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 the Netherlands

BioPolis has been funded under FP6, Priority 5: Food Quality and Safety
Contract No. 514174

Christien Enzing

Innovation Policy Group
TNO Quality of Life
Delft, The Netherlands

March 2007

Table of contents

Summary

With its 16.3 million inhabitants, the Netherlands is one of the smaller countries in the EU. The main economic sectors are food processing, chemicals, petroleum refining and electrical machinery. Agriculture is historically important, but now only accounts for 4% of the total labour force. However, the agriculture sector still provides great surpluses, destined for export.

The economic performance of the Netherlands is strong in terms of GDP per capita. In 2004, the GDP was 476 300M EUR. It is, and has long been, amongst the highest in the EU. However, GDP growth has been relatively slow in recent years. The international competitiveness of the Netherlands has also decreased. For the last decade, general expenditure on R&D (GERD) has fluctuated around 2% of the GDP, but is now slowly increasing (1.72 in 2002, 1.76 in 2003). Over 50% of the GERD is funded by industry and almost 40% by the government. The remaining 10% comes from abroad.

A relatively large share of private R&D expenditure is attributable to seven large multinationals performing roughly half of total private R&D. Three of these are active in the biotechnology sector and are included among the 375 dedicated and diversified life sciences companies that existed in the Netherlands at the end of 2004. Approximately 40% of these firms are active in the human health sector, 32% in the industrial biotech and equipments/instruments sector, 24% in agro-food and 4% in the environmental sector.

The Netherlands has a well-developed system of science, technology and innovation policies that is revised and renewed on a regular basis. Since the late 1970s there has been an active and stimulating policy on biotechnology. This has resulted in a highly-qualified public and private research base. Since that time there has also been a change in biotech policies, with a focus on biotech-specific instruments in the 1980s, more generic instruments in the 1990s and a return to more biotech-specific instruments from 2000 onwards. In the period covered by the BioPolis project (2002-2005), the Dutch government stimulated biotechnology research, commercialisation and other activities using five biotech-specific (including BioPartner and the Netherlands Genomics Initiative) and five generic instruments. This was accomplished through its own funding organisations and through so-called non-policy-directed funding, with a budget of at least 523.9M EUR. Most of the funds (almost 75%) were spent through policy-directed channels and were rather equally spread over generic and biotech-specific instruments.

The scientific performance of the Netherlands in the field of biotechnology research is very good, as shown by a number of indicators. The number of Dutch biotech publications per million capita for the period 1994-2004 far exceeded the EU25 average and USA level. The share of biotechnology publications in relation to the total publications in the country decreased during this period, although it remained high in relation to other EU countries. Also with respect to the number of citations per biotechnology publication, the Netherlands remained at a high level. By contrast, the number of graduates in life sciences per million capita was far below the EU25 average

and USA level.

Commercial performance, in terms of biotech patents per million capita and number of start-ups per million capita, was also very good. Patent numbers declined over the period 1994-2003, but still far exceeded the EU25 average in 2003 and USA numbers in 2001-2003. The number of start-ups per million capita also exceeded the EU25 average and USA level. On the other hand, industrial performance in biotechnology in terms of the number of biotech companies per million capita and IPOs was rated average to poor. In the period 2001-2003, the Netherlands remained at the same level as the EU25 and USA in terms of the number of biotech firms per million capita. The number of IPOs in the period 2002-2005 was zero, which was far below the USA level but equal to the EU25 average. Indicators for market conditions show that no biomedicines developed by Dutch companies were introduced on the European market in the period 2002-2005. The number of field trials was below EU25 and USA levels, which is understandable given the differences in regulations and public acceptance.

The main goal in Dutch national biotechnology policy-making is to stimulate a high level of industry-oriented and applied research: approximately 50% of the funds of policy-directed programmes are used for this purpose. The second important goal is to stimulate basic research in biotechnology, accounting for almost one quarter of the funding. The remaining quarter is used for cooperation between industry and public research organisations, support of firm creation and public acceptance of biotechnology.

Almost a third of available research funds are spent on basic research in biotechnology and its supporting disciplines (29.9%). Food biotechnology comes in second position (23.5%). Contrary to many other countries where health biotech (after basic biotech) receives most of the funding targeted at biotechnology, in the Netherlands health comes in third place (21.5%), close to food biotech. Industrial biotech takes a middle position (14%). Plant biotech, environmental biotech and the ethical, legal, social aspects of biotechnology constitute the last group. Animal biotech research is not being funded through Dutch policy-directed programmes. In total nine different activities are funded. Applied research carried out by public research organisations and collaborative research between industry and these organisations cover more than 60% of the budget. Basic research comes next, followed by centres of excellence, the budgets of which also mainly cover research activities.

Compared to the period 1994-1998, 2002-2005 saw a doubling of spending on biotech activities. Comparing sets of programmes during both periods shows that the Netherlands Genomics Initiative and, to a lesser extent, the BioPartner Programme account for this difference. Policy goals covered in both periods demonstrate that technology transfer to industry, firm creation and social acceptance of biotechnology were being addressed in the second period. Funding of health biotechnology held second place in 1994-1998, whereas food biotechnology came in second position, just ahead of health biotech research, in 2002-2005.

In the period after 2005, the number of new programmes already initiated indicates that stimulation of life sciences and biotechnology in the Netherlands will keep its priority status and maintain the momentum it had in the period 2002-2005.

1. Introduction and background

1.1 General introduction

With its 16.3 million inhabitants, the Netherlands is one of the smaller countries in the EU. The main economic sectors are food processing, chemicals, petroleum refining and electrical machinery. Agriculture is historically important, but now only constitutes 4% of the total labour force. However, the agriculture sector still provides great surpluses, destined for export. The Netherlands, therefore, has a positive trade balance with 240 000M EUR earned from exports and 207 000M EUR spent on imports (Eurostat 2004). The Netherlands has one of the largest natural gas fields in the world, providing a total revenue of 159 000M EUR (2006 figures) since the mid 1970s. With just over half of the reserves depleted and an expected continued rise in oil prices, revenues over the next few decades are expected to be at least as high.

The performance of the relatively small economy of the Netherlands is strong in terms of GDP per capita. In 2004 the GDP was 476 300M EUR. It is, and has long been, amongst the highest in the EU. However, GDP growth has been relatively slow in recent years. The international competitiveness of the Netherlands has also decreased; one indicator is its international ranking by the Institute for Management Development, which shows a drop from 4th position in 2002 to 13th position in 2005 (TrendChart 2005). For the last decade, expenditure on R&D (GERD) has fluctuated at around 2% of the GDP, but it is now slowly increasing (1.72 in 2002, 1.76 in 2003). This gives an R&D expenditure in 2003 of 8 380M EUR. The rising GDP compared with the slowly decreasing GERD keeps the net amount of R&D expenditure at approximately the same level (Eurostat 2004). Slightly more than 50% of the GERD is funded by the industry, while nearly 40% is funded by the government. The remaining 10% represents foreign funding.

A relatively large part of private R&D expenditure is attributable to the so-called Big Seven: seven large multinationals are responsible for roughly half of the total private R&D in the Netherlands. Three of them are active in biotechnology: Akzo Nobel (chemicals and pharmaceuticals), DSM (chemicals) and Unilever (food, personal care). The other four are Philips (electronics), Shell (oil and gas), ASML (integrated circuits equipment) and Océ (copiers). The three multinationals that are active in the biotechnology sector are included among the 375 dedicated and diversified life sciences companies that existed in the Netherlands at the end of 2004. Approximately 40% of these firms are active in the human health sector, 32% in the industrial biotech and equipments/instruments sector, 24% in agro-food and 4% in the environment sector.

In the period 1994-2004 there was a major expansion in the number of dedicated biotech firms (partly due to the BioPartner programme). In 2004, they had a total turnover of 190M EUR and employed 2 150 FTEs (full-time equivalents). Most of these companies are small: 73% employ less than 10 FTEs (SenterNovem 2005).

Despite this broad industrial biotech base, there is considerable and ongoing volatility as many of these firms consider investing or already invest abroad. These (potential) investments not only include production facilities or sales organisations but also an increasing number of R&D activities (MoEZ, 2005).

1.2 Characteristics of national S&T and innovation system

The Netherlands has a well-developed system of science, technology and innovation policies that is revised and renewed on a regular basis.

In 2003, the Minister of Economic Affairs presented the Innovation White paper called 'Innovation Letter: Action for Innovation in 2003'. It addresses innovation-driven growth and outlines the policy aimed at *inter alia* improving labour productivity, by increasing efforts in R&D/innovation and strengthening human capital (MoEZ, 2003). The Innovation Letter is part of an integral strategy 'for the build-up of a sustainable knowledge-driven economy'. A number of different pillars support this strategy: innovation, education and research. Industry-oriented R&D and innovation policy are specifically addressed in the 'Innovation Letter'. Education and research are also addressed in the policy documents HOOP 2004 (Higher Education and Research Plan) and Science Budget 2004 of the Ministry of Education, Culture and Sciences.

The 'Innovation Letter' identified three focus areas for innovation policy:
- Improving the climate for innovation and creating a favourable business environment (good macro-economic policy, fewer restrictive laws and regulations, *etc.*);
- Creating the right dynamics: encouraging more companies to be innovative (more new products and processes) by enhancing competition;
- Taking advantage of opportunities for innovation by selecting and investing in strategic areas that provide the best opportunities for strengthening national competitiveness and generating social benefits. This includes stimulating Dutch research institutes and companies to carry out more joint research projects in these strategic areas.

Other relevant documents addressing innovation that the Ministry of Economic Affairs published in this period are the policy memoranda 'Action for Entrepreneurs!' (enterprise policy), 'Peaks in the Delta' (regional economic policy) and 'Industry Memorandum: Heart for Industry' (industry policy). These memoranda put a strong emphasis on creating focus and mass in areas where the Netherlands has (or can achieve) a strong international position. They illustrate a recent trend in Dutch innovation policy in which generic innovation policy is complemented by more sector-specific innovation policies.

In a more practical way, the main national innovation policy objectives were formulated as follows (MoEZ, 2004a):
- Increasing the number of start-ups that develop and apply technological knowledge, since (high-tech) start-ups are an ideal mechanism for translating fundamental research into new products and services;
- Increasing the application of knowledge by SMEs;
- Increasing the development and application of technological knowledge by industry,

given that business expenditure on R&D is relatively low;
- Strengthening the knowledge base through cooperation between industry and the public knowledge infrastructure;
- Improving the protection of knowledge.

A rather unusual initiative (copied from Finland) was the launch of the Innovation Platform in 2003. The objective of the Platform is to propose strategic plans that reinforce the Dutch economy. This is done by stimulating business enterprises and public R&D organisations to work closely together and become more innovative. The Innovation Platform is headed by the Prime Minister and takes its members from government, business enterprises and knowledge institutes, on a personal rather than representative basis.

In November 2004, the working group on 'Dynamics of the Dutch Innovation System' (operating in the context of the Innovation Platform) published its report on 'Vitalising the knowledge economy'. The working group was established to address the 'knowledge paradox' and make recommendations for restructuring the Dutch national innovation system.

The group made recommendations according to three main themes they had identified:
1. Increased and targeted investment in knowledge,
2. Organisational and institutional renewal, and
3. Improving linkages within the innovation system.

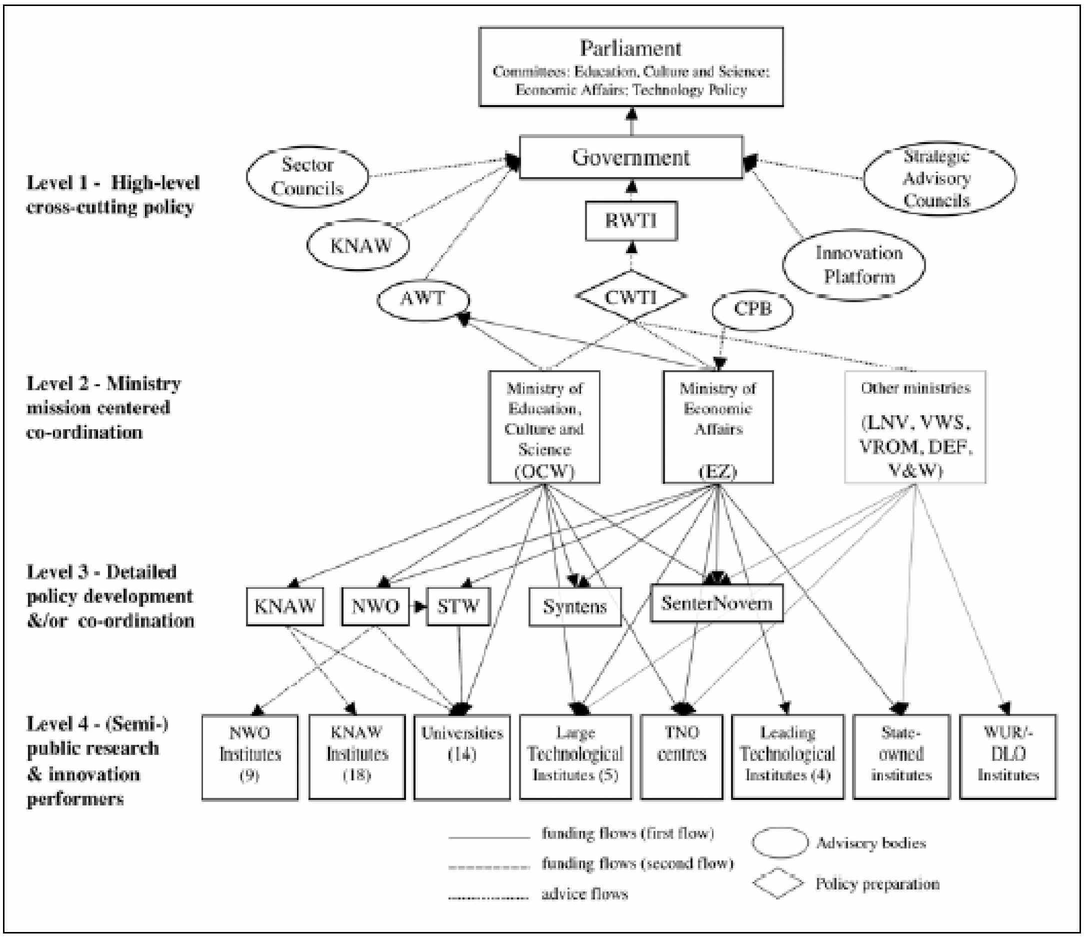
The Innovation Platform also played a key role in the identification of the 'strategic areas' mentioned in the Innovation Letter. In May 2004, a bottom-up process was started, inviting parties to submit proposals for 'key areas characterised by strong combinations of knowledge and business'. Based on several criteria, the Innovation Platform selected four key areas in the Dutch economy: Food and Flowers, High-Tech Systems and Materials, Water; and Creative Industry. In addition, two emerging key areas were identified: Pensions and Social Security, and The Hague: Residence of Peace and Justice (TrendChart, 2005).

