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 Switzerland

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

Ralf Lindner
Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI)
Karlsruhe, Germany

March 2007

Table of contents

Summary

Traditionally, Switzerland's GERD as a percentage of GDP is comparatively high; with an investment of 2.9% of its GDP in R&D in 2004, the country ranks among the international top group composed of countries such as Sweden and Japan. Hence, the Lisbon objective of 3% GERD is clearly coming into reach. Compared to other European countries, Switzerland is in the privileged position of having a private sector that strongly contributes to R&D spending: In 2004, 70% of total GERD was supplied by industry.

Within Switzerland's decentralised, cooperative federalism, the responsibilities for education, science, research and innovation are not only horizontally distributed between different ministries and departments, but also between the two levels of government. This, in combination with the pronounced consensus orientation and the involvement of large numbers of actors from different levels of government and societal groups, causes complex interlocking and therefore time-consuming decision-making procedures. For instance, due to the existence of numerous consultative bodies and consensus-building mechanisms, the process of setting up new National Research Programmes (NFP) may take several years. However, the high density of formal and informal contacts between the relevant actors also has its merits as the stakeholders are better informed about ongoing initiatives. In effect, overlap and organisational friction are less pronounced as could be expected, and the actors involved tend to be committed to the general policy direction once a decision has been made. And indeed, at the level of the funding instruments, a considerable duplication of programmes or parts of them was not identified.

Life sciences and biotechnology in Switzerland are well established both as a scientific research field and a flourishing industry. The bulk of scientific research is performed at the universities and the two federal institutes of technology (ETH); only a comparatively small number of publicly funded non-university institutes, such as the renowned Friedrich-Miescher Institut and the Paul Scherrer Institut contribute to the scientific knowledge base. A very important pillar of Switzerland's biotechnology scene are the research activities performed by industry.

In comparative perspective, the Swiss biotechnology scene performers extremely well in creating a sound knowledge base; the indicators presented in this national report clearly underscore the country's excellent reputation as a leading location for scientific research in the area of life sciences.

More than 80% of the Swiss biotechnology R&D activities are performed in one of the country's three main biotechnology/life science clusters. These tightly knit regional networks around the cities of Basel, Zurich and Lake Geneva effectively fulfil important functions of bringing together actors from different sectors of the regional innovation systems.

The thematic strongholds of the Swiss biotechnology scene are mainly to be found in the area of medical biotechnology, particularly (bio)pharmaceuticals, genomics and proteomics. The bibliometric analysis confirms this general pattern. The areas with the

strongest growth rates (measured by publications) between 1994/96 and 2002/04 were industrial and food, followed by plant and environmental biotechnology, all of which starting from very low publication activity levels.

The density of biotechnology companies relative to population size is one of the highest in the world. Among the factors contributing to the success of the Swiss biotech industry are, in addition to the excellent knowledge base and favourable economic conditions, the geographic proximity to the important biotechnology markets of the neighbouring countries and the presence of leading multi-national corporations in the chemical-pharmaceutical industry such as Aventis, Novartis and Roche.

With regard to public promotion activities, biotechnology enjoyed intensified support through the Swiss Priority Programme Biotech in the 1990s. The programme successfully contributed to the establishment of biotechnology R&D in Switzerland. The scientific field is still granted a priority position by the federal government, but due to maturity and the high degree of institutionalisation, special funding for basic research does not seem as expedient anymore. Instead, funding is increasingly channelled through bottom-up schemes such as the National Research Programmes (NFP) and the newly created instruments of the National Centers of Competence in Research (NCCR). Four NCCRs focusing on biotechnology, which were executed between 2002 and 2005, supported biotechnology with 43M EUR public funds. More biotechnology-specific promotion activities were initiated at the valorisation side of the innovation process. In 2003, the Innovation Promotion Agency (CTI) introduced its programme CTI Biotech, which aims to encourage technology transfer and the creation of new companies. Between 2003 and 2005, the programme funded biotechnology-related projects with a total sum of more than 13M EUR. Apart from these policy-directed programmes, non-policy-directed instruments such as bottom-up response mode schemes are still of great importance as a source of funding.

During the last few years it could also be observed that the once sharp separation between the Swiss Federal Science Foundation, as the chief promotion agency for basic scientific research, and the CTI was being gradually supplanted by a more integrative approach. Increasingly, these two institutions jointly design and develop funding instruments as an attempt to respond to the necessities of complex innovation processes.

