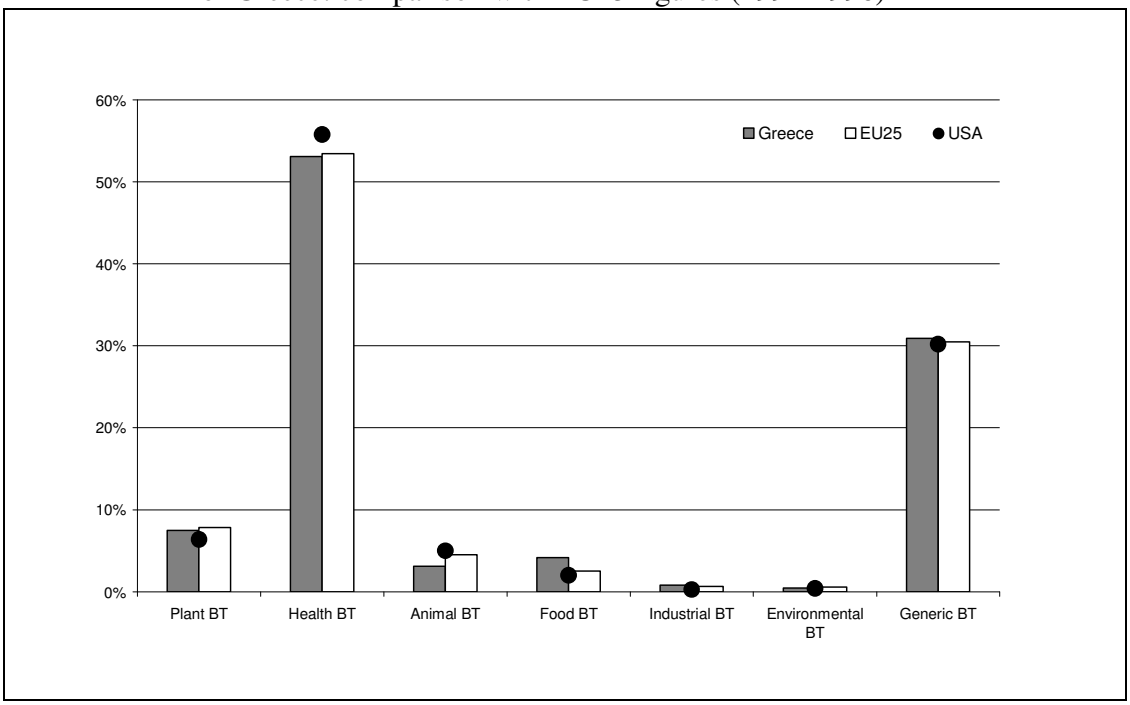


Source: BioPolis Research
Data: Science Citation Index

Greek biotechnology publications are especially prevalent in the field of human health biotechnology and in generic biotechnology. This picture did not really change between the periods 1994-1996 and 2002-2004. The share of human health biotechnology remained most prominent, with a slight increase from 53% to 58%. The share of generic biotechnology remained second, although it decreased from 31% to 25%.