In 2005, the Ministry of Economic Affairs presented a 'recalibration' (Her-Ijking) of its innovation policy mix in response to an assessment that its innovation policies did not sufficiently address the specific needs of the target group, *i.e.* the entrepreneurs. The new mix should become more flexible, coherent and specific. Transparency and accessibility for entrepreneurs should be increased. The number of instruments would be reduced substantially. The new policy mix consists of a 'basic package' for information and capital for entrepreneurs, and a 'programmatic package' to stimulate excellent innovation performance in specific areas of strategic importance (ibid).

Main actors in policy-making and implementation[1]

The main actors in science, technology and innovation policy-making in the Netherlands are the Ministry of Economic Affairs, which is responsible for (industry-oriented) R&D and innovation policy, and the Ministry of Education, Culture and Science, which also plays an important role in defining innovation policy, with respect to scientific research and education in particular. Figure 1.1 provides an overview of the main actors in science, technology and innovation policy (levels 1, 2 and 3).

Figure 1.1 General overview of the governance system of the Netherlands



Source: TrendChart 2005

The Ministry of Economic Affairs seeks to strengthen the innovativeness and competitiveness of the Dutch economy. Within the ministry, the Directorate General for Enterprise and Innovation has as its mission 'to create an excellent location and business enterprise climate that offers room for successful and innovative commercial enterprise'.

[1] This section is based on TrendChart 2005.

The Innovation Department of the Directorate General for Enterprise and Innovation focuses specifically on strengthening the innovativeness of the Dutch economy through improvement of the innovation climate, stimulation of innovation by companies, promotion of collaboration between businesses and knowledge institutions, and utilisation of opportunities in a number of strategic technological areas such as ICT, life sciences and renewable resource technology.

The Ministry of Science, Culture and Education has the mission to create a research climate that encourages optimal performance, through the production of high-quality science that stimulates wealth and well-being. The ministry is responsible for ensuring a sound research infrastructure, in terms of its size, innovative capacity, quality and efficient use of resources.

Other ministries also address research and innovation in their policies. The Ministry of Agriculture, Nature and Food Quality has identified innovation as an important instrument in the transition to sustainable agriculture. A related policy objective is the development of knowledge with added value for the agro-food sector and the sustainable use of green spaces by all actors. The Ministry of Agriculture, Nature and Food Quality has three policy lines to implement this objective: strengthening the basic knowledge/ research infrastructure, policy-oriented research and statutory research tasks.

The Ministry of Health, Welfare and Sport funds research that is relevant to its policy domains. An important research institute of this ministry is the National Institute for Public Health and the Environment (RIVM). The ministry also co-funds the Dutch Organisation for Health Research and Development (ZonMW), which is part of the national research council, NWO. The Ministry of Spatial Planning, Housing and Environment funds research in its policy areas. The Ministry of Transport, Public Works and Water Management recently launched the Action Programme Knowledge and Innovation in an attempt to stimulate innovations in the mobility and transport sector, improve the innovation climate and increase market innovativeness. The Ministry of Defence has developed a departmental knowledge strategy. Knowledge is required to anticipate political, societal, technological and scientific developments and to articulate requirements, procure equipment and deploy resources effectively.

Important advisory bodies are the Innovation Platform, the Advisory Council for Science and Technology Policy (AWT), the Sector Councils, the Strategic Advisory Councils, the Royal Dutch Academy of Arts and Sciences (KNAW) and the Dutch Bureau for Economic Policy Analysis (CPB).

SenterNovem and the national research council NWO (Netherlands Organisation for Scientific Research) are the main agencies in the Netherlands for the implementation of sciences, technology and innovation policy. SenterNovem is an agency of the Ministry of Economic Affairs, which implements innovation schemes for this and other ministries. It provides advice, initiates and facilitates networks (partner searches), provides information and manages financial support schemes (fiscal, grant, credit) in the areas of technology, energy, environment, export and international collaboration. NWO is an independent administrative body, which functions as a funding agency of the Ministry of Science, Culture and Education. Its mission is to promote and raise the quality and innovative content of fundamental scientific research at Dutch universities and research institutes, and to stimulate the dissemination and use of research results. NWO encompasses all scientific fields. Its most important tasks are to provide grants for (excellent) research and research equipment and to co-ordinate research programs. In addition, NWO administers nine research institutes in the fields of physics, mathematics and computer science, astronomy and space research, marine research, history and penal science.

In four key fields (ICT, life sciences, nanotechnology, catalysis) new bodies have been set up to coordinate and execute programmes. Currently, there are three so-called Temporary Task Forces that execute ministerial policy: Advanced Catalytic Technologies for Sustainability (ACTS), the Dutch Genomics Initiative (NGI) and the National ICT Research and Innovation Authority (ICTRO). They have a semi-permanent status and are accommodated by NWO.

Syntens is a network of fifteen regional centres, which aims to strengthen innovativeness of SMEs by making technological and non-technological innovation-oriented knowledge accessible and relevant. Syntens is an instrument of the Ministry of Economic Affairs, used to increase knowledge application by SMEs. The four regional development agencies initiate, in collaboration with the business enterprise sector, new economic investments in their regions. Funding for the regional development agencies is provided by the Ministry of Economic Affairs and the provinces.

1.3 National support and framework conditions for biotechnology

Since the late 1970s, there has been an active and stimulating biotechnology policy in the country, which has resulted in a well-established and qualified public and private research base. Since that time, the focus of biotech policies has continuously changed from using biotech-specific instruments to more generic instruments. In the late 1970s, biotech-specific instruments were designed and organisations set up to stimulate biotechnological research and its industrial application, i.e. the Innovation-Oriented Research Programme pertaining to biotechnology (IOP-b). IOPs aim at developing basic scientific and technical knowledge in specific areas relevant to Dutch industry. The first IOP was on biotechnology. Whereas in the early 1980s, science and technology policy was mainly oriented towards a reinforcement of the science base, in the mid-1980s the Dutch government reformulated its policy: market orientation became the central focus. As a result, the policy on biotechnological R&D was intensified and became more market-oriented. On the basis of the existing IOP-b scheme, which focuses mainly on industrial biotechnology, additional programmes on medical, environmental and agricultural biotechnology were introduced. In 1987, the Ministry of Economic Affairs introduced Programmatic Industry-Oriented Technology Stimulation (PBTS). This cooperative scheme started as a specific biotech scheme (PBTS-Biotechnology), was followed by other technologies and, in 1997, transformed into a generic scheme: Technological Cooperation. The IOP Biotechnology programme and PBTS Biotechnology were the main instruments used to stimulate biotechnological R&D during the 1980s and beginning of the 1990s (Enzing, 2003).

In 1994, the Minister of Economic Affairs presented the biotechnology policy for the second half of the 1990s: ‘Biotechnology policy: from research to market’ (‘Biotechnologiebeleid: van onderzoek naar markt’, 1994). The central theme was facilitating the conversion of biotechnology research results into marketable products. The main goals of the policy were:

1. Reinforcement of existing networks between the knowledge infrastructure and biotechnology industry;
2. Reinforcement of participation in European research programmes by Dutch firms and research organisations;
3. Enlargement of the industrial base and reinforcement of relations between firms and research organisations;
4. Stimulation of consultations between producers of new biotechnological products and consumer and environmental organisations;
5. Development by different ministries of a transparent regulatory policy on the admittance of biotechnology.

Despite these policies, biotechnology has since the beginning of the 1990s mostly been stimulated through general technology schemes, and has had to compete with other technologies. In the period 1994–1998, the Netherlands belonged, together with Austria and Iceland, to the group of countries that had a decreasing number of specific biotechnology programmes. In this period, Dutch government spending on specific biotechnology programmes was, in absolute as well as relative terms, the smallest in Europe. Except for Greece and Portugal, all other European member states considered biotechnology an important area of R&D policy, which needed to be stimulated through specific and large R&D programmes (Enzing et al., 1999). One of the main reasons for this was that the ‘market-driven’ concept became dominant in the innovation policy of the Netherlands. Criteria such as commercial application and, in the case of some programmes, sustainable development played an important role in the selection of the projects (Enzing, 2003).

In 1999, the Dutch government realised that biotechnology would be an important technology for future economic growth, and developed plans for the reinforcement of Dutch biotechnology research and industry. The Ministry of Economic Affairs introduced a new programme to stimulate start-ups in the life sciences. This Life Sciences Action Plan – also known as the BioPartner programme – aimed to establish 75 new life science companies in the period 2000-2005. In 2000, Dutch industry and public sector research organisations presented a Strategic Action Plan for Genomics in which they made a plea for reinforcing Dutch research infrastructure in the field of genomics. Following the advice of the Temporary Advisory Committee for Genomics Knowledge Infrastructure, the Dutch government decided to invest 188M EUR over a period of five years. One key element of the strategic plan was the establishment of a national council to coordinate all initiatives and programmes in the field of genomics. The Netherlands Genomics Initiative was initiated in 2002.

In 2004, the Ministry of Economic Affairs published a new strategy document ‘Action Plan Life Sciences: kansen grijpen en knelpunten aanpakken’ (MoEZ, 2004b). There is a clear focus on entrepreneurship and technology spin-offs, which is the number one issue on the action list. Other issues include regulation (more simple procedures and fewer rules), R&D, international networks and clear communication of public bodies. Other issues from the 1994 plan are also addressed, but the message has changed. One of the main goals of the new policy is to tackle the innovation paradox: ensuring that the results of Dutch biotechnology research are effectively transferred to new start-ups and applied to new products and processes.

Public debate

There has always been an active public debate on biotechnology. In the past, the government has initiated and facilitated several public debates on different aspects on biotechnology, for example cloning and the use of stem cells in biotechnology research. The last debate (in 2001) was on biotechnology and food: 'Eten en Genen'. One of the current main ethical discussions concerns the use of embryonic human stem cells for research. The Netherlands has always shown reluctance to using these cells, but in recent years some regulations have changed and more possibilities are being explored in this field.

A survey conducted by the Eurobarometer (2005) showed that 63% of Dutch respondents said they believe that biotechnology and genetic engineering will have a positive effect on their way of living over the next 20 years. The Netherlands belonged to the middle group, with Austria claiming the lowest score (43%) and Hungary the highest (74%). With regard to specific applications, among the EU25, the Netherlands was placed in the middle segment of countries that were not strongly against but also not very much in favour (in all circumstances) of most of the specific applications mentioned: cloning animals to research cures for human diseases, cloning human stem cells from embryos to reconstruct cells and organs for transplant, developing GM-crops to create a greater regional food variety, and using GM bacteria to clean up the environment. The Netherlands belonged to the group of countries that were strongly against the following applications: human cloning, so couples with a genetic disorder can still have a baby, and growing meat from cell cultures instead of slaughtering animals.

Regulation

Dutch biotechnology regulation is mostly based on EU regulation. The Dutch government has a website that provides an overview of all laws and regulations that actors active in the biotech field must consult: http://www.overheid.nl/home/biotech/regels. The most relevant are discussed in this section.

The Ministry of Housing, Spatial Planning and the Environment is responsible for the regulation that deals with health and safety aspects of using GMOs in research and industrial applications.

The controlled use of GMOs (90/119/EEC and updates) is laid down in the 'Besluit Genetische Gemodificeerde Organismen (GGO)' that includes the 'Regulation GGO'.

For the introduction of GMOs in the environment (90/220/EEC and updates), two procedures are active. The first is an EU regulation that deals with the marketing of products containing GMOs. The second is a national procedure of the ministry that has been included in the Law on Environmental Management (Wet Milieubeheer en het Inrichtingen en Vergunningenbesluit Milieubeheer). Other 'outdoor' activities are covered by the 'Besluit GGO'.

For the genetic modification of animals, the regulation 'Besluit Biotechnologie bij Dieren' is in place, under the responsibility of the Ministry of Agriculture, Nature Management and Fisheries. The Animals Experiments Committee (DEC) also has to give permission. The regulation on animals used in biotechnology is based on the Animal Experiments Act and the Animal Health and Welfare Act.