1. Introduction and background

1.1 General Introduction

The Swiss Confederation (*Confoederatio Helvetica*), with a population of 7.4M one of the smallest countries in central Europe, belongs to the wealthiest nations in the world. This stable and prosperous economy achieves per capita GDP rates (in PPS) of more than 30% above the EU25 average.[1] However, in terms of annual growth of GDP, Switzerland has been suffering under low performance rates since the 1990s. In the period between 2002 and 2005, the country only reached a mean annual growth rate of roughly 0.8%,[2] which was significantly below the EU25 (1.6%) and the EU15 (1.5%) values. Yet, considering an unemployment rate of 4% in 2005 (EU25: 8.7%), the economic situation altogether is not too gloomy.

As a typical small open market economy, imports and exports contribute largely to Swiss GDP. Despite its strong integration into the world economy in general and the European market in particular, the country has up to now refrained from becoming a member of the EU. Nevertheless, in order to minimise the negative consequences of isolation from the rest of Europe and the single market, Switzerland has brought its economic and trade practises largely into conformity with those of the EU; in addition, numerous bilateral agreements in a broad range of policy fields between Bern and Brussels have been signed. For instance, Swiss researchers have been able to participate in EU Framework Programmes since 1987. As a consequence of the association agreement with the EU, which was signed in 2004, Swiss partners now have full access to FP6.[3] A renewal of the agreement with regard to the upcoming FP7 is currently being prepared.

In Switzerland's highly industrialised service economy less than 4% of the workforce was employed in the primary sector, whereas the secondary and the tertiary sectors accounted for 23.7% and 72.4%, respectively of the total number of employees in 2005.[4] The secondary sector is traditionally dominated by small and medium sized enterprises in the watch and mechanical engineering industries and by large, multinational chemicals and pharmaceutical producers. The tertiary sector is characterised by an important role of both financial services (banks and insurances) and the tourism industries.

Switzerland's gross expenditure on research and development (GERD) as a percentage of GPD is, compared to the European average, traditionally high: In 2001, the country invested 2.6% of its GDP in R&D annually, bringing it into proximity of the international top group composed of countries such as Sweden (4.27% GERD), Japan (3.06% GERD) or the USA (2.80% GERD). The R&D-expenditures in the EU25 and the EU15 merely

1 Unless otherwise indicated, the macro-economic data are taken from the Eurostat online database, structural indicators (URL: <http://epp.eurostat.cec.eu.int>, 12-12-2005).

2 The Swiss data is taken from Swiss Federal Statistical Office online sources (URL: <http://http://www.bfs.admin.ch/bfs/portal/de/index/themen/volkswirtschaft/volkswirtschaftliche.html>, 12-12-2005).

3 For details cf. Bieri et al. (2005).

4 Swiss Federal Statistical Office online source (URL: <http://www.bfs.admin.ch/bfs/portal/de/index/themen/arbeit_und_e/erwerbstaetigkeit/blank/kennzahlen0/detaillierte_ergebnisse.html> 12-12-2005.

reached 1.93% and 1.98%, respectively. According to data published by the Swiss Federal Statistical Office in 2006, Swiss GERD reached 2.9% in 2004, bringing the country very close to the Lisbon objective (Bundesamt für Statistik 2006: 17).[5]

This very positive impression is slightly tainted by the fact that the federal government's initial plan to substantially increase spending for R&D and education by 6% annually between 2004 and 2007 (Bundesrat 2002)[6] was lowered to an increase of 5%. Due to additional cutbacks, the annual growth was eventually watered down to merely 3%. In total, the federal level supported R&D with 913M EUR in 2004, up from 761M EUR in 2002.

Traditionally, the private sector contributes quite strongly to Swiss R&D spending. In 2004, industry's share of total GERD accounted for 70% (EU15: 54.6% in 2003), whereas the public sector's (federal government and cantons) support for R&D amounted to 22.7% of GERD (EU15: 34.7% in 2003). The percentage of R&D financed from abroad ranks among the lowest in Europe: in 2004, foreign contributions to Swiss GERD reached 5.2%, whereas R&D expenditures financed from abroad in the EU15 account for about 8.5% (in 2003) of total GERD.[7] However, compared to 1.9% in 1992, the foreign share to domestic R&D increased significantly (Staatssekretariat für Bildung und Forschung 2005: 34)[8].

Swiss biotech sector

Switzerland has the highest density of biotechnology companies relative to population size worldwide (Veraguth 2004: 22)[9]. According to a recent Swiss Biotech Report (2006: 32), 229 enterprises were active in the biotech sector in 2005, 91 of which being biotech suppliers and 138 core biotech companies (see also chapter 3.4), employing around 14 000 people. The two largest Swiss biotechnology companies are Actelion and Merck-Serono, the latter even being listed as the third largest biotech firm worldwide (Veraguth 2004: 20). Other notable enterprises that are present on the world markets are Cytos, Basilea, Biomarin or Prionics. Since the 1990s, Switzerland enjoyed a quite steady growth in the sector. Over 80% of the core biotech companies conduct their business in the areas of human and animal health biotech, while less than 15% of the companies are active in the grey and green areas of biotechnology (ibid.). The bulk of biotechnology-related activities is concentrated in three geographic regions: the Zurich (Greater Zurich Area/Zurich MedNet), Basel (Basel Area Life Sciences) and Lake Geneva (BioAlps) areas.