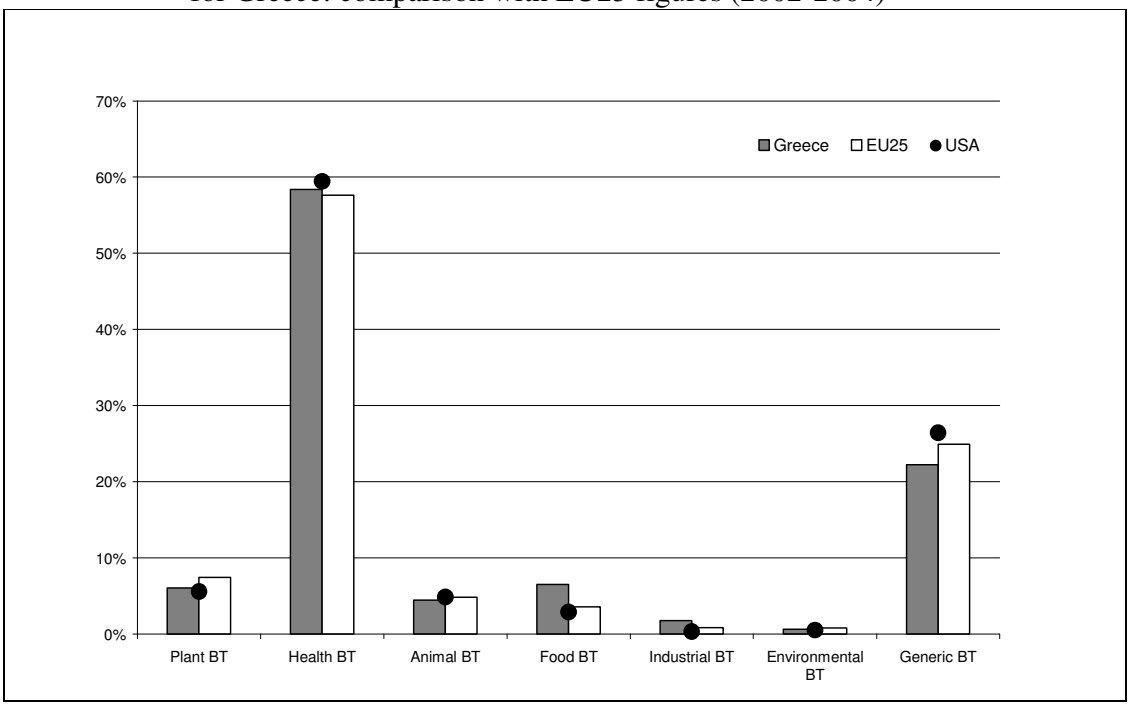
Concerning the distribution of biotechnology publications over the various research fields, Charts 3.2.1 and 3.2.2 show the various shares for Greece, the USA and EU25 in period 1994-1996 and period 2002-2004.

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



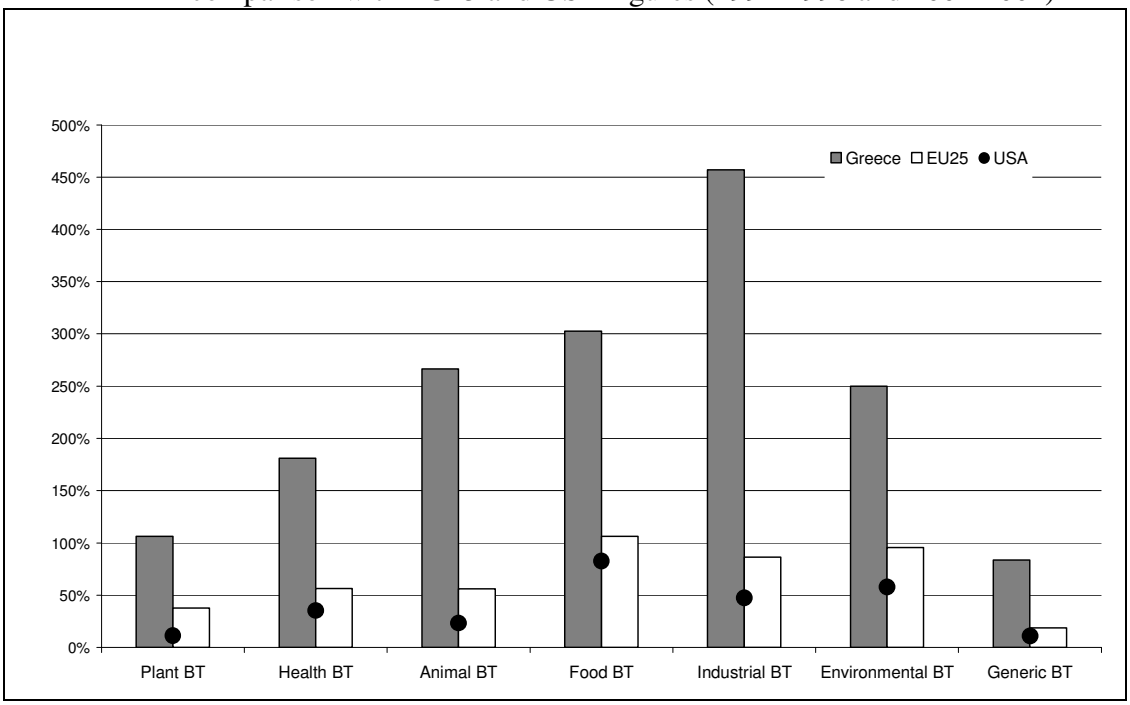
Source: BioPolis Research
Data: Science Citation Index