The Ministry of Health, Welfare and Sport is responsible for the regulation of (new) food products entering the market and/or genetically modified plants (which are mostly used for food), and for all research carried out on humans. All research programmes must be approved by the Central Committee on Research involving Human Subjects (CCMO). The Embryo Act, which came into effect on 1 September 2002, sets conditions for and restrictions on the use of embryos and gametes in the Netherlands. It bans the cloning of human beings, as well as any experiments combining human and animal cells. Under this Act, a baby's sex may not be predetermined, nor may the genetic code of gametes or embryos be changed. Embryos may not be produced for any purpose other than pregnancy. The Act also bans trade in gametes and embryos.

The Ministry of Economic Affairs is responsible for patenting. The Dutch parliament had for a number of years been very successful in opposing the implementation of the European Patent Directive (98/44, implemented on July 30, 2000) as it did not want to allow patenting of plants and animals. Due to the large interest shown by Dutch companies in the field, the parliament gave up resistance at the end of 2004 and implemented the EU regulation, now formalised in the National Patent Law for Biotechnological Findings.

1.4 The main biotech policy and research actors in the Netherlands

Biotechnology policy actors

A large number of ministries are involved in biotechnology policy. The division of tasks between them is as follows:

- Ministry of Economic Affairs: life sciences (including biotechnology) for economic growth, subsidies for start-ups and life sciences R&D, attracting foreign companies, removing barriers to innovation and entrepreneurship;
- Ministry of Science, Culture and Education: education in biotechnology, stimulating biotech R&D for applications, informing citizens about biotechnology;
- Ministry of Agriculture, Nature and Food Quality: biotechnology for sustainable agriculture; co-existence of GMO crops and non-GMO crops; food safety and quality, including monitoring and safeguarding safety of GM food; biodiversity and regulation GM of animals, including ethical assessment;
- Ministry of Health, Welfare and Sport: biotechnology for improved quality of health

and health care, and for monitoring of GM food labelling so consumers can make their choice. In April 2003, the State Secretary for Health, Welfare and Sport initiated the Dutch Forum for Biotechnology and Genetics. The Forum's primary objective is to identify new developments in medical biotechnology and human genetics, and to encourage those developments that offer an added value to patient care;
- Ministry of Spatial Planning, Housing and Environment: biotechnology for cleaner environment and production processes, safety guarantees for human beings and the environment, regulations for genetic modification;
- Ministry of Foreign Affairs: biotechnology for sustainable development and suppression of poverty in developing countries, coordination of the Dutch contribution to European and international negotiations in biotech development matters;
- Ministry of Justice: forensic biotechnology.

Networking is an integral part of the Dutch biotechnology innovation system. Dutch ministries involved in biotechnology policy-making regularly meet in the so-called 'Interdepartementaal Overleg Biotechnologie'. The publication in 2000 of the 'Integrale Nota Biotechnologie' (INB) was unique at the time, insofar as it was a co-production of five ministries: Economic Affairs, Education, Agriculture, Environment and Health. The INB paper presented policy goals and plans. In recent years, other common papers have followed, such as the integral framework for the assessment of biotechnology, 'Verantwoord en zorgvuldig toetsen', in 2003. The ministries also co-fund a number of large programmes, such as the Netherlands Genomics Initiative which is funded by five ministries (Enzing, 2003).

Biotechnology research actors

The public science and research community in the Netherlands covers 14 universities, three of which are technical and one agricultural. The former Agricultural University of Wageningen and the Agricultural Research Department of the Ministry of Agriculture were recently integrated into the Wageningen University and Research Centre (WUR). Except for the University of Tilburg (which has no natural science or medical science faculty), all universities are involved in biotechnology/life sciences research. This includes the medical research centres of the academic hospitals. WUR research institutes active in biotechnology/life sciences research include Plant Research International, Agrotechnology and Food Sciences Group (AFSG) and Alterra.

In addition, there are 18 so-called KNAW institutes, which are primarily engaged in basic and strategic scientific research and information dissemination. The Royal Dutch Academy of Arts and Sciences (KNAW) acts as an umbrella organisation for these institutes. Two of them are active in biotechnology/life sciences research: the Netherlands Institute for Development Biology (NIOB) and the Netherlands Institute of Ecology (NIOO).

There are also nine so-called NWO institutes that operate under the Dutch Organisation for Scientific Research (NWO); three of them are active in biotechnology/life sciences research: the Royal Netherlands Institute for Sea Research (NIOZ), the Institute for Atomic and Molecular Physics (AMOLF) and the National Research Centre for

Mathematics and Computer Sciences (CWI).

Furthermore, there are five large technological institutes conducting applied research and related activities, such as advising industry and government in specific fields, though none of them in the field of biotechnology/life sciences.

TNO, the Dutch Organisation for Applied Research, is an independent contract research organisation that was established by law in 1930. It is by far the largest (semi-)public research organisation in the Netherlands. TNO is an umbrella organisation with several research centres in the five key areas of its activity: Quality of Life; Defence, Security and Safety; Science and Industry; Built Environment and Geosciences; and Information and Communication Technology. Biotechnology/life sciences research is a key field of study in the Quality of Life area, as well as the Defence, Security and Safety area.

The National Institute for Public Health and the Environment (RIVM) is a centre of expertise in the fields of health, nutrition and environmental protection. Its research, monitoring, modelling and risk assessment are done mainly for the government (Ministries of Environment and Health) and used to underpin policy on public health, food, safety and the environment. The Institute of Food Safety (RIKILT) is another research centre working in the field of safety research, focused on food quality, health and the safety of food and animal feed. The institute provides consultancy services to national and international governmental authorities.

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

2.1 Introduction

This chapter reviews the funding of biotechnology research and commercialisation in the Netherlands during the period 2002-2005. 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 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.

In this chapter, funding of biotechnology research through policy- and non-policy-directed instruments, and of biotechnology commercialisation through policy-directed instruments are presented. 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. Website of the funding organisations and their programmes and the names of contact persons that participated in the survey and/or who were interviewed can be found in Annex 3 (List of contact persons) and Annex 4 (References). Section 2.2 presents the non-policy-directed funding and section 2.3 the policy-directed funding. Charities also play an important role in the funding of biotechnology research in some countries; they will be addressed in section 2.4. The final section provides a short overview of European funding of biotechnology research in the Netherlands through the 6th Framework Programme.

2.2 Non-policy-directed funding of biotechnology research

Important non-policy-directed programmes (response mode) through which biotechnology/life sciences research is financed include two programmes of NWO (Netherlands Organisation for Scientific Research) and the Open Technology Programme of the Technology Foundation.

The Open Programme of the Division for Earth and Life Sciences of NWO is divided into two parts: 'From Molecule to Organism' and 'Geo- and Biosphere'. The annual budget of the Open Programme is 7M EUR. Proposals for the first part of the programme can cover any subject within the range of molecule to organism as long as a fundamental biological question is addressed in the research. In 2004, 43 projects were approved, six of which were on biotech. In 2005, 10 of the 62 projects approved were on biotech. The average budget of a project is 200-240 000 EUR. Data for 2002 and 2003 are not available; estimates for these two years have been made on the basis of average figures for 2004 and 2005.

The Innovational Research Incentives Scheme (Vernieuwingsimpuls) was jointly set up in 2000 by NWO, KNAW and the universities. The aim of the scheme is to promote innovation in academic research in general. It gives individual talented researchers the opportunity to conduct their own research programme independently so they can enter and remain committed to the scientific profession. The Scheme has three types of grants:
- *Veni* grants for researchers who recently completed their PhD, to allow them to continue developing their ideas. In the period 2002-2005, 15 biotech projects were awarded this grant (at 200 000 EUR per project);
- *Vidi* grants for researchers who want to develop their own innovative line of research and appoint one or more other researchers. In the period 2002-2005, seven biotech projects were awarded this grant (at 600 000 EUR per project);
- *Vici* grants for senior researchers to build their own research group. In the period 2002-2005, four biotech projects were awarded this grant (at 1.25M EUR per project).

The Technology Foundation has an Open Technology Programme. This programme funds projects that have a so-called 'utilisation component', meaning that there is a chance that research will lead to an application. Scientific quality and utilisation are the two main selection criteria. The average annual budget in the period 2002-2005 for projects in this programme was 48M EUR. During these four years approximately 17.5% was spent on biotechnology/life sciences research, representing approximately 33.5M EUR.

Non-policy-directed funding by ministries of research institutes and universities is, for a considerable part, used by these organisations to match project funding through policy-directed programmes. As the next section shows, a large number of policy-directed programmes provide only half or one-third of the budget; the rest must be funded by the research organisations themselves and, for certain programmes, by industry or other potential users as well. On the basis of the matching funds required by the policy-directed programmes, a rough estimate has been made of non-policy funding by ministries (see Table 2.1).

Table 2.1 Non-policy-directed funding of biotechnology research

Funding organisation	Public research institutions / Response mode programmes	Funding of biotech/LS research in the period 2002-2005 (in M EUR)
NWO	Open ALW programme, part 'From molecule to Organism' (response mode)	7.04
NWO	Vernieuwingsimpuls (response mode)	12.2
STW	Open Technology Programme (response mode)	33.5
Several Ministries	Matching of policy-directed programmes (public research institutes)	76
TOTAL		128.74

Source: BioPolis Research

2.3 Policy-directed funding of biotechnology research and commercialisation

In this section we present the policy-directed instruments that have supported (and still support) biotechnology/life sciences research, transfer and commercialisation in the Netherlands during the period 2002-2005. Table 2.2 gives an overview of the instruments, their funding organisations, biotech budget and share of the total budget. The regions in the Netherlands do not have any programmes, and no use is made of international developments funds or EU structural funds for Dutch programmes.

Table 2.2 National public policy-directed biotechnology-stimulating instruments during the period 2002–2005

Instrument	Funding organisation	Biotech (part of the) budget (M EUR)*	% of total spent on biotech
Generic			
ACTS	NWO	22.5	5.7
IOP – Industrial Proteins	SenterNovem	1.69	0.4
ICES-KIS-2 and -3	SenterNovem	16.1	4.1
Technology Cooperation	SenterNovem	102.5	25.9
TTI - WCFS	Ministry of Economic Affairs	54	13.7
Biotech-specific			
From Molecule to Cell	NWO	5.4	1.4
Computational Life Sciences	NWO	3.3	0.8
Translational Gene Therapy Research	NWO	4.8	1.2
NGI	NWO	157.93	34.0

Instrument	Funding organisation	Biotech (part of the) budget (M EUR)*	% of total spent on biotech
BioPartner	Ministry of Economic Affairs	27	6.8
TOTAL		395.22	100%

* The budget of the programme has been divided by the number of years that its runs. For those years that the programme was running during the period 2002-2005, the annual budget was added up.
Source: BioPolis Research

In the next sections, these instruments are presented in more detail. Grouped by funding organisation, biotech-specific programmes followed by generic programmes are presented.

2.3.1 Instrument(s) of the Netherlands Organisation for Scientific Research

The Netherlands Organization for Scientific Research (NWO) stimulates and finances research in every conceivable scientific discipline and facilitates innovations. In this way, NWO acts as a national research council. It also strives to cultivate enthusiasm for scientific research and its results, and to communicate this to a broad public. Furthermore, NWO is playing an increasingly pivotal role within Dutch science. This pivotal role between industry, society and research not only facilitates the cooperation, but also the dissemination and application of fundamental research results. The central role of NWO is illustrated in figure 1.1.

NWO is organised into several specialised divisions that have their own programmes and also share programmes. NWO also hosts a number of temporary task forces that operate with a relatively large amount of autonomy within NWO. Two of these task forces work in the field of biotechnology / life sciences research: the Netherlands Genomics Initiative and ACTS.

2.3.1.1 NWO programmes

From Molecule to Cell: Budget: 8.1M EUR (2002-2008)
The research programme *From Molecule to Cell* is a joint programme of three NWO divisions: Earth and Life Sciences, Chemical Sciences and Physical Sciences. It is part of 'The Foundations of Life Processes', one of the nine themes that NWO presents in its strategy paper entitled 'Themes with Talent' (2002-2005). The programme aims to develop a better understanding of complex mechanisms of biological processes by encouraging cooperation between biological, physical, chemical and mathematical disciplines and information sciences. High-quality research is promoted in four domains: dynamic protein structures in their cellular context; membrane assemblage; formation, structure, regulation and function of multi-biomolecular systems; and foundational methods and techniques. The research must lead to the development of a quantitative model of biosystems and related technologies and methods of analysis.

Computational Life Sciences: Budget: 5.5M EUR (2003-2008)
The Computational Life Sciences programme is a joint initiative of the NWO divisions for Physical Sciences, Earth and Life Sciences, Medical Sciences and the NWO National Computing Facilities Foundation. Computational Life Sciences focuses on complex problems in the life sciences that allow model formation, simulation and visualisation. These complex problems concern processes where interactions between different unities take place according to highly diverse scales of time and length, such as multi-unit interactions in cells and tissues, information processing in the brain, *in silico* models, hierarchical models of diseases and evolutionary processes. The scientific challenge of the programme is to understand the behaviour of this kind of coupled dynamic models that give attention to the effects at micro, meso and macro scales and their mutual relations. The programme focuses on three themes: 'From Data to Model', 'From Model to Simulation' and 'Visualisation'.