---

5 Bundesamt für Statistik (2006) Indikatoren "Wissenschaft und Technologie", F + E der Schweiz, Neuchâtel.

6 Bundesrat der Schweiz (2002) Botschaft über die Förderung von Bildung, Forschung und Technologie in den Jahren 2004-2007, 29. November 2002

7 The data for Switzerland are taken from Bundesamt für Statistik (2006) Indikatoren "Wissenschaft und Technologie", F + E der Schweiz, Neuchâtel.

8 Staatssekretariat für Bildung und Forschung; Bundesamt für Berufsbildung und Technologie (2005) Kosten und Finanzierung der Hochschulen und der Forschung in der Schweiz: Ausgewählte Indikatoren, Bern, Staatssekretariat für Bildung und Forschung; Bundesamt für Berufsbildung und Technologie

9 Veraguth, T. (2004) Zukunft der Biotechnologie, BIOforum, 7-8, p. 20-22

The reasons for the overall success of the Swiss biotech scene are manifold, including the following central factors: (1) Switzerland is a prime location for research and science with a long-standing tradition of excellence of university research and a rich knowledge-base; (2) the geographic proximity to the European markets in general and to leading biotechnology regions of the neighbouring parts of Germany and France in particular; and (3) the presence of leading multi-national corporations in the chemical-pharmaceutical industry such as Novartis, Roche, or Clariant.

1.2 Characteristics of national S&T and innovation system

1.2.1 Evolution of national S&T policies

Switzerland is one of the world's leading locations for science and technology. The country's innovation system benefits from a well developed knowledge base and excellent academic research. First class research is represented by top universities such as the Federal Institute of Technology Zurich and others, which hold strong positions internationally. Furthermore, Swiss companies – SMEs in particular – are generally known for their technical precision combined with high innovativeness.

Against this background, Swiss science and technology policy is traditionally preoccupied with the maintenance of these comparatively favourable conditions. In the past, the policy community had to respond to challenges such as economic downturn in the 1970s and 1990s, intensified international competition between locations and fiscal retrenchment. Especially the policies of austerity which had been introduced periodically after the first oil crisis in 1973 confined the possibilities of public research policies considerably, contributing to the continuously low share of public expenditures for R&D.

Strategic framework

The strategic priorities of the federal science and technology policy are outlined in the so-called Education-Research-Technology-Message (Botschaft über die Förderung von Bildung, Forschung und Technologie, BFT-Botschaft) to Parliament every four years.[10] The BFT-Botschaft 2000-2003 was the first instance in which the relevant policy areas were integrated in a single document in an attempt to develop a coherent policy framework. Among the five priorities set out in the document, special emphasis was put on the tertiary education sector and the valorisation of knowledge (Vock 2002)[11].

This is reflected, for instance, in a revision of the law for the ETH-domain, which entered force in 2004. The changes strengthened the autonomy of the Federal Institutes of Technology and also contained new provisions with regard to IPR. The institutes within the ETH-domain now have improved opportunities to commercialise their research results.

10 The most recent BFT-message, which was made public in November 2002, covers the years 2004-2007. (URL: <http://www.bbt.admin.ch/dossiers/bildung/d/bft.pdf>, 21-12-2005.)
11 Vock, P. (2002) Swiss Science and Innovation Policies, Recent developments (late 1999-2001), Center for Science and Technology Studies (CEST), February 2002

The second and current message covers the period 2004-2007. As the policy community largely agreed on the over-all direction of the policy document, the debates centred on the allocation of funds. The main objectives of the message are the improvement of the tertiary education landscape, increasing research, promotion of innovation and intensifying international cooperation (Bundesrat der Schweiz 2002).

Targeted research

The early 1970s marked the beginning of a more visible and active role of the federal administration in the areas of higher education, science and innovation policy. For instance, in 1973 a constitutional amendment assigned the responsibility to foster scientific research to the federal level. Since then, science policy gradually underwent a paradigm shift from providing global grants and open project funding to a more focused and goal-oriented approach in science and innovation policy (Lepori 2006)[12]. This is indicated, for instance, by the growing importance of thematically specified research programmes (so-called targeted research) and the increasing number of initiatives promoting technology development (Braun 1999: 857)[13].