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



Source: BioPolis Research
Data: Science Citation Index

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



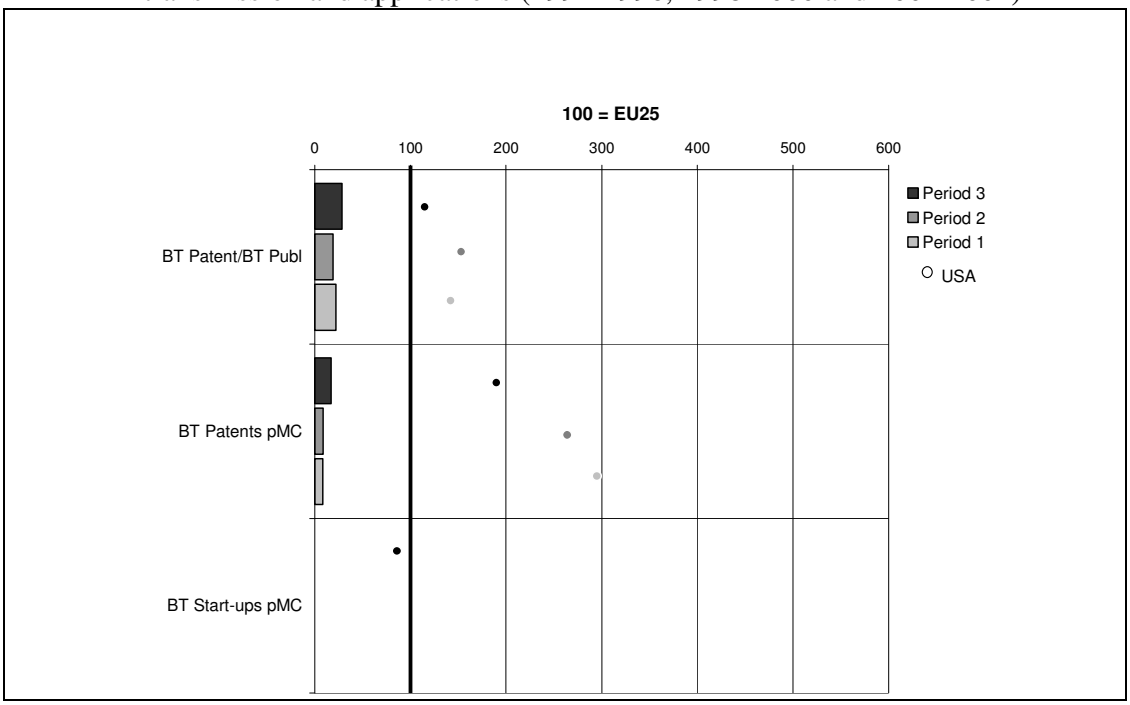
Source: BioPolis Research
Data: Science Citation Index

With regard to growth rates in the number of biotechnology publications in the various biotechnology subfields between 1994-1996 and 2002-2004, publications in industrial biotechnology grew most significantly at 457%. This was followed by significant growth rates in all other subfields: food biotechnology (303%), animal biotechnology (267%), environment biotechnology (250%), health biotechnology (181%), plant biotechnology (106%) and generic biotechnology (84%). Greek growth rates were all significantly above those of the USA and EU25. This was mainly due to the relatively low starting point of Greek biotechnology research.

3.3 Performance in knowledge transmission and application

In terms of biotech patent applications per biotech publications, the output of Greece slightly improved over the ten-year time frame (from 22 for 1994-1996 to 28 for 2002-2004). Similarly, with regard to biotech patents per million capita, the output of Greece slightly increased over the ten-year period (from index 9 for 1994-1996 to index 17 for 2002-2004). When compared to the performances of the EU 25 and the USA for the same indicators, Greece's performance was much lower. With regard to biotechnology start-ups, there is no data for Greece.