Translational Gene Therapy Research: Budget: 15.6M EUR (2001-2013)
The Translational Gene Therapeutic Research programme of the division Medical Sciences of NWO (also: Netherlands Organisation for Health Research and Development) aims to bridge the gap between basic research and patient care. It consists of 2 sub-programmes:

- Preclinical translational research into the safety and effectiveness of new approaches, aimed at continuation in clinical studies. Possibilities are the development of animal models and validation of new approaches in animal experiments. Production and quality control of batches of gene therapy vector used in clinical research will receive special attention. This may be carried out in cooperation with external parties.
- Clinical research in phase I and/or phase II trials if justified by proper preclinical research, including the development of clinical protocols for these gene therapy studies.

2.3.1.2 Programmes of Temporary Task Forces under NWO

Netherlands Genomics Initiative
The Netherlands Genomics Initiative (NGI) is a task force dedicated to strengthening genomics-based research and business in the Netherlands. The key elements in the NGI strategy are research, business and society. By clustering leading Dutch research groups together with (Dutch and international) industrial parties and societal organisations, NGI aims to build a world-class genomics infrastructure, stimulate innovative research that generates tangible social benefits, economic value and new business activity.

NGI was established end of 2002 by the Dutch government to formulate and execute a clearly focused national genomics strategy aimed at capturing a leading position in scientific and industrial genomics within the next five years. The main themes of the programme are: the relationship between food and health, including food safety; the mechanisms of infectious diseases; the origins of multifactoral diseases, in which both genetic and environmental factors play a role; and the functioning of ecosystems, focused on sustainable, environmentally safe and healthy vegetable and animal products. NGI is funded by five ministries: the Ministry of Education, Culture and Science; Ministry of

Economic Affairs; Ministry of Agriculture, Nature and Food Quality; Ministry of Health, Welfare and Sport; and Ministry of Housing, Spatial Planning and Environment. The total budget of NGI is 296.42M EUR. The bulk (210.32M EUR) is financed by the five ministries (see 1.3) for a five-year period; the additional 86.1M EUR is financed by ICES/KIS-3 (see below). 277.38M EUR is used for the funding of the research programmes and for valorisation activities, the rest is for management. All programmes require matching funds from the research organisations and participating companies. The matching varies between programmes.

The six NGI programmes are outlined below:

1. Genomics Centres of Excellence: Subsidy: 70.98M EUR (2002-2008)
The five centres of excellence form the core of the Netherlands Genomics Initiative. The centres are consortia of universities, research institutes and companies, with a clearly focused programme that comprises excellent fundamental and applied genomics research. They support the process of innovation by carrying out unique research on a par with the world's leading groups.
The centres of excellence are:
- The Centre for BioSystems Genomics (Wageningen),
- The Centre for Medical Systems Biology (Leiden),
- The Cancer Genomics Centre (Utrecht),
- The Kluyver Centre for Genomics of Industrial Fermentation (Delft), and
- The Centre for Society and Genomics (Nijmegen).

The last centre aims to become the national debating and dialogue centre in the field of genomics and society. It organises on a regular basis communication and debating activities, and also has a research programme.

2. Technology Centres: Subsidy: 61.3M EUR (2003-2009)
Genomics technology centres act as national facilities. They provide high-quality equipment and services to the (inter)national research community and carry out a research programme aimed at the development of new tools.
The technology centres are:
- The Netherlands Bioinformatics Centre, and
- The Netherlands Proteomics Centre.

3. Innovative Clusters
Innovative clusters focus on fundamental research that originates from industrial demand. Companies take the lead in the consortia, which also comprise universities and research institutes. The innovative clusters are:
- *Ecogenomics*: Subsidy: 11M EUR (2004-2009)
The general objective of the Ecogenomics Consortium is to enhance the understanding of the functioning of ecosystems, in order to unlock their full genetic potential for sustainable use of ecosystems for agricultural and other anthropogenic purposes.

– *VIRGO Consortium*: Subsidy: 10.8M EUR (2004-2009)
The few intervention methods that are currently available for respiratory virus infections have limited efficacy. Drawing on fundamental insight into the interaction between host (human or animal) and virus, the VIRGO Consortium is working on a rational approach to develop new vaccines and other methods of intervention.
– *Coeliac Disease Consortium*: Subsidy: 7.7M EUR (2004-2009)
The Coeliac Disease Consortium aims to establish a firm scientific basis for the development of safer foods and more effective diagnosis, prevention and treatment of CD. The consortium will use functional genomics to clarify the complex molecular interplay between the human host and the disease-causing gluten proteins.
– *Nutrigenomics*: Subsidy: 10M EUR (2003-2008)
The Nutrigenomics Consortium combines nutrition research with genomics techniques to understand the development process of metabolic stress. The consortium searches for biomarkers that indicate metabolic stress at a very early stage. In these early stages, targeted dietary intervention – another area of research within the consortium – can be used to prevent the development of full-blown metabolic syndrome and its related serious consequences.

4. Genomics Programmes:
There are a number of programmes different in scope in this category. They include:
– *The Horizon Programme*: Subsidy: 12.3M EUR (2003-2008)
The Horizon Programme encourages ground-breaking genomics and bioinformatics research. Its objective is twofold: on the one hand, it aims to ensure the continuation of top-level genomics research in the Netherlands, and, on the other, it strives to stimulate and nourish (young) research talents by allowing them to pursue fresh and creative ideas. Two genomics programmes, initiated by NWO in 2001 (BioMolecular Informatics and Genomics) are integrated into this programme.
– *The Fellowship Programme*: Subsidy: 1M EUR (2004-2008)
Exchanging knowledge is at the heart of scientific research. One of the ways to achieve this is by allowing scientists to work abroad for a certain period of time. These scientists will in turn bring back new skills and expertise to the Netherlands. This is the aim of the Fellowship Programme. It includes short-term fellowships (1-3 months) aimed at developing and/or increasing specific technological knowledge, and long-term fellowships (up to 12 months) aimed at carrying out (part of) a research project.
– *IOP Genomics*: Subsidy: 35.5M EUR (2001-2008)
IOP Genomics stimulates strategic pre-competitive genomics research at universities and institutes. Cooperation with companies in the field is a prerequisite for funding. As such, the programme links excellent research and the innovation needs of Dutch industry. IOP Genomics focuses on four main themes: pathogenesis of chronic and old age disease; functionality, quality and safety of food production; understanding biomolecular processes (e.g. signal transduction, metabolic pathways); and genomics technologies (both equipment-related and experimental laboratory technologies). Knowledge transfer and long-term public-private collaborations are two additional goals of the programme.

– *Innovative Genomics Clusters:* Subsidy: 11.9M EUR (2004-2008)
This is a cooperative programme of NGI and the Technology Foundation (STW). The goal of the programme is to stimulate genomics in public research organisations in fields that are relevant for industry or other stakeholders. The stakeholders – at least two per project – are involved in decision-making about research plans and help to steer the project. Their commitment to the project is also made in the form of funds, materials or personnel. The programme has five themes for research: the potato genome, genomics and food safety, toxicogenomics, genomics and cow milk production, and systems biology.
– *Social Component of Genomics Research:* Subsidy 9.35M EUR (2002-2008)
The Social Component of Genomics Research programme funds research on societal aspects of genomics from different viewpoints: ethical, legal, psychological and social. The programme focuses on the mutual interaction between genomics, on the one hand, and, on the other hand, the foundations and organisations in our society, the self-image of individuals and how they deal with animals, nature and the environment. The programme committee cooperates closely with the Centre for Society and Genomics.

5. *Special activities*
In 2004, the Netherlands Toxicogenomics Centre received a start subsidy for the development of a business plan. The centre applied for two 'innovative cluster projects' which were approved (subsidy of 4M EUR) and has since applied for two FP6 integrated projects. NTC is in the process of becoming a genomics centre of excellence.

6. *Science to Business*
The Sci2B fund was set up in 2005. Similar to the TechnoPartner programme (see 2.3.2.1), it provides loans to young entrepreneurs to set up new companies and also supports young companies that are spin-offs of NGI research projects.

Advanced Catalytic Technologies for Sustainability
Advanced Catalytic Technologies for Sustainability (ACTS) is a temporary task force for pre-competitive research in catalysis and related disciplines. ACTS is also a platform for industry, academia and government to cooperate in the development of new technological concepts aimed at sustainable production of materials and energy carriers essential for food supply, comfort, health, shelter and mobility. ACTS activities are joint initiatives of the parties mentioned above. This is reflected in the programme budgets, which are put together by ministries, NWO and the participating industries. The participating universities take care of housing and supervision of project researchers.

Three of the five ACTS programmes deal (partly) with biotech research.
These programmes are:
– *Bio-based Sustainable Industrial Chemistry* Budget: 31M EUR (2004-2009)
The mission of this programme is to provide the chemical industry with an advanced set of tools and concepts by approaching bio-based sustainable industrial chemistry in a fully integrated manner, combining functional genomics, intensified bioprocess technology and feedstock scenarios. The programme is financed by the Ministry of Economic Affairs (25M EUR) and industry (6M EUR).

– *Process on a Chip*: Budget : 8M EUR (2003-2009)
The goal of this programme is the development of an integrated circuit (in silicon or synthetic fibre) with microchannels, reaction nodes, steps for characterisation and reprocessing, allowing chemical reactions to be produced on a very small scale and with unprecedented precision. In order to realise this, Process on a Chip combines a number of disciplinary research fields and aims, by means of fundamental research, to make visible and foster new chances for industrial development. The programme is financed by NWO (2M EUR), the Ministry of Economic Affairs (4M EUR) and industry (2M EUR). The research institutes themselves also have to finance part of the budget.

– *Integration of Bio- and Organic Synthesis* Budget:13.6M EUR (2003–2009)
The main goal of this programme is to develop new methods of synthesizing complex molecules by applying principles of molecular biology. The full integration of organic synthesis and biosynthesis is a long-term goal, but achievable within this programme (7-10 years). Processes for simple and complex molecules with a molecular weight up of to 1 000 should become available through this programme, allowing straightforward development and sustainable commercialisation in industry (one-time-right scenario). The programme is financed by NWO (4.54M EUR), the Ministry of Economic Affairs (4.54M EUR) and industry (4.54M EUR).

2.3.2 Instrument(s) of the Ministry of Economic Affairs and SenterNovem

The most important instrument of the Ministry of Economic Affairs during the period 2002-2004 was the BioPartner programme. Other, non-specific but generic instruments are the Innovative Research Programme (see also 1.3), the ICES/KIS programmes and Technology Stimulation Programme, all managed by SenterNovem and the so-called Leading Technological Institutes.

BioPartner
BioPartner was first presented in the Action Plan for Life Sciences published by the Ministry of Economic Affairs in 1999. The programme was launched in 2000 for a period of five years. The aim of BioPartner was to stimulate entrepreneurship in life sciences in the Netherlands by improving the entrepreneurial climate and creating facilities for potential start-ups. More precisely, after the five-year period, 75 new dedicated firms in the life sciences were started in the Netherlands. The total budget of the BioPartner initiative was 45M EUR.

BioPartner was composed of five different instruments, each focusing on a different aspect of (facilitation of) entrepreneurship:

– *BioPartner Network*
BioPartner Network was the central point of contact for entrepreneurs in life sciences. It focused on the facilitation and stimulation of entrepreneurship in life sciences in the Netherlands. BioPartner Network assisted potential entrepreneurs by establishing and expanding networks, both national and international; by providing courses on

entrepreneurship; by brokering relationships between starters, investors and other parties; and by promoting the Dutch life science industry at home and abroad. The BioPartner board included prominent life scientists, life science entrepreneurs and investors.

– *BioPartner First Stage Grant*
This subsidy was aimed at encouraging researchers to translate their knowledge into a viable business plan from the moment they no longer qualified for scientific funding but when it was still hard for a start-up company to attract investors. The First Stage Grant also helped to find the best starting position for the company. Project proposals could only be submitted by researches who worked for public research institutes like universities, hospitals, *etc.*

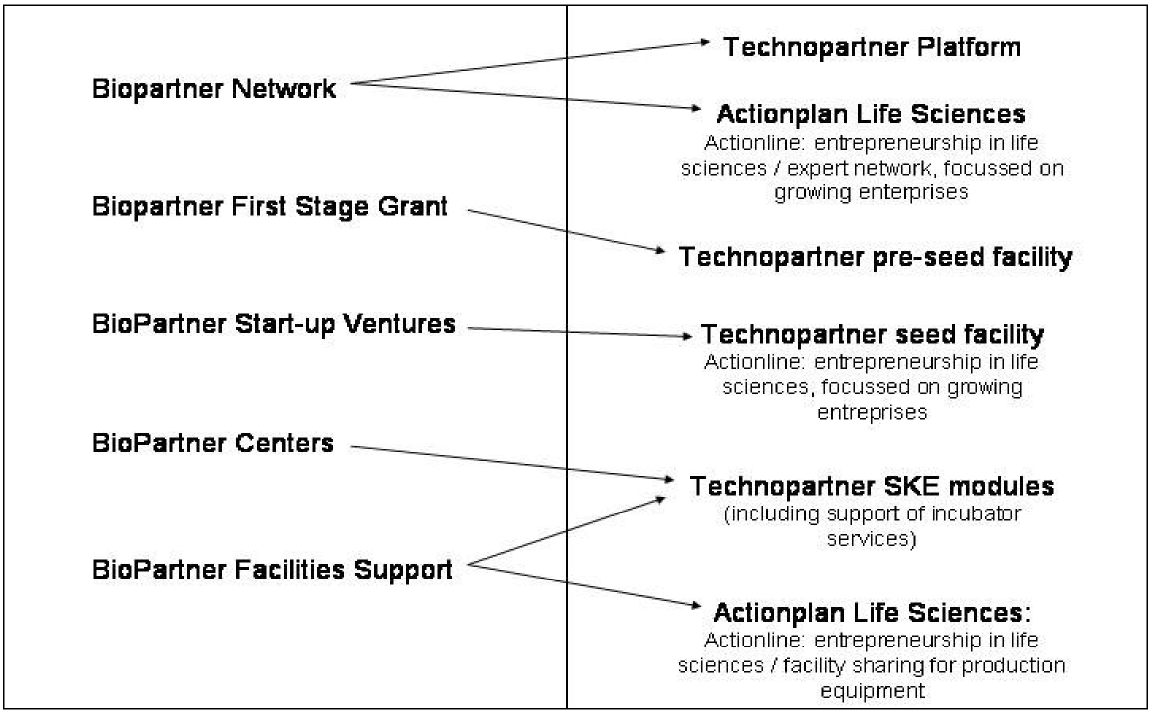
– *BioPartner Centres*
The BioPartner Centres provided incubator facilities for start-up companies, located in the vicinity of life science 'knowledge clusters' in the Netherlands. Five centres were selected after a competition. The incubator provided office and laboratory space and also specific services.