The two most important instruments in the area of targeted research have been the National Research Projects (Nationale Forschungsprogramme, NFP) and the Swiss Priority Programmes (Schwerpunktprogramme, SPP).[14] The SPPs were terminated at the end of the 1990s and replaced by a new instrument, the National Centers of Competence in Research (NCCR, Nationale Forschungsschwerpunkte) in 2001. All three instruments are being or have been administered by the SNF.

Technology and innovation

In international comparison, the number of initiatives and quantity of public funding in the area of private-sector R&D are low. The reluctance to directly finance business R&D is linked to the country's long-standing liberal economic philosophy.

Public policies with regard to applied research and innovation basically followed a similar path as the promotion of academic science. After being a rather marginal institution within the Swiss innovation system, the Innovation Promotion Agency (Kommission für

12 Lepori, B. (2006) Public research funding and research policy: a long-term analysis for the Swiss case, Science and Public Policy, Vol. 33, No. 3, pp. 205-216.

13 Braun, D. (1999) Bildungs-, Wissenschafts- und Kulturpolitik, in: Klöti, Ulrich et al. Handbuch der Schweizer Politik, Manuel de la politique suisse, Zürich, Verlag Neue Zürcher Zeitung, S. 841-879.

14 The SPPs were launched in 1992 in response to a joint initiative of the scientific community of the ETH-domain and the State Secretariat for Education and Research (SBF). The instrument was designed to strengthen research areas of strategic importance. It was hoped to enhance the existing research infrastructure at Swiss universities by stimulating inter- and transdisciplinary collaboration and to influence international competitiveness by improving the interface of academic research and industry. The individual large-scale SPPs had a running time of eight to ten years. The Swiss biotech sector was significantly supported by the SPP Biotech which ran from 1992 until 2001. The rationale to discontinue the SPPs was mainly based on the growing understanding within the policy-community that the instrument's top-down approach with regard to the selection of research topics was ill-suited (see chapter 1.3).

Technologie und Innovation, CTI)[15] significantly gained importance from the 1970s onwards. Again, the economic downturn during that decade contributed to the growing demand for initiatives aiming to remedy structural deficiencies of certain economic sectors by enhancing R&D. In this context, two impulse programmes (in 1978 and 1982) were introduced with a special focus on SMEs. As these instruments proved to be quite successful, the Innovation Promotion Agency's institutional position within the Swiss R&D promotion system was strengthened at the end of the 1980s (Braun 1999: 858).

In the meantime, the CTI has become the federal government's key institution with regard to the valorisation of knowledge. Next to its general bottom-up funding approach, the agency has introduced several cross-sectoral programmes in the past. For instance, since 1996 the programme CTI-Start-up supports scientists in the process of realising their business ideas. About 40% of the new companies that benefited from the initiative are active in the life sciences area.

Applied research

From 1996 until 2003, the universities of applied science (Fachhochschulen, FH), emanating from numerous specialised professional schools and institutions of advanced studies, were established. The impetus for the reorganisation of the Swiss education landscape was the attempt to bridge the gap in the area of industry-oriented, applied research and education. The seven Swiss FH fall under the formal jurisdiction of the cantons but are jointly governed by the two levels of government. Moreover, with the catch-phrase "equivalent but different", it has been officially acknowledged that the FH are supposed to contribute to the Swiss research scene. In order to support R&D cooperation between the FH and industry, the CTI has set up the special programme line "KTI-Fachhochschulen".

Another aspect seems to be relevant with regard to general approach to the promotion of science and technology: the once prevailing sharp separation of basic and applied research funding – as represented in the two major funding agencies SNF and CTI, respectively – is currently being supplanted by a more integrative approach. This seems to be a reaction to an understanding of the innovation process that is less mechanistic in the sense that basic research and applied research are consecutive sequences. Instead, both institutions are now increasingly open to close cooperation in all phases of the scientific process.

1.2.2 Institutional setting and main policy actors: effective integration

The domains of university education, research and science policy are comparatively well integrated in Switzerland. The bulk of research activities financed by governmental institutions are conducted by cantonal and federal universities. In many other industrialised nations, a large portion of basic and applied research takes place in non-university institutions.

15 The CTI's predecessor was the Kommission zur Förderung der wissenschaftlichen Forschung (KWF), which was founded in 1943; the agency was renamed in 1996.

Within Switzerland's decentralised, cooperative federalism, the responsibilities for education and research are distributed between the two levels of government. The 26 cantons have the formal authority over the ten regular universities and the seven universities of applied science; the federal level carries the responsibility for the two federal institutes of technology (ETH Zurich and EPF Lausanne). In addition, the national government holds most of the responsibilities in the policy areas related to "innovation policy" in the narrow sense of the term.