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



Source: BioPolis Research
Data: Science Citation Index

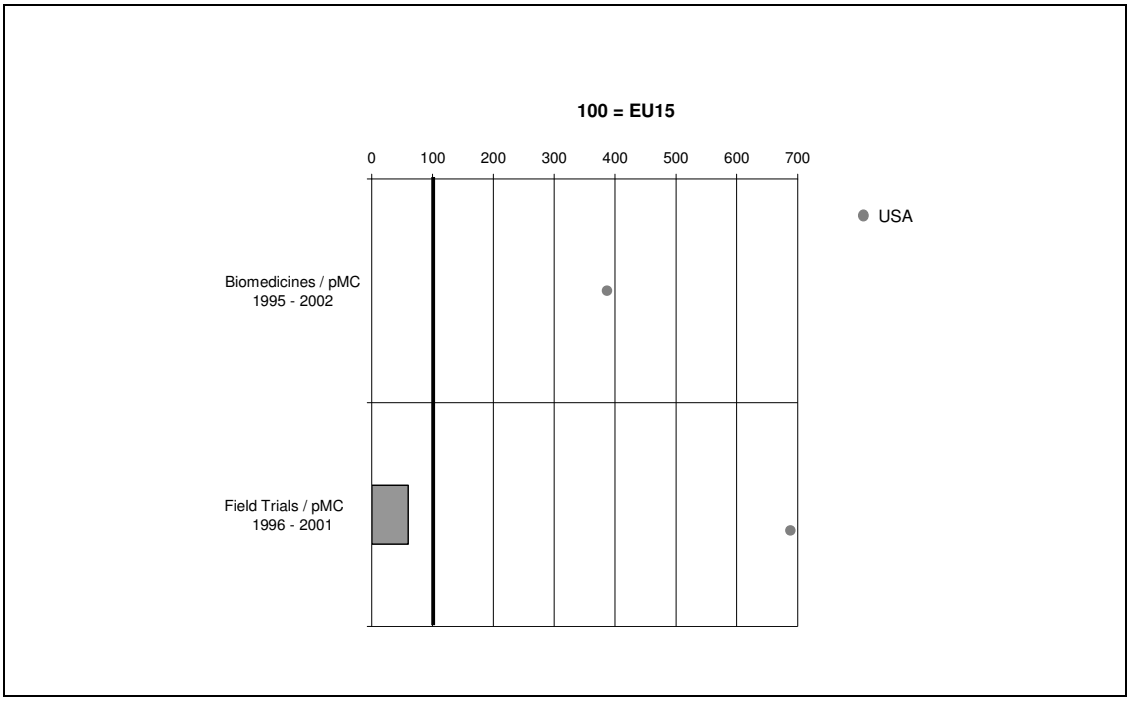
3.4 Industrial development

Three indicators based on 2001 data are used for performance in industrial development: the number of biotechnology companies pMC, the number of biotech IPOs pMC and venture capital in EUR pC. Greece has zero biotechnology IPOs pMC, while there is no data available for Greece's number of biotechnology companies pMC and venture capital in EUR pC.

3.5. Market conditions

Two indicators are used to assess market conditions: approved biomedicines (1995-2002) and field trials (1996-2002). For the period covered, there were no approved biomedicines in Greece. However, there were 60 field trials in Greece. This figure was lower than the EU25 average and well below the number of field trials in the USA (688).

Chart 3.5 Performance indicators for Greece's market conditions



Source: BioPolis Research
Data: Science Citation Index

4. Conclusions

4.1 Introduction

This concluding chapter contains tables that summarise information about Greece's funding of biotechnology, in terms of the types of policy instruments used, the policy goals addressed, the research applications areas funded and the activities stimulated. It also provides a comparison with the period 1994-1998.

4.2 Public funding of biotechnology through policy instruments

In Greece, public funding for biotechnology is only available through one national policy-directed generic instrument. The OP 'COM' Programme (or EPAN) has been set up in response mode and open call for competitive proposals. In relative terms, the budget spent on biotechnology is 13.1% of the total budget of the OP 'COM' Programme.