– *BioPartner Facilities Support*
BioPartner Facilities Support operated on the basis of joint use of special apparatus, located in a public knowledge institute, by at least two companies, one of which was a start-up. In this way, expensive equipment did not have to be purchased by the start-up but only paid for when used.

– *BioPartner Start-up Ventures*
BioPartner Start-up Ventures is a holding fund intended to invest in life science start-ups in combination with one or more private investors. Risk capital is provided in exchange for shares in the company. Profits made by BioPartner in this way go back to the holding fund. BioPartner participation involves a minority share, so that at least as of much funding is provided by a private investor as by BioPartner. BioPartner Start-up Ventures also offers management support to start-ups.

The BioPartner programme ended in December 2004. Because of the great success of this and similar programmes, a new generic programme was developed and launched in 2005. This so-called TechnoPartner programme gives support to starters in high technology sectors. Most instruments of the BioPartner programme were continued in the TechnoPartner programme.

Figure 2.1 BioPartner programmes and their TechnoPartner follow-ups



Source: MoEZ (2004c) TechnoPartner Actieprogramma, Van Kennis naar Welvaart, Ministry of Economic Affairs, Den Haag

IOP - Industrial Proteins

Through the IOP instrument, several strategic technological fields concerning Dutch industry have been stimulated since the early 1980s. During the period 2002-2005, two IOPs were running in the field of biotechnology/life sciences: the IOP Genomics (part of the National Genomics Programme under NGI/NWO: see 2.3.1.2) and the IOP Industrial Proteins.

IOP Industrial Proteins ran from 1992 to 2004 and had a budget of 7.3M EUR. It was also financed by the Ministry of Agriculture, Nature and Fisheries. This IOP examined the relationship between the molecular structure of proteins and their function in industrial applications. Fundamental knowledge of this relationship has made it possible for companies to understand the behaviour of proteins and use them more specifically in new and existing products.

ICES/KIS

The Interdepartmental Commission for Economic Structure (ICES) comprises almost all Dutch ministries involved in science and technology policy-making. The ICES advises the Dutch government on financial and economic issues that should receive extra funding from the Economic Structure Fund (FES, which is constantly replenished with natural gas revenues). Within the ICES, a committee has been set up that specialises in research infrastructures (ICES/KIS) to advise on investments in research and research infrastructure. The first ICES/KIS programmes (ICES/KIS-1) started in 1994. For the period covered in this report, ICES/KIS-2 and ICES/KIS-3 are relevant. ICES/KIS funding consists of 60 to 65% of the total budget of the funded organisation/programme.

ICES/KIS-2 started in 1998. Twelve projects have been funded; one of them is in the field of biotechnology/life sciences:

– *BioMade* Subsidy: 7M EUR (2004-2008)
BioMade Technology is a multidisciplinary research organisation founded in 2000 and dedicated to developing molecular nanotechnology. It made a successful application for ICES/KIS-2 funding. Most technologies developed by BioMade Technology are in the field of molecular nanotechnology, including drug delivery, vaccine development, peptide stabilisation and protein coatings. The research projects originate from basic research undertaken in universities, and are being carried out by BioMade research staff in close conjunction with university staff. This ensures continued and unfettered access to high-quality basic research taking place in the institutes, and the necessary freedom to focus projects on commercialization.

In November 2003, the Dutch government agreed on a budget and projects for ICES/KIS-3 (now known as Bsik): 800M EUR for nearly 40 projects addressing five themes: ICT; use of space; durable system innovations; microsystems and nanotechnology; and health-, food, gene- and biotechnological breakthroughs (including genomics). Twelve of these projects have a health theme, six of which are clustered under the programme managed by NGI: the four innovative clusters, the Netherlands Proteomics Centre and BioRange (which is part of the Netherlands Bioinformatics Centre).

Five other ICES/KIS-3 projects deal with life sciences in the health area. These are:

– *Molecular Imaging Ischemic Heart Disease*: Subsidy: 10.8M EUR (2005-2009)
The aim of this programme is to develop a substance able to recognise a certain molecule, after which it can be linked to a contrast medium and be located and visualised through imaging techniques (X-ray, CT scan, MRI scan). The new technique may play an important role in early detection of the disease or in assessing the effectiveness of certain drugs.

– *Stems Cells in Development and Diseases*: Subsidy: 8.8M EUR (2005 – 2009)
This research programme aims to identify and characterise the genetic cascades and regulatory pathways that control cell identity throughout development in several stem cell and tissue systems. To achieve these goals, integrated biochemical and functional genetic approaches are being used in combination with gene expression analysis, novel gene disruption technology, stem cell culture systems and rapid monoclonal antibody production. Bioinformatics databases will be integrated using the latest three-dimensional visualisation technology, and will lead to a new perception of multifactoral processes. This in turn will lead to validation and the subsequent formulation of novel intervention strategies for disease and trauma.

– *Neuro-Bsik Mouse Phenomics*: Subsidy: 13.1M EUR (2005-2009)
The aim of the Mouse Phenomics programme is to define novel mouse models for brain disorders in which intelligent screening of mutant mice and inbred strains, with subsequent in-depth analyses of selected lines, are combined. This will lead to methods that can be used as a so-called macro-circuitry signature of the network.

- *Dutch Programme for Tissue Engineering*: Subsidy: 25M EUR (2005-2009)
Following a pilot programme initiated in 2002 by the Medical Sciences Division of NWO and the Technology Foundation, the Dutch Programme for Tissue Engineering was set up. The programme, which is managed by NWO Medical Sciences and STW, consists of 20 sub-projects which are part of three platforms: stem cells, matrices and bioreactors. There will also be separate translational projects. Through its knowledge infrastructure, the programme aims to contribute to the development of key knowledge and the creation of business activities in the aforementioned areas.

– *Cyttron* Subsidy: 8.8M EUR (2005-2009)
The Cyttron programme focuses on bio-imaging techniques. The programme aims to implement a comprehensive, integrated infrastructure for bio-imaging and modelling cells down to atomic detail. The goal is to provide a generic tool for identifying the molecular causes of disease, essential for the prevention of disease and the development of new drugs and therapies, and to establish a platform for advanced diagnosis and tuning of individualised therapy, thereby increasing the effectiveness of health care in The Netherlands.

Technology Cooperation Programme
The 'Technologische Samenwerking' programme began as a funding programme that stimulated technological innovation, with a potential economic perspective, through national and international cooperation. Since 2005, it has become part of the new funding scheme 'Innovation subsidies for cooperation projects' (Innovatiesubsidie Samenwerkings-projecten). 102.5 M EUR were spent on biotech/life sciences projects in the period 2002-2005 through this programme.

Leading Technological Institutes
After a severe competition, four so-called Leading Technological Institutes (Technologische Top Instituten – TTI's) were established in 1997. These are virtual organisations in which companies, universities and research institutes participate in public-private partnerships for research and innovation. TTI's are financed 50% for a period of four years by the Ministry of Economic Affairs. The remaining half must be financed by the public research organisations involved and by industry. One of the four TTI's works in the field of biotechnology/life sciences: the Wageningen Centre for Food Sciences. The other three specialise in metals, polymers and telematics.

In the Wageningen Centre for Food Sciences (WCFS), Dutch food businesses, government, and research organisations have joined forces and cooperate in fundamental strategic research. Currently, 200 researchers are working at five research institutes and seven food companies participating in the WCFS. WCFS focuses on three research programmes: research on nutrition and health; structure and functionality of food; and microbial functionality and safety. In 2005, the Leading Technological Institutes were evaluated. The outcome of this evaluation was very positive, resulting in subsidies being extended for an additional four years. For both four-year periods, WCFS had an annual budget of approximately 27M EUR, half of which was financed by the government.

In 2006, WCFS received additional funding in the amount of 33M EUR from so-called FES-funds (see Chapter 5). These funds were granted to WCFS to encourage it to become one of Europe's top institutes for food sciences ('Food and Nutrition Delta') and ultimately help turn the Netherlands into one of Europe's elite regions for nutrition and food research.

2.4 Charities

There are a large number of charity funds in the Netherlands, but only a few have their own research programmes or projects. The most important charity involved in active funding of biotechnology research is the Dutch Cancer Society (Koningin Wilhelmina Fonds - KWF). It is the private organisation for cancer control in the Netherlands. It raises funds through door-to-door campaigns, as well as private donations, lotteries and industry-oriented campaigns. This resulted in 2004 in an annual budget of 44.8M EUR. 50% of this budget goes to cancer cause and development research, 40% to treatment research and the remaining 10% to other types of research, such as improved diagnosis and patient information.

A lot of the research funded by the KWF is done by the Netherlands Cancer Institute and the Daniel de Hoed Kliniek in Rotterdam. Funds are granted after research proposals are evaluated by two experts selected from an international panel.

Other large charity funds involved in active funding of biotechnology-related research are the Dutch Heart Foundation, the Dutch Aids Fund, the Asthma Fund and the Kidney Foundation. These charity funds all have research programmes that incorporate biotechnology. Table 2.3 shows the research budgets of these charities. No data are available on biotech's share of these R&D budgets.

Table 2.3 Overview of charities that fund biotechnology research, their annual budget and research budget

Charity organisation	Annual budget (M EUR)	Research budget (M EUR)
Queen Wilhelmina Fund	44.8	18
Dutch Heart Foundation	29	12.5
Dutch Aids Fund	13.3	1.8
Asthma Fund	11	3 (225 000 per project)
Kidney Foundation	13. 5	4.5

Source: BioPolis Research

2.5 Participation in the 6th Framework Programme and use of development funds

The participation of Dutch research groups in the 6th Framework Programme is rather high (see Table 2.4). In the 'Genomics and Life Sciences for Health' part of the programme, 60 (of the 759) projects are coordinated by Dutch researchers; 578 researchers (of the 8 537 included in the research groups) participate in these projects. Participation in the 'Food Quality and Safety' part of the programme is in absolute terms much smaller, but the programme itself also has a much smaller budget. Twelve (of the 90) projects are coordinated by Dutch researchers, which is a relatively high level of involvement; 137 (of the 1 599) researchers involved participate in these projects. In 'Nanobiotech' only one (of 12) projects is coordinated by a Dutch researcher, whereas Dutch researchers participate in five (of 106) projects.

Table 2.4 Involvement of the Netherlands in biotech parts of the 6th Framework Programme

Thematic priorities	**Participation as project manager in # of projects (% of total)**	**Participation as member of the project team in # of projects (% of total)**
Genomics and Life Sciences for Health	60 (7.9%)	578 (6.8%)
Food Quality and Safety	12 (13.3)	137 (8.6%)
Nanobiotech part of the Nanotechnology programme	1 (8.3%)	5 (4.7%)

Source: BioPolis Research

3. Performance of the national biotechnology innovation system

3.1 Introduction

This chapter analyses the performance of the Dutch 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.