The specific type of the federal distribution of responsibilities in the education and research areas yields some negative side effects with regard to the overall effectiveness of the organisation of science and technology policies. Due to the existence of numerous consultative bodies and cooperation mechanisms which draw together the relevant stakeholders and members of the policy community from a broad range of institutions and from different levels of government, the Swiss policy regime in the areas of education, science and innovation has become highly complex. As a consequence, decision-making processes tend to be extremely time consuming, are accompanied by organisational friction and constrain the number of available policy options. Similarly, institutional reforms usually are instigated by piecemeal engineering, entailing incremental change. However, the pronounced consensus-orientation also has its merits as the actors involved tend to be committed to the general policy direction, once a decision has been agreed upon.

Federal level: overview of relevant departments and agencies

The promotion of science, research and innovation at the federal level is concentrated in two key ministries: the Federal Department of Home Affairs (Eidgenössisches Departement des Innern, EDI) and the Federal Department of Economic Affairs (Eidgenössisches Volkswirtschaftsdepartement, EVD). University education and the promotion of scientific research falls under the jurisdiction of the EDI, whereas applied research, technology transfer and innovation are targeted by the EVD and its specialised agencies.

Under the jurisdiction of the EDI, the State Secretariat for Education and Research (Staatssekretariat für Bildung und Forschung, SBF), which is the federal government's central institution for matters concerning university education, scientific research and space, administers the bulk of federal funding for university research. The SBF's 110 employees manage an annual budget of roughly 1 040M EUR. In the field of education, the Secretariat is responsible for all issues concerning the ETH-domain with its two federal institutes of technology and the Annex institutes, supports the cantonal universities financially and awards grants to students. With regard to research and science, the SBF finances about 20 non-university research institutes, supports and manages international scientific cooperation and plays a significant role in designing and coordinating Swiss science policy. Most importantly, the SBF finances the Swiss National Science Foundation (Schweizerische Nationalfonds, SNF), which is the country's chief institution for the promotion of scientific research (see below).

The ETH-domain, which represents the by far most important part of the federal level's university and research infrastructure, is managed by the ETH-Board. Formally, the ETH-domain is also assigned to the EDI, but enjoys a large degree of autonomy.

Within the responsibility of the EVD, the areas of vocational training, applied universities and innovation policy are mainly dealt with by the Federal Office for Professional Education and Technology (Bundesamt für Berufsbildung und Technologie, BBT). In 2004, the BBT controlled a budget of around 541M EUR. With regard to technology and innovation in particular, the BBT operates the Innovation Promotion Agency (Kommission für Technologie und Innovation, CTI) which focuses specifically on innovation, technology transfer and commercialisation. The CTI is understood to be an integral element of the federal government's economic policy (for more details see below).

Policy-process and policy coordination

In the past decades, the federal level has significantly gained importance in the field of higher education as well as in science and technology policy. As a consequence, several arenas for policy coordination have been newly established and/or expanded their scope, reflecting the growing interdependence of the relevant actors of the polity (Braun 1999: 842f.).

Due to the interlocking policy processes within the area of research, science and innovation, it is difficult to identify any single institution which dominates decision-making. Thus, several interdependent actors have to be taken into account.

Within Switzerland's bi-cameral parliament, the two Committees for Science, Education and Culture[16] (Kommission für Wissenschaft, Bildung und Kultur, WBK) deal with, among other matters, issues concerning science, science policy, research and the promotion of research, research institutes, and technology assessment. The WBK prepares the decisions of Parliament regarding the research priorities which are to be supported. On the governmental side, a number of departments – mainly the EDI and the EVD – have a stake in the policy areas under consideration.

Within the federal administration, the SBF plays a central role in coordinating and steering the national science and innovation policy. Due to its membership in numerous committees and governing bodies both inside and outside of government, the Secretariat represents the federal government's position in the policy field and, given the large number of actors involved, contributes to the development of coherent policies in the areas of science, research and higher education. For instance, the SBF consults closely with the ETH-Board on issues that are relevant for the country's research landscape.

With regard to the development of a strategic framework for science and innovation policy, the Swiss Science and Technology Council (Schweizerischer Wissenschafts- und Technologierat, SWTR) plays a highly influential role. As the central advisory body of the federal government in all matters related to science and research, its mission is to