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

	2002	2003	2004	2005	Total
RESEARCH					
1. *Non-policy-directed*	n.a.*	n.a.	n.a.	n.a.	n.a.
2a. *Policy–directed, Generic*					
National	23.71	27.93	38.54	n.a.	90.18
COMMERCIALISATION	n.a.	n.a.	n.a.	n.a.	n.a.
GRAND TOTALS	23.71	27.93	38.54	n.a.	90.18

* n.a.: not data available
Source: BioPolis Research

4.3 Specific features of the instruments

Table 4.2 provides further information about the recipients of grants, and the proportion of grants provided by public authorities. The recipients of the grants, PROs and SMEs, reflect the government's objectives of stimulating partnerships between the public and private sectors. A 50% contribution from the recipient is requested. This may be in the form of non-policy-directed budget allocations, which are generally used for staff salaries, as discussed in Section 2.1.

Table 4.2 Instrument features

Instrument	Funding agency	Participants/Recipients			Financial contribution required (%)	
		PROs	SMEs	LFs	Recipients	Public authorities
Generic						
OP 'COM'	GSRT	√	√		√	

Source: BioPolis Research

4.4 Policy goals

The policy goals covered by the policy-directed generic instrument show consistency in funding linkages between academia, public research organisations and industry. This reflects the government's goal of bolstering the country's innovativeness and competitiveness in high technologies.

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

	Policy goals								
	1	2	3	4	5	6	7	8	9
National									
Generic									
Operational Programme 'Competitiveness' (OP 'COM' or EPAN)	√	√	√		√	√			√
Total	n.a.	n.a.	n.a.		n.a.	n.a.			n.a.

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

Source: BioPolis Research

4.5 Biotech research application areas

Table 4.4 shows the application areas of biotechnology funded by EPAN programmes. Human health biotechnology received most of the funding. The emphasis on human health is consistent with the health subfield having the highest share of biotechnology publications as described in Chapter 3. The second biotech application area is the ethical, legal and social aspects of biotechnology. Other application areas which received less funding include environmental, industrial and basic biotechnology.

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

	Biotech application areas							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
National								
Generic								
Operational Programme 'Competitiveness' (OP 'COM' or EPAN)			√	√		√	√	√
Total			0.8	46.69		3.5	4.67	34.52
Grand Total			0.8	46.69		3.5	4.67	34.52
% of Grand Total			0.9	51.77		3.8	5.18	38.28

1 = Plant biotechnology
2 = Animal biotechnology
3 = Environmental biotechnology
4 = Health biotechnology
5 = Food biotechnology
6 = Industrial biotechnology
7 = Basic biotechnology
8 = Ethical, legal, social aspects of biotechnology

Source: BioPolis Research

4.6 Stimulation of biotech activities through the instruments

Table 4.5 shows the type of activities that were stimulated for the period 2002-2005 through EPAN programmes. The EPAN programmes addressed eight different activities. Taking relative budget allocation as a measure of activity, it can be concluded that technology transfer activities in particular were given high priority (activities 11, 12, 15), followed by collaborative research and, to a lesser extent, basic research.

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

	Biotech activities							
	1	**2**	**3**	**8**	**10**	**11**	**12**	**15**
National								
Generic								
OP 'COM' or EPAN	√	√	√	√	√	√	√	√
Total	12.09	6.54	2.25	16.34	6.54	18.52	16.57	11.34
Grand Total	12.09	6.54	2.25	16.34	6.54	18.52	16.57	11.34
% of Grand Total	13.41	7.25	2.50	18.12	7.25	20.54	18.37	12.58

1 Basic research
2 Applied research
3 Centres of excellence
4 Research network
5 Mobility of researchers among disciplines
6 Biotechnology training
7 Mobility of researchers between academia and industry
8 Collaborative research between industry and public research organisations
9 Set up research institute/centre of industrial interest
11 Science and technology park
12 Protection of IPR in public research organisations
13 Financial support for start-ups
14 Non-financial support for start-ups
15 Creation of incubators
16 Awareness of biotech by companies not yet active
17 Grants for industrial research
18 Other incentives for business investment
19 Support for public discourse activities

10 Technology transfer office
Source: BioPolis Research

4.7 Dynamics: comparison with 1994-1998

This section compares the period of study 2002-2005, with the Inventory Study of Greece,[1] which covered the period 1994-1998. The basis of comparison is the average total funding per annum (Table 4.6) and the presence of policy instruments for specific policy goals (Table 4.7).