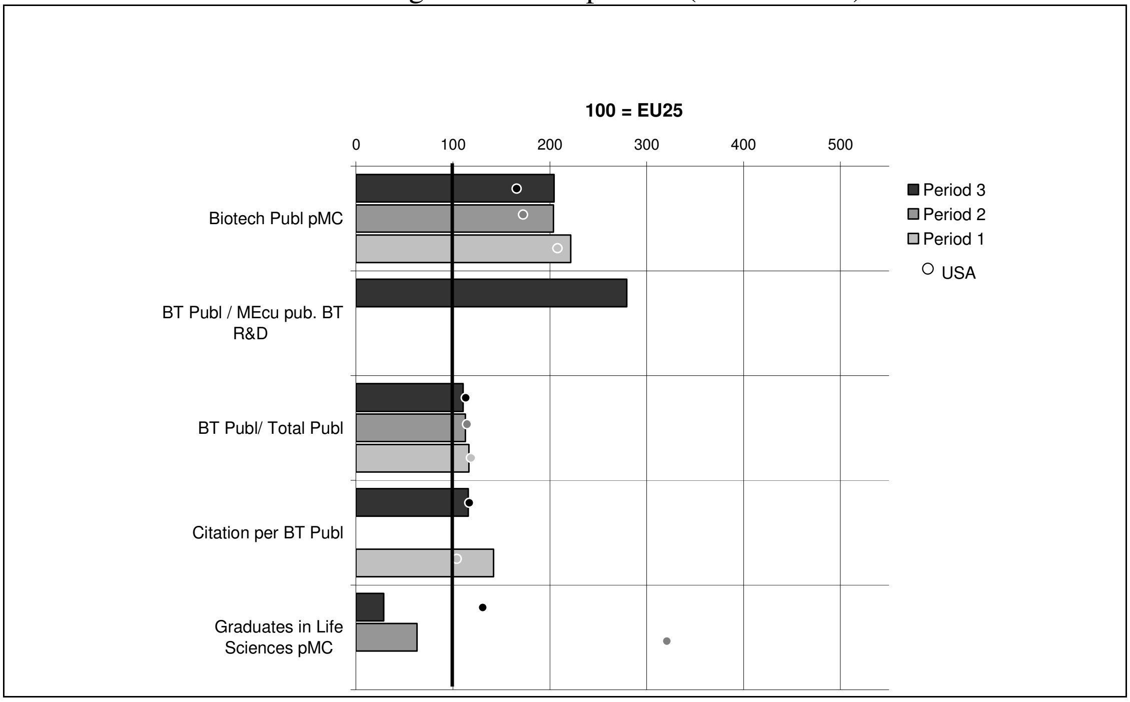
The presentation of the performance is structured along four main areas of the innovation system: the knowledge base, processes of knowledge transmission and application, industrial development and markets for biotechnology-based products. For each area, data of a number of different indicators for the Netherlands, USA and EU25 are shown. 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 time frame, Chart 3.1 shows that the output level of Dutch biotechnology publications per million capita remained more or less the same, with a small decrease between period 1 (1994-1996, index 222), period 2 (1998-2000, index 204) and period 3 (2002-2004, index 205). The Dutch biotech publications output per million capita for the three periods was far above EU25 and USA levels.

The country's share of biotechnology publications, in relation to the total number of publications, decreased from index 117 in the period 1994-1996 to index 110 in the period 2002-2004, but still remained above the EU25 level. Moreover, Dutch biotechnology publications, in relation to the total number of publications, were only slightly lower than in the USA (index 119 in 1994-1996 to index 113 in 2002-2004). When considering the number of citations per biotechnology publication, the Netherlands remained at the same high level (index 142 in the period 1994-1996 to index 116 in the period 2002-2004) and showed a higher performance than the USA (index 104 in 1994-1996 and index 117 in 2002-2004). With regard to the number of graduates in life sciences per million capita, there was a decrease in the Netherlands from the period 1998-1999 (index 63) to 2000 (index 29).

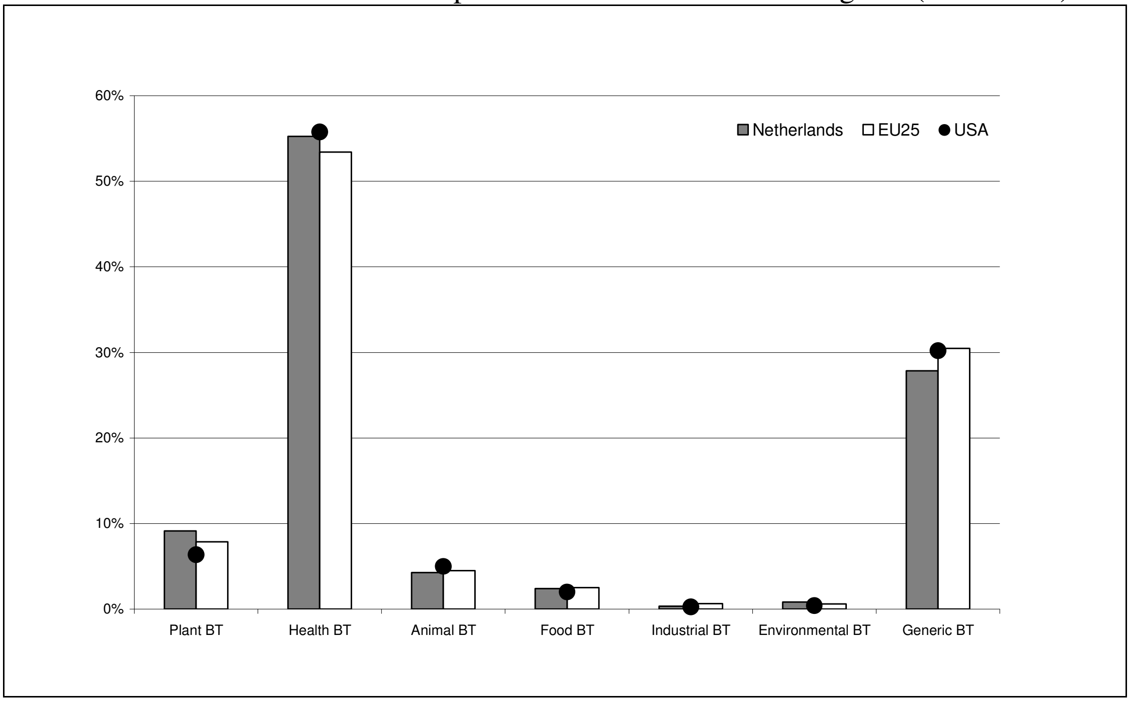
Chart 3.1 Netherlands biotechnology knowledge base indicators: comparison with EU25 and USA figures in three periods (index values)



Source: BioPolis Research

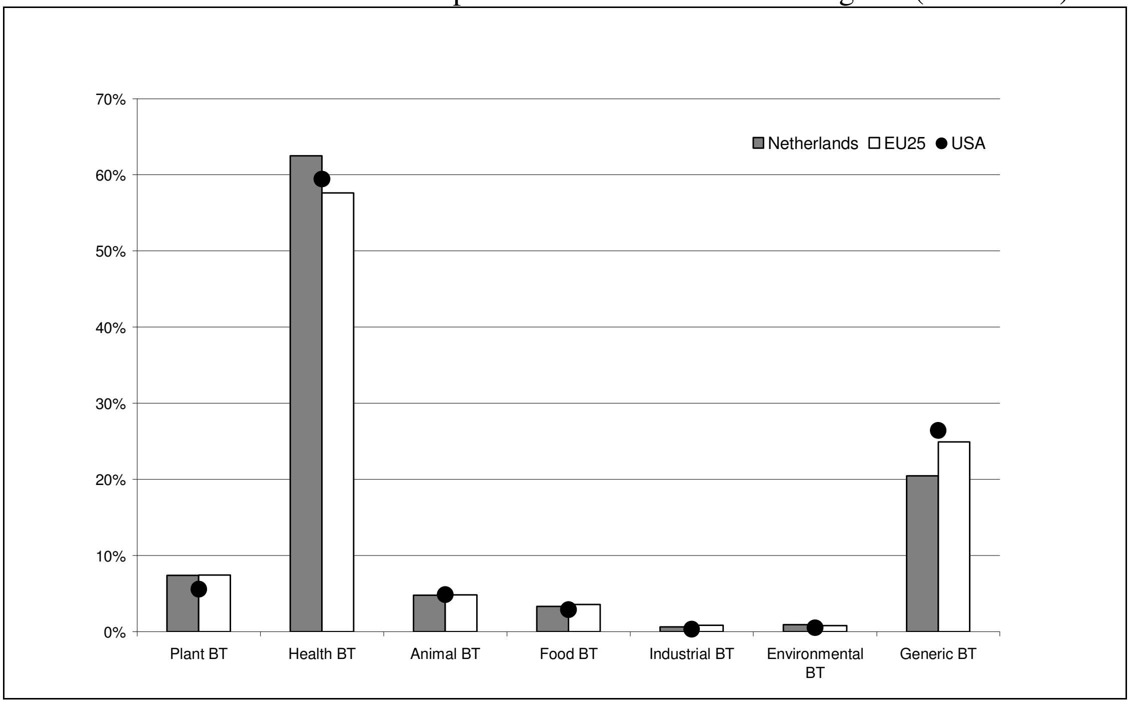
Dutch biotechnology publications can be found especially in the fields of human health and generic biotechnology (see Chart 3.2.1). If we compare the figures for the period 1994-1996 (Chart 3.2.1) and the period 2002-2004 (Chart 3.2.2) the picture has not really changed. The share of human health biotechnology increased from 55% to 63%, and the share of generic biotechnology decreased from 28% to 20%. The plant biotechnology field dropped from 9% to 7%; other fields had a relative growth of 1%.

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



Source: BioPolis research

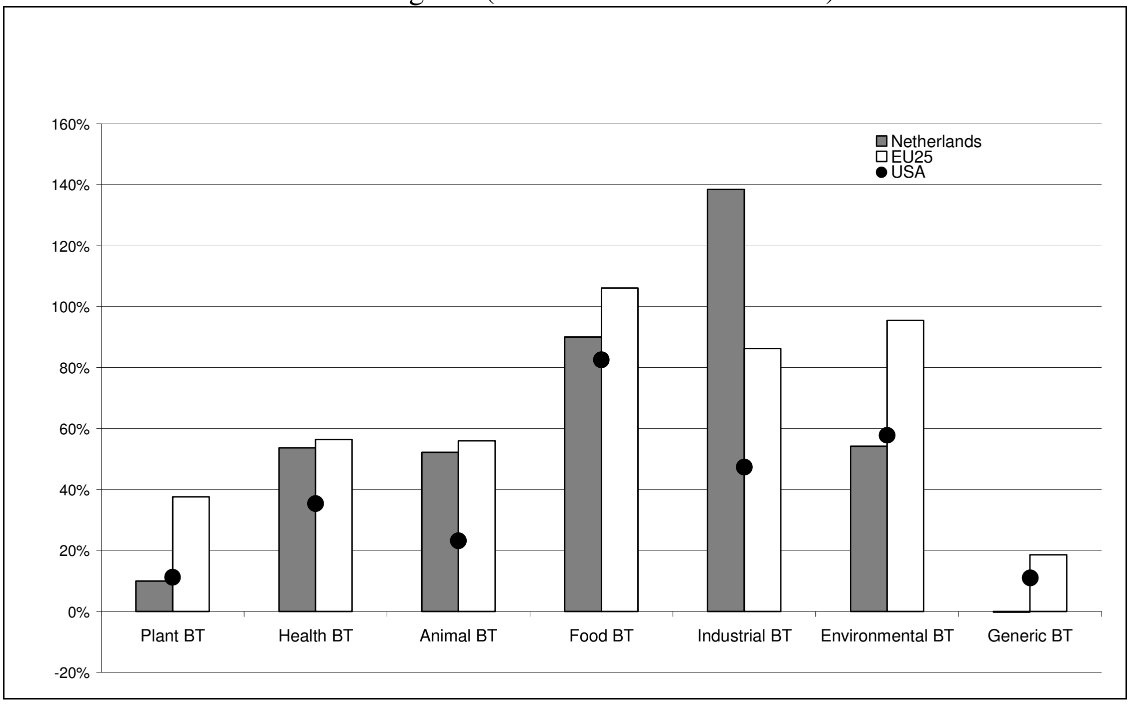
Chart 3.2.2 Share of subfields, as a percentage of total biotechnology publications, for the Netherlands: comparison with EU25 and USA figures (2002-2004)



Source: BioPolis Research

In terms of the growth rate of biotechnology publications in various subfields, industrial biotechnology performed best (138%), far above EU25 (86%) and USA (47%) growth rates (see Chart 3.3). Food biotechnology publications increased by 90% between 1994-1996 and 2002-2004, which is lower than the EU25 average (106%), but higher than the USA figure (83%). Health biotechnology (54%), environmental biotechnology (54%) and animal biotechnology (52%) also showed considerable growth. The plant biotechnology field was the lowest performer in terms of number of publications, increasing only by 10% between 1994-1996 and 2002-2004.

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



Source: BioPolis Research

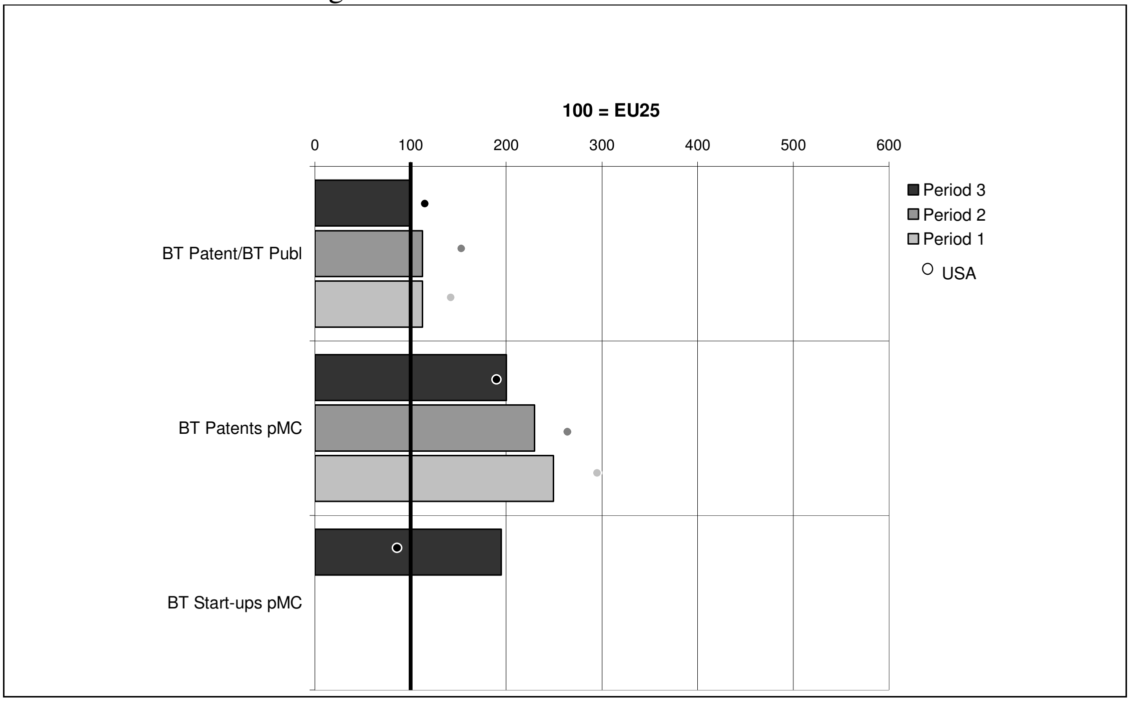
3.3 Performance in knowledge transmission and application

In terms of biotech patent applications per biotech publication, Dutch output has experienced a slight decline over the last ten years (from index 112 in 1994-1996 to index 113 in 1998-2000 to index 100 in 2001-2003). The Netherlands performed below the USA level, which also declined from index 142 to index 115 between the first and last periods.