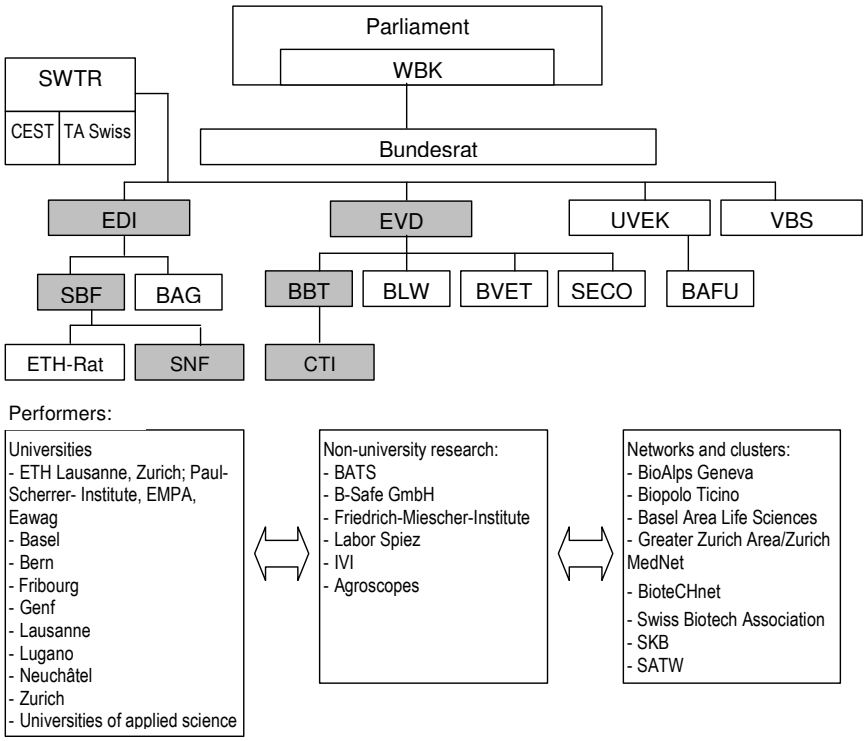
16 One Committee for each chamber.

identify problems, develop recommendations for improvements and discuss ways for implementation in this field. The SWTR, which was called Swiss Science Council prior to its reform in 1999, is currently composed of eleven distinguished scientists from all major academic fields. The Council's most important function is to support the government in defining and substantiating the medium and long-term objectives for the federal science policy which are laid down every four years in the Education-Research-Technology-Message (BTF-Botschaft). In this process, the SWTR consults with numerous actors, such as representatives of the SBF, the SNF, the CTI, the ETH-Board, the Rectors' Conference of the Swiss Universities (Conférence des Recteurs des Universités Suisses, CRUS), and the four Swiss Academies of Science.

Attached to the SWTR are the research institutes Centre for Science and Technology Studies (CEST) and TA-SWISS. Both provide expertise serving as a basis for the country's innovation policy.

Next to the formal and informal policy-making activities of the legislative, executive and administrative bodies, referenda regularly exert significant influence on the development of any policy-field in Switzerland. For instance, in May 2006, a referendum regarding a change of the constitutional provisions in the field of education was held. As will be shown in more detail in chapter 1.3, direct-democratic procedures also have considerable implications for the certain areas of biotechnology and its application. An overview over the most important actors in the area of biotechnology and their organisational linkages in the Swiss public funding regime is presented in Figure 1.1.

Figure 1.1: Biotechnology promotion in Switzerland – institutional landscape



Source: BioPolis Research

Delivery structures and funding agencies

SNF

Switzerland's chief research promotion agency is the SNF (Swiss Federal Science Foundation). The foundation, which was established under private law in 1952, supports scientific research, mostly on an open-call, bottom-up basis. Of the 275M EUR of funds directed towards research in 2004, roughly 60% were aimed at project funding and about 18% supported individual scientists. Apart from these thematically unspecified basic research activities, the SNF also manages two large programme lines – so-called targeted research – that set out predefined objectives. These programmes account for nearly 20% of the foundation's annual funds (SNF 2005b: 21[17]; SNF: 2006: 21[18]).

The SNF is financed by the federal government. Despite its formal independence, the federal government as well as representatives of the cantons and selected societal groups can exert influence on the agency through its membership in the Foundation's Council. Conversely, representatives of the SNF participate in numerous consultation and coordination processes.

CTI

The CTI (Innovation Promotion Agency), founded in 1943, is Switzerland's chief funding agency for applied and industry-oriented R&D. The agency is a unit within the federal Office of Professional Education and Technology (BBT). Under the programmatic heading "from science to market", the CTI covers the common functions of innovation promotion agencies, including project funding, support for technology transfer, training, consulting and networking. Generally, the promotion activities are bottom-up, meaning that project partners define their own research objectives. In order to ensure market conformity, only non-profit institutions are directly funded by the CTI, whereas industry partners are usually required to contribute at least 50% of the overall costs. In 2004, the budget for technology and innovation promotion amounted to 46,5M EUR. With these funds, the CTI supported 227 projects involving 448 companies, most of which SMEs (KTI 2005: 6)[19].