Despite the lack of specific biotechnology instruments for 2002-2005, funding for biotechnology research increased dramatically, from an average total funding per annum of 3.9M EUR for the period 1994-1998 to 30.06M EUR. In relative terms, however, the increase of percentage spent on biotechnology within total research funding was less dramatic. The increase was from 9.26% during period 1994-1998 (Benedictus and Enzing, 1999) to 13.1% for period 2002-2005.

Table 4.6 Comparison of biotechnology research funding, by non-policy-directed funding and policy-directed instruments, in the periods 1994-1998 and 2002-2005 ('Inventory countries' only)

Funding	Average total funding per annum for biotechnology research in the period 1994-1998	Average total funding per annum for biotechnology research in the period 2002-2005
National	3.9 M ECU	30.06* M EUR
Regional	None	None
Total	3.9 M ECU	30.06 M EUR

* Data for the 2005 budget is not yet available. The average funding per annum for 2002-2005 was computed for three years
Source: BioPolis Research

The policy goals for both periods remain consistent, particularly in their orientation towards stimulating private-public partnerships through, for example, the promotion of high-level industry-oriented research, support to knowledge transfer and encouragement of business investment in research and development. GSRT's research funding for both periods, necessitated a strong interest from the private sector and a commercial application. An additional goal in the period 2002-2005 was to stimulate the adoption of biotechnology for new industrial applications

[1] Benedictus, J.N. and C.M. Enzing, 'National Report of Greece', in *European Commission 2000. Inventory of Public Biotechnology R&D programmes in Europe Volume 2 - National Report: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland,* Luxembourg, Office for Official Publications of the European Communities, 1999.

Table 4.7 Presence of policy-directed instruments for specific policy goals in the periods 1994-1998 and 2002-2005

Presence of instruments					
Policy areas	**Policy goals**	**1994-1998**		**2002-2005**	
		G*	**S****	**G**	**S**
1. Creation of knowledge base and human resources	1. To promote high level of biotechnology basic research		√	√	
	2. To promote high level of industry-oriented (and applied) research	√	√	√	
	3. To support knowledge flow and collaboration among scientific disciplines		√	√	
	4. To assure availability of human resources				
2. Knowledge transmission and application	5. To facilitate transmission of knowledge from academia to the industry and its application for industrial purposes	√	√	√	
	6. To stimulate the adoption of biotechnology for new industrial applications			√	
	7. To assist firm creation				
3. Market	8. To monitor and improve the social acceptance of biotechnology				
4. Industrial development	9. To encourage business investment in R&D	√	√	√	

*G =Generic instruments; ** S = Biotechnology-specific instruments
Source: BioPolis Research

5. Future developments

A new general research strategy is due in 2007. The future importance and policy directions of biotechnology in Greece will be defined within the context of this forthcoming general research strategy. Hence at this stage, it is difficult to state how biotechnology research and corresponding policy instruments will be defined by the Greek government. Nevertheless, it is very likely that high technologies, such as biotechnology and cooperation with the private sector, will remain important.. It is also very likely that a programme similar to the OP 'COM' Programme will be continued in the future.