With regard to biotech patents per million capita, the output of the Netherlands has also declined over the last ten years (from index 249 in 1994-1996 to index 200 in 2001-2003). Starting from a higher level in the period 1994-1996, the USA achieved a lower level than the Netherlands in terms of biotech patent applications per million capita in period 3.

For the number of start-ups, only data for 2003 is available (see Annex 5). The Netherlands performs rather well, showing an index of 223 compared to 79 for the USA.

Chart 3.4 Performance indicators for biotechnology knowledge transmission and applications in the Netherlands over three periods: comparison with EU25 and USA figures



Source: BioPolis Research

3.4 Industrial development

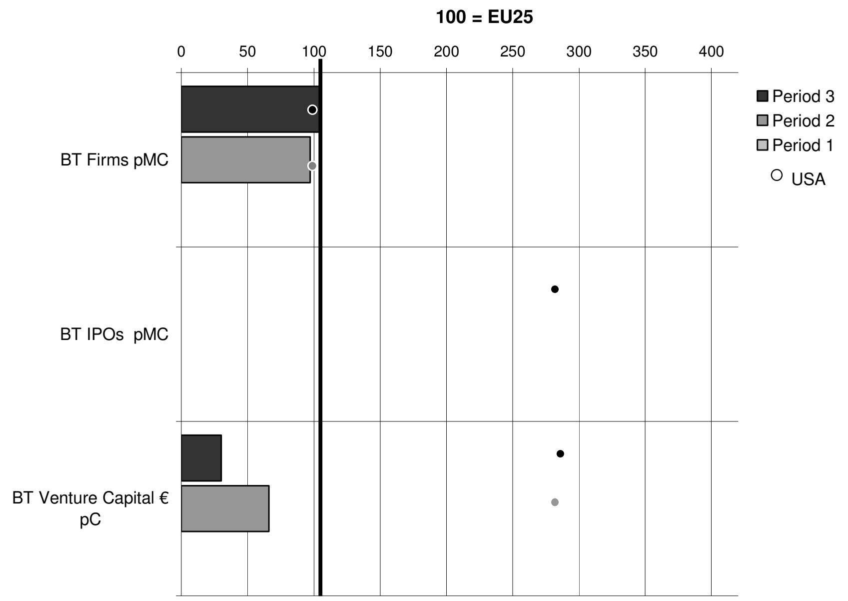
Industrial development is measured by the number of biotechnology companies pMC, biotech Initial Public Offerings pMC and Venture Capital invested in biotechnology companies pC.

The Netherlands showed a small increase in the number of biotech companies pMC in the period 2001-2003 (index 97 to index 113), with a decrease in 2004 (index 105). The USA remained at index 99 in the years 2001, 2002 and 2004, with a short rise in 2003 (index 116).

In the period 2002-2005, there were no biotech companies that went to the stock exchange, and therefore no IPOs and zero values for IPOs pMC. Chart 3.5 shows that the USA performed far above EU and Dutch levels.

With respect to the amount of venture capital invested in Dutch biotech firms, here again the Netherlands performed far below EU and USA levels. There was even a decrease in period 2 (index 86) to period 3 (index 30).

Chart 3.5 Performance indicators for industrial development in the Netherlands over three periods: comparison with EU25 and USA figures



Source: BioPolis Research

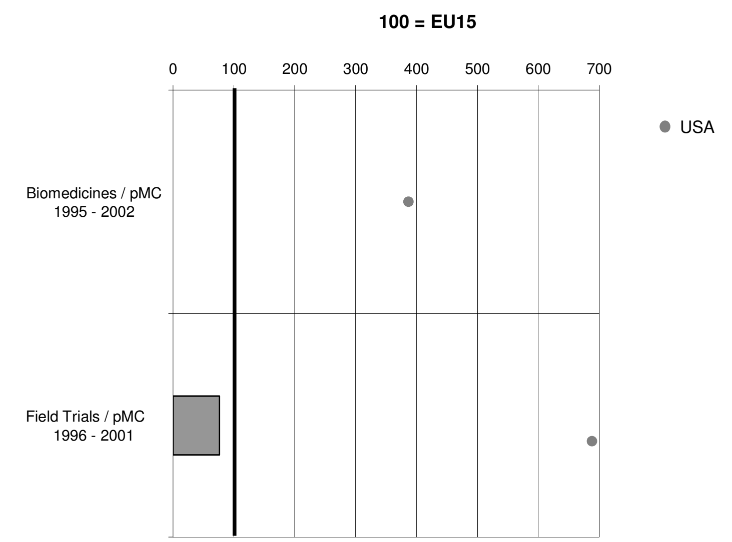
3.5 Market conditions

Indicators for market conditions are measured by the number of field trials and number of approved biomedicines (Chart 3.6).

In the period 2002-2005, Dutch companies did not develop or produce any biomedicines that were introduced on the European market.

In the period 1996-2001, 43 field trials were held in the Netherlands. Indexed, this is 76, which is far below the USA level. This is understandable given the differences that exist in regulations and public acceptance.

Chart 3.6 Performance indicators for market conditions in the Netherlands: comparison with EU25 and USA figures



Source: BioPolis Research

4. Conclusions

4.1 Introduction

This concluding chapter provides an overview of the main characteristics of the group of policy-directed instruments that have been used by the Dutch government in the period 2002-2005 to stimulate biotechnology R&D, technology transfer and commercialisation, including research on social, ethical and legal aspects of biotechnology. The overview summarises the funding of biotechnology, in terms of types of policy instruments used, policy goals addressed, research applications areas funded and activities stimulated. It also provides a comparison with the period 1994-1998.

4.2 Public funding of biotechnology through policy instruments

In the period 2002-2005 the Dutch government spent at least 523.9M EUR on biotechnology (see Table 4.1). Most of the funds (almost 75%) were spent through policy-directed channels and were rather equally spread over generic and biotech-specific instruments.

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

	2002	2003	2004	2005	Total*
RESEARCH					
1. *Non-policy-directed*					
Public research institutions	19	19	19	19	76
Response mode	12.1	10.3	13.2	17.1	52.7
Total	31.1	29.3	32.2	36.1	128.7
2a. *Policy-directed, Generic*					
National	26.1	34.0	45.1	41.6	146.8
Regional	-	-	-	-	-
Total	26.1	34.0	45.1	41.6	146.8
2b. *Policy-directed, Biotech-specific*					
National	38.6	39.7	39.7	39.7	157.7
Regional	-	-	-	-	-
Total	38.6	39.7	39.7	39.7	157.7
COMMERCIALISATION					
1a. *Policy-directed, Generic*					
National	10.0	10.0	14.6	15.4	50
Regional	-	-	-	-	-
Total	10.0	10.0	14.6	15.4	50
1b. *Policy-directed, Biotech-specific*					
National	10.4	10.4	10.4	1.5	32.7
Regional	-	-	-	-	-
Total	10.4	10.4	10.4	1.5	32.7

	2002	2003	2004	2005	Total*
OTHER					
1a. *Policy-directed, Generic*					
National	-	-	-	-	-
Regional	-	-	-	-	-
Total	-	-	-	-	-
1b. *Policy-directed, Biotech-specific*					
National	2	2	2	2	8
Regional	-	-	-	-	-
Total					
GRAND TOTALS	117.2	125.4	144.0	136.3	523.9

* only data for the four-year period is available; yearly figures were calculated by dividing the total by four.
Source: BioPolis Research

4.3 Specific features of the instruments

Except for the three NWO programmes that fund basic research, all other programmes require matching funds from research organisations and, in some cases, also from participating companies or organisations (such as patient organisations or industry associations).

The Technological Cooperation programme, the BioPartner programme and some of the NGI programmes have companies as their main recipients. In the Technological Cooperation programme, research organisations also participate but are contracted and paid by the companies. In all other programmes, research organisations are the main recipients; in the case of NWO programmes (excluding some NGI and ACTS programmes), these are university research groups. Research institutes can only participate if they work together with a university in the project. Table 4.2 provides an overview.

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

Instrument	Funding agency	Participants/Recipients			Co-finance required from:	
		PRO's	SME's	LFs	Recipients	Other public authorities
National						
Generic						
ACTS	NWO	√			√	
IOP-Industrial Proteins	SenterNovem	√			√	
ICES-KIS-2 and -3	SenterNovem	√			√	
Technological Cooperation	SenterNovem		√	√	√	
TTI-WCFS	Ministry of Economic Affairs	√			√	
Biotech-specific						
From Molecule to	NWO	√				

Instrument	Funding agency	Participants/Recipients			Co-finance required from:	
		PRO's	SME's	LFs	Recipients	Other public authorities
Cell						
Computational Life Sciences	NWO	√				
Translational Gene Therapy Research	NWO	√				
NGI	NWO	√	√	√	√	
BioPartner	Ministry of Economic Affairs	√	√		√	

Source: BioPolis Research

4.4 Policy goals

On the basis of funds attributed to ten different policy goals (see Table 4.3), it can be concluded that the main policy goal in Dutch national biotechnology policy making is the stimulation of high levels of industry-oriented and applied research; 50% of policy-directed programme funding is directed at this goal. The second important goal is the stimulation of basic research in biotechnology, receiving almost one quarter of total funding. The other quarter is used for cooperation between industry and public research organisations, support of firm creation and matters of public acceptance of biotechnology.

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

	1*	2	3	4	5	6	7	8	9	10
Generic										
ACTS	√	√								
IOP-Industrial Proteins		√								
ICES-KIS-2 and -3		√								
TTI - WCFS		√								
Technological Cooperation		√			√					
Total	4.43	142.36			50					
Biotech-specific										
From Molecule to Cell	√		√							
Computational Life Sciences	√									
Translational Gene Therapy Research		√								
NGI	√	√			√		√	√		
BioPartner					√		√			
Total	99.98	55.06	2.7		9.09		23.63	7.97		
Grand Total	104.41	197.42	2.7		59.09		23.63	7.97		
% of Grand Total	26.3	50.0	0.7		15.0		6.0	2.0		

*

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
6 = Adoption of biotechnology for new industrial applications
7 = Firm creation
8 = Social acceptance of biotechnology
9 = Business investments in R&D
10 = Bio-safety, risk assessment

Source: BioPolis Research

4.5 Biotech research application areas

Table 4.4 shows coverage of biotech areas by Dutch generic and biotech-specific programmes. Two programmes (Technological Cooperation and BioPartner) have not indicated a specific application field.

The funding distribution of other programmes shows that almost one-third of research funds are spent on basic research in biotechnology and its supporting disciplines (29.9%). Food biotechnology and health biotechnology compete for second place, which is held by food biotech (23.5%). This is in contrast to many other countries where health biotech is the area (after basic biotech) that receives by far most of the funding. Industrial biotech takes a middle position with 14%. Plant biotech, environmental biotech and the ethical, legal and social aspects of biotechnology form the third group. Animal biotech research is not funded through Dutch policy-directed programmes.

Table 4.4 Coverage of biotech research application areas 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								
ACTS						√		
IOP-Industrial Proteins						√		
ICES-KIS-2 and -3				√				
TTI-WCFS					√			
Technological Cooperation								
Total				16.1	54	24.19		
Biotech-specific								
From Molecule to Cell							√	
Computational Life Sciences							√	
Translational Gene Therapy Research				√				
NGI	√		√	√	√	√	√	√
BioPartner								
Total	12.88		7.82	40.08	7.11	12.23	77.61	7.97
Grand Total	12.88		7.82	56.18	61.11	36.42	77.61	7.97

*

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 biotechnology activities funded by each policy-directed instrument. In total, nine different activities are funded. Applied research in public research organisations (activity 2) and collaborative research between industry and these organisations (activity 8) cover more than 60% of the budget. Basic research comes third (activity 1), followed by centres of excellence (activity 3), the budgets of which also cover mainly research activities. This is more or less in line with the results for policy goals concerning funding. The same applies for technology transfer and commercialisation activities and support for public discourse activities.