Research on behalf of the federal administration

Apart from the direct promotion of scientific research and innovation, the Swiss knowledge-base is also enriched by research activities undertaken by the federal administration. This so-called "Ressortforschung" (research conducted on behalf of the federal administration or through its own research facilities) aims to acquire knowledge that supports the design and implementation of federal policies in a broad range of fields.

17 SNF (2005b) Jahresbericht 2004, Bern, Schweizerische Nationalfonds zur Förderung der wissenschaftlichen Forschung.
18 SNF (2006) Jahresbericht 2005, Bern, Schweizerische Nationalfonds zur Förderung der wissenschaftlichen Forschung.
19 KTI (2005) Jahresbericht 2004, Bern, Bundesamt für Berufsbildung und Technologie.

Table 1.1 lists the federal departments and their respective specialised offices that conduct "Ressortforschung" with potential relevance to biotechnology.

In 2000, the Swiss government spent roughly 147M EUR for its own research activities. More than 50% of these funds were directed towards biology and medical research; about one-third of the project volume was carried out by state-owned research facilities (Bundesamt für Berufsbildung und Technologie 2003)[20].

Table 1.1: Biotechnology research commissioned by the federal administration

Federal Department	Specialised Office/Agency
Federal Department of Home Affairs (EDI)	- Federal Office of Public Health (Bundesamt für Gesundheit, BAG) - State Secretariat for Education and Research (Staatssekretariat für Bildung und Forschung, SBF)
Federal Department of Economic Affairs (EVD)	- Federal Office for Agriculture (Bundesamt für Landwirtschaft, BLW) - Federal Veterinary Office (Bundesamt für Veterinärwesen, BVET)
Federal Department of Defence, Civil Protection and Sports (Eidgenössisches Departement für Verteidigung, Bevölkerungsschutz und Sport, VBS)	- Spiez Laboratory
Federal Department of Environment, Transport, Energy and Communications (Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation, UVEK)	- Federal Office for the Environment (Bundesamt für Umwelt, BAFU) - Swiss Federal Office of Energy (Bundesamt für Energie, BfE)

Source: BioPolis Research

1.3 National support and framework conditions for biotechnology

Public promotion of biotechnology

Within the Swiss discourse on science and technology policy, biotechnology widely was regarded as one of the most promising research areas already in the early 1990s. The federal government shared this assessment and decided to promote this technology sector with considerable funding (Reiss 1999)[21]. This pronounced support for biotechnology has basically been kept up in the BFT-Botschaft for 2000-2003. However, the current BFT-message has shifted its focus towards the commercialisation side of the innovation process with regard to biotechnology and puts stronger emphasis on cross-sectoral, func-

20 Bundesamt für Berufsbildung und Technologie (Hrsg.) (2003) Ressortforschung des Bundes, Forschung im Dienst der Gesellschaft, Konzepte 2004 - 2007, Staatssekretariat der Gruppe für Wissenschaft und Forschung, Bern, Bundesamt für Berufsbildung und Technologie.

21 Reiss, T. (1999) National Report of Switzerland. In: Europäische Kommission / GD Wissenschaft, Forschung und Entwicklung / RTD actions – Biotechnology (DG XII/E.1) u.a.: Inventory of public biotechnology R&D programmes in Europe: Volume 3: National Reports (Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom), Luxembourg, Office for Official Publications of the EC (European Commission: Studies), p. CH-1-CH-26.

tional objectives than on thematic ones. This is reflected, for instance, in the establishment of a special biotechnology support unit within the CTI in 2003 (see section 2.3.2).

SPP BioTech

Public funding for biotechnology-related activities during the 1990s was mainly based on the Swiss Priority Programme Biotechnology (SPP Biotech), which ran from 1992 until 2001 (see FN 7). This large-scale programme had the general objectives to strengthen research in promising areas, stimulate networks and centres of excellence, advance the collaboration between science and industry and improve human resources. The goal of increasing technology transfer and commercialisation was included a few years after the initial start of the programme. In total, SPP BioTech was funded with a total budget of 60M Ecu (Reiss 1999: CH-10).

Within the thematic and functional orientation of SPP BioTech, the programme generally followed a bottom-up scheme. Applications were open to all researchers from academia, research institutions and industry. Special emphasis was put on international cooperation and the applicants' ability to generate funding from additional sources. Next to its strong focus on the promotion of junior scientists, the programme also aimed at building up and improving the infrastructure for biotechnology research. Thematically, biosafety, bioengineering, bioelectronics, neuroinformatics and plant biotechnology were among the areas that received the bulk of the funding.

SPP BioTech clearly made large contributions to the solid establishment and integration of biotechnology-related activities in the Swiss research landscape. In this sense, the SPP by and large fulfilled its central objectives. Hence, new large-scale biotechnology-specific programmes are not to be expected for the upcoming years. In addition, within the S&T policy community, top-down approaches with regard to the definition of research goals are increasingly being considered to be inadequate to successfully foster sustainable high-level research. Instead, bottom-up schemes are viewed to be better suited to guarantee scientific excellence and are more context-sensitive to existing conditions.