Annex 1 List of tables

Annex 2 List of figures and charts

Annex 3 List of contact persons

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Mona Papadakou	University of Athens, Centre of Financial Studies, author of the Greece EU TrendChart report
Prof. Athanasios Tsaftaris	Director of the Institute of Agrobiotechnology Centre for Research and Technology

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Annex 5 Performance raw data

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

	Indicator	Chart	Comments	Time periods
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[2]	2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100 US data for	1995-2002

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

	Indicator	Chart	Comments	Time periods
			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 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
Greece	891	1441	2245	11	11	11
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
Greece	83	132	203	38	46	64
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 publi-cations	**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.		
Greece	2245		0	19.7	20	114	710
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
Greece	891	1441	2245	10932	16086	22847
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
Greece	8%	9%	10%	72	71	75
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
Greece	6.51	7.43	106	102
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
Greece	n.a.	n.a.	11*	11
USA	75253*	70950	276*	288
	Graduates pMC		**Index EU17=100**	
	1998 / 1999	**2002**	**1998 / 1999**	**2002**
EU17	91**	189	100	100
Greece	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 availiable
* data for 1998; ** data for 1999
Source: BioPolis Research
Population source for US OECD
OECD Education Database

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**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Greece	100%	7%	53%	3%	4%	1%	0%	31%
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 total number of BT publications for the period 2002-2004

	2002-2004							
	Total	**Plant**	**Health**	**Animal**	**Food**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	7%	58%	5%	4%	1%	1%	25%
Greece	100%	6%	58%	4%	7%	2%	1%	22%
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**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	97217	7629	51944	4375	2434	624	576	29635
Greece	870	65	462	27	36	7	4	269
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**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	140984	10494	81220	6821	5017	1162	1126	35144
Greece	2223	134	1298	99	145	39	14	494
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**	**Environ-mental**	**Generic**
EU25	38%	56%	56%	106%	86%	95%	19%
Greece	106%	181%	267%	303%	457%	250%	84%
USA	11%	35%	23%	83%	47%	58%	11%

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
Greece	10	19	42	11	11	11
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
Greece	1	2	4	9	9	17
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
Greece	10	19	42	891	1441	2043
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
Greece	0.01	0.01	0.02	22	19	28
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 2001-004: 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
Greece	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
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
USA	5.11	5.11	5.07	4.95	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	
Greece	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
Greece	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 pMC: absolute and indexed values

	BT IPO	Population T				
	2002-2005	2002	2003	2004	2005	2002-2005
EU Availiable	29	452927	454869	457154	461593	456636
Greece	0	10969	11006	11041	11076	11023
USA	52	287941	290789	291685		290138

	IPO /pMC	Index
	2002-2005	2002-2005
EU Availiable	0.00	100
Greece	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: E&Y 2002-2005, 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€			Population in T		
	2002	2002	2002	2002	2003	2004
Europe	1100	920	2800			
EU Availiable	890	883	1111	315584	319663	325131
Greece	n.a.	n.a.	n.a.	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 Availiable	2.8	2.8	3.4	100	100	100
Greece	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
Greece	0	11	0.00	0
USA	115	289	0.40	387

Note: EU 15 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
Greece	23	11	2	60
USA	6745	278	24	688

Note: EU 15 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)
EU - 15*	100.29	16828
Greece	101.05	988

*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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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

CERTH	Centre for Research and Technology
CPERI	Chemical Process Engineering Research Institute
CSF	Community Support Framework
EFET	Hellenic Food Control Agency
ELEFTHO	Programme for the creation of S&T parks and incubators
EPET	Programme for Research and Technology
ERA	European Research Area
FORTH	Foundation of Research and Technology
GSI	General Secretariat for Industry
GSRT	General Secretariat for Research and Technology
I.TRA	Institute of Transportation
IBRI	Ioannina Biomedical Research Institute
ICE-HT	Institute of Chemical Engineering and High Temperature Chemical Processes
IMBB	Institute of Molecular Biology and Biotechnology
IN.A	Institute of Agrobiotechnology
ITI	Informatics and Telematics Institute
MEF	Ministry of Economy and Finance
MoD	Ministry of Development
MoE	Ministry of Education
NAGREF	National Agricultural Research Foundation
NCRT	National Council for Research and Technology
NHRF	National Hellenic Research Foundation
OP 'Com'/ EPAN	Operational Programme 'Competitiveness'
PABE	Industrial Research Development Programme
PAVET	Programme for the Development of Industrial Research and Technology
PENED	Programme for the Support of Researchers
PENED	Programme for the Enhancement of Research Manpower Operational
PEPER	Programme for Demonstration Projects
PRAXE	Programme for the Exploitation of Research Results
TANEO	Fund for the Development of the New Economy