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**	**13**	**14**	**15**	**19**
National									
Generic									
ACTS		√							
IOP-Industrial Proteins		√							
ICES-KIS-2 and -3	√	√							
TTI-WCFS		√							
Technological Cooperation				√					
Total	4.43	89.86		102.5					
Biotech-specific									
From Molecule to Cell	√								
Computational Life Sciences	√								
Translational Gene Therapy Research		√							
NGI	√	√	√	√		√	√	√	√
BioPartner					√	√	√		
Total	64.05	25.68	38.63	29.37	8.4	9.43	6.49	8.4	7.97
Grand Total	68.48	115.54	38.63	131.87	8.4	9.43	6.49	8.4	7.97

*

1 Basic research
2 Applied research
3 Centres of excellence
4 Research networks
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 Establishment of research institute/centre of industrial interest
10 Technology transfer office
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

Source: BioPolis Research

4.7 Dynamics: comparison with 1994-1998

The data collected on biotechnology research for the period 2002-2005 can be compared with those collected for the period 1994-1998. The inventory project provides, in a similar but less systematic way, an overview of public funding of biotech research during the period 1994–1998 in 15 member states, Iceland, Norway and Switzerland (Enzing et al., 1999).

Funding

In the five-year period covered in the inventory study, biotechnology research funded through generic and specific programmes and non-directed funding in the Netherlands (only data for the Ministry of Agriculture were available) was 58.7M ECU per year (ibid).

During the period 2002-2005, funding of biotech research came to 131M EUR per year (for the total of all funds spent on the eight biotech areas, see Table 4.4). This was more than double the funding in the period 1994-1998. A closer look at the set of programmes in both periods shows that similar programmes were run by NWO and the Ministry of Economic Affairs in both periods, but that those of the Netherlands Genomics Initiative and, to a lesser extent, BioPartner made the difference.

Table 4.6 Comparison of biotechnology research funding, by non-policy-directed and policy-directed instruments, in the periods 1994-1998 and 2002-2005

Funding	Average total funding per annum for biotechnology research in 1994-1998	Average total funding per annum for biotechnology research in 2002-2005
National	58.7M ECU	131.0M EUR
Regional	-	-
Total	58.7M ECU	131.0M EUR

Source: BioPolis Research

Policy goals

When comparing policy goals of programmes running during the period 1994-1998 (ibid) and the period 2002-2005 (this report), it can be concluded that the promotion of basic and industry-oriented/applied research (goals 1 and 2) and knowledge transmission between academia and industry (goal 5) remained important goals. A number of new instruments have since been introduced that address new types of goals (goals not yet addressed in the mid-1990s): technology transfer to industry, firm creation and the social acceptance of biotechnology.

Table 4.7 Coverage of policy goals, by policy-directed instruments, in the periods 1994-1998 and 2002-2005

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

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

Biotech areas

Funding by area was not quantified in the inventory project; only total budgets and coverage of each biotech area were provided. The coverage data show that most of the funding in 1994-1998 was for basic research in biotechnology; this was still the case in 2002-2005. However, the positions of the sub-top areas changed. While health was in second position in 1994-1998, food biotechnology was 2%-points above health biotech research in 2002-2005 (see Table 4.4). In 2002-2005, as in 1994-1998, industrial biotech was in fourth position, above environmental biotech. Plant biotech consistently remained in near-last position. Non-technical aspects (legal, ethical, social) of biotechnology had not yet been addressed in 1994-1998, but were incorporated into the NGI programme in 2002-2005. Animal biotech was not addressed through policy-directed programmes in the Netherlands in either period.

5. Future developments

The Action Plan for Life Sciences of the Ministry of Economic Affairs that was presented in December 2005 (MoEZ 2005a) has five actions:
1: Entrepreneurship in life sciences,
2: De-regulation,
3: Enforcement of R&D infrastructure,
4: Strengthening of international networks, and
5: Clear-cut communication by government.

The third action in particular witnessed many new initiatives in 2006, and more are foreseen for 2007. The other actions, except for action 1 which deals with TechnoPartner (see Chapter 2), focus on activities that are not biotech-specific but correspond to more general government policies (deregulation, international networks, communication).

For the period after 2005, enforcement of R&D infrastructure had gained substantial momentum. In the so-called 'Easter Agreement' (April 2005), which was drawn up to stop the smallest coalition partner from leaving the Cabinet, additional funds from the FES (Economic Structure Enhancing Fund, with natural gas revenues) were made available for knowledge, innovation and education. Apart from the 140M EUR that were already reserved for R&D and innovation, an additional amount of 293M EUR was allocated. In 2006, the final selection of FES projects took place. Since 'Food and Flowers' is one of the key innovation policy areas of the Ministry of Economic Affairs (2005b), four biotechnology projects in this area were approved during the first round (Green Generics Top Institute, two potato genomics projects and additional funds for the Technological Top Institute WCFS: Food and Nutrition Delta) with a total subsidy of approximately 66M EUR. A large part of the additional allocated funding was for biotechnology projects: 130M EUR for the Top Institute Pharma and 10M EUR for the Ecology Regarding Gene-modified Organisms project. This in total amounted to 206M EUR.

In September 2006, it was announced that a third batch of R&D projects will be financed by the FES 2007 budget. It will include the Centre for Translational Molecular Medicine (150M EUR and an additional 150M EUR in a later stage), 'Parelsnoer' to set up a national infrastructure for national biobanks (35M EUR), and 'Knowledge Chain Infectious Diseases Animals', which will focus on bird flu research (15M EUR). A fourth project on Biomedical Materials has been given the opportunity to write up a business plan that must be finalised before the end of 2007.

The main NGI programmes are running until the end of 2007. NGI management has written a strategic plan for a second period of five years, requesting a budget of 300M EUR. Decision-making will take place end of 2006/beginning of 2007.

Annex 1 List of tables

in the periods 1994-1998 and 2002-2005

Annex 2 List of figures and charts

Annex 3 List of contact persons

Dr.M. Horning	Ministry of Economic Affairs
Dr.J. Timmerman	SenterNovem
Dr. Chr. Mombers	STW
Dr. M.A. Verschoor	NWO

Annex 4 References

Publications:

Enzing, C.M., J.N. Benedictus, E. Engelen-Smeets, J.M. Senker, P.A. Martin, T. Reiss, H. Schmidt, G. Assouline, P.B. Joly, and L. Nesta, *Inventory of Public Biotechnology R&D in Europe: Analytical Report*, Vol. 1, EU Publications Office, European Commission, 1999.

Enzing, C.M., 'Dutch cluster policy and the character of regional concentration of biotech firms' in Gerhard Fuchs (ed), *Biotechnology in Comparative Perspective*, Routledge, London, 2003, pp. 169-191.

Eurobarometer, *Social values, Science and Technology*, Special Eurobarometer 225 / Wave 63.1, TNS Opinion & Social, Brussels, 2005.

Eurostat, *Eurostat Yearbook 2004: The statistical guide to Europe*, 2004.

MoEZ, *Innovation Letter: Action for Innovation in 2003*, Ministry of Economic Affairs, The Hague, 2003.

MoEZ, *Science, Technology and Innovation in the Netherlands: Policies, facts and figures,* Ministry of Economic Affairs, The Hague, 2004(a).

MoEZ, *Actieplan Life Sciences: Kansen grijpen, Knelpunten Aanpakken*, Ministry of Economic Affairs, The Hague, 2004(b).

MoEZ, *TechnoPartner Actieprogramma: Van Kennis naar Welvaart*, Ministry of Economic Affairs, The Hague, 2004(c).

MoEZ, *Life Sciences Monitor: Stand van Zaken EZ-Actieplan Life Sciences*, Ministry of Economic Affairs, The Hague, 2005(a).

MoEZ, *Organiserend vermogen. Sleutelgebieden-aanpak: Samen werken aan innovatie op kansrijke gebieden*, Ministry of Economic Affairs, The Hague, 2005(b).

SenterNovem, *Dynamiek van de hoog-innovatieve Life Sciences bedrijven in Nederland. Een analyse van bedrijven, beleidsgelden en samenwerkingsverbanden in de periode 1994-2004*, SenterNovem, The Hague, 2005.

TrendChart, *European TrendChart on Innovation, Annual Innovation Policy Trends and Appraisal Report, The Netherlands, 2004-2005*, European Commission, DG Enterprise, Brussels, 2005.

Websites:

- NWO: www.nwo.nl
- Ministry of Economic Affairs: www.ez.nl
- Ministry of Education, Culture, and Science: www.minocw.nl
- Ministry of Health, Welfare and Sport: www.minvws.nl
- Ministry of Agriculture, Nature Management and Food Quality: www.minlnv.nl
- Ministry of Housing, Spatial Planning and Environment: www.minvrom.nl
- Ministry of Foreign Affairs: www.minbuza.nl
- RIVM: www.rivm.nl
- RIKILT: www.rikilt.nl
- TNO: www.tno.nl
- SenterNovem: www.senternovem.nl
- National Genomics Initiative. www.genomics.nl
- BioPartner. www.biopartner.nl
- KWF: www.kwfkankerbestrijding.nl
- Dutch Heart Foundation: www.hartstichting.nl
- Dutch Aids Fund: www.aidsfonds.nl
- Asthma Fund: www.astmafonds.nl
- Kidney Foundation: www.nierstichting.nl

Annex 5 Performance

Introduction

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

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

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

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

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

	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 3.2.2	Data in % EU25 and US data for comparison	1994-1996 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 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
Netherlands	7488	9226	10610	15	16	16
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
Netherlands	483	582	653	222	204	205
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.		
Nether-lands	10610	81.5	11	144	237	45	279
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
Netherlands	7488	9226	10610	56600	64990	73683
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
Netherlands	13%	14%	14%	117	113	110
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
Netherlands	8.72	8.43	142	116
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
Netherlands	839	876	16*	16
USA	75253*	70950	276*	288
	Graduates pMC		Index EU17=100	
	1998 / 1999	2002	1998 / 1999	2002
EU17	85**	189	100	100
Netherlands	54*	54	63	29
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**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Netherlands	100%	9%	55%	4%	2%	0%	1%	28%
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**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	7%	58%	5%	4%	1%	1%	25%
Netherlands	100%	7%	63%	5%	3%	1%	1%	20%
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
Netherlands	7559	690	4174	324	180	26	61	2104
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
Netherlands	10261	758	6414	493	342	62	94	2098
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%
Netherlands	10%	54%	52%	90%	138%	54%	0%
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
Netherlands	425	720	722	15	16	16
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
Netherlands	27	45	45	249	229	200
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
Netherlands	425	720	722	7488	9226	10052
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
Netherlands	0.06	0.08	0.07	112	113	100
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
Netherlands	80	85	80	85	15987	16105	16193	16258
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
Netherlands	5.004	5.278	4.941	5.228	97	102	113	105
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	
Netherlands	45	13	16193	
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
Netherlands	2.8	195	0.80	223
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
Netherlands	0	16105	16193	16258	16306	16215
USA	52	287941	290789	291685		290138
	IPO /pMC	**Index**				
	2002-2005	**2002-2005**				
EU Available	0.00	100				
Netherlands	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, Burril & 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
Netherlands	30	38	17	16105	16193	16258
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
Netherlands	2	2	1	66	86	30
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
Netherlands	0	16	0.00	0
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
Netherlands	43	16	3	76
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
The Netherlands	101.29	982

*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

References:

Biotechnology Innovation Scoreboard 2002, European Commission, Enterprise and Industry DG, Brussels, 2002. http://194.78.229.48/extranettrend/reports/documents/report7.pdf, accessed 1/6/2005.

Enzing, C.M. et al., *Inventory of Public Biotechnology R&D Programmes in Europe*, Office for Official Publications of the European Communities, Luxembourg, 1999.

Ernst & Young. *Beyond Borders: The Global Biotechnology Report*, Ernst & Young Global Health Sciences, Cambridge, 2002, 2003, 2004.

Reiss, T. et al., *Benchmarking of public biotechnology policy 2005*, European Commission Enterprise and Industry DG, Brussels, 2005. http://europa.eu.int/comm/enterprise/phabiocom/comp_biotech_comp.htm, accessed 1/6/2005.

Websites:

London Stock Exchange: http://www.londonstockexchange.com/

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

ACTS	Advanced Catalytic Technologies for Sustainability
AWT	Adviesraad voor Wetenschap en Technologie Advisory Council for Science and Technology Policy
FES	Fonds voor de Economische Structuur Fund for the Economic Structure
CPB	Centraal Plan Bureau National Bureau for Economic Policy Analysis
ICES	Interdepartementale Commissie voor de versterking van de Economische Structuur Interdepartmental Commission for Economic Structure
INB	Integrale Nota Biotechnologie
IOP	Innovatiegericht Onderzoeksprogramma Innovation-Oriented Research Programme
KIS	Kennisinfrastructuur R&D Infrastructure
KNAW	Koninklijke Nederlandse Academie van Wetenschappen Royal Dutch Academy of Arts and Sciences
KWF	Koningin Wilhelmina Fonds Dutch Cancer Society
MoEZ	Ministerie van Economische Zaken Ministry of Economic Affairs
NGI	Netherlands Genomics Initiative
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek Netherlands Organisation for Scientific Research
PBTS	Programmatische Bedrijfsgerichte Technologie Stimulering Programmatic Industry-Oriented Technology Stimulation
R&D	Research and Development
STW	Stichting Toegepaste wetenschappen

	Technology Foundation
TTI	Technologische Top Instituten Leading Technological Institutes
WCFS	Wageningen Centre for Food Sciences