One of the main weaknesses in Switzerland's innovation system has been the commercial exploitation of the country's rich knowledge base. In the early 1990s the federal government started to develop an increased awareness for the necessity to improve the conditions for technology transfer and commercialisation. In this context, biotechnology became one of the main target technologies for the support of diffusion (Reiss 1999: CH-5). Within the programme framework of SPP BioTech, the technology transfer agency for biotechnology Biotectra was established in 1996. Already in 1999, Biotectra was transformed into Unitectra, a non-profit organisation jointly set up by the universities of Zurich and Bern. Unitectra's mission is to provide services to researchers from all technology fields.

Another example for the increased efforts to improve the relationship between science and the private sector of the last few years has been demonstrated by the Swiss universi-

ties of applied science. Five of the FH (Basel, Burgdorf, Sion, Wädenswil and Winterthur) have joined forces in the national biotechnology network Swiss BioteCHnet.

Regulatory framework

The regulatory environment for biotechnological research, products and services resembles the common policy approach of most of the larger continental European nations. As in other countries, Swiss policy makers are confronted with the contradictory objectives of facilitating an innovative technology with high economic potential and ensuring consumer and environmental protection at the same time.

With regard to biotechnology related to human health and reproduction, several laws and regulations are in force. In 2003, a federal law on stem cell research was passed, introducing clear regulations for the derivation of human embryonic stem cells and their handling. The use of surplus stem cells for research purposes has to be authorised by the federal administration upon the advice of an ethics commission. Reproductive cloning is prohibited by the constitution (Art. 119 & 120) since 1992.

In the medium range, a comprehensive federal law for research on humans (Humanforschungsgesetz) is on the agenda. The law would integrate existing regulations and also close important regulatory gaps which presently create some uncertainty in the scientific community. It is planned to cover the following areas with the new law: clinical trials with humans, research on biological materials and personal data, and research on foetuses, embryos and germlines. The Humanforschungsgesetz, which is currently being prepared by the BAG, will not enter force prior to 2010.

Since 2004, the so-called Gentechnikgesetz or Gen-Lex (law on genetic engineering) is in force, regulating biotechnology in the non-human area. By and large, the law is in accordance with the respective EU guidelines and directives. Consumer goods have to be labelled if they contain more than 1% GMOs; products containing genetically modified organisms may only be placed on the market if they have been officially authorised by the federal administration. Until recently, liability provisions in the case of GMO deployment in the environment were in place, and the authorisation of outdoor tests was possible if the aspired research insights could not be obtained under regular laboratory conditions.

However, due to a referendum held in November 2005, a five year moratorium on the cultivation of transgenic plants and the use of transgenic livestock in agriculture has been imposed.[22] The moratorium will be in force until November 2010.

Nevertheless, the Swiss public is not opposed to genetic engineering per se. Other referenda have been held on animal experiments, genetic engineering, reproductive medicine and stem cell research in the past: In April 1998, a people's initiative to restrict genetic engineering was rejected with a solid 2/3rds majority; and in November 2004, a referen-

22 The referendum (Gentechfrei-Initiative) was held on 21-11-2005. 55.7% of the participating voters supported the moratorium.

dum aiming to bring down the stem cell research law failed to convince the majority of the voters. In short, public opinion on these issues is generally structured along the pragmatic lines of 'no prohibition, but effective regulation and control' (Bodenmüller 2005: 26)[23].

Revisions of the Swiss patenting laws are underway since 2005; the legislative process is expected to be concluded in 2007. The changes will most likely include an improved definition of the limits to patenting of human genes, further harmonisation with the EU biotechnology directive and safeguards against undue and speculative patenting. In international comparison, scientists in Switzerland will remain privileged because research on patented inventions is basically allowed without restrictions.

Public acceptance

Generally, the Helvetian population holds positive views on science and research. According to a recent Eurobarometer (European Commission 2005: 73-97)[24] survey, the Swiss people are quite receptive to the advances of science and technology. The responses to a number of technology fields, such as solar energy, nano technology, or new medical technologies, by and large show conformity with the EU25 average. However, the data also reveal reservations regarding new technologies in several controversial fields, including nuclear energy and mobile phones. The opinions on biotechnology and genetic engineering show solid support – 58% of the respondents think that this technology will have positive effects (EU25: 65%) – without being overly enthusiastic. This attitude is contrasted by the pronounced scepticism towards genetically modified foods and agricultural products, as it was demonstrated by the strong support for the above mentioned five-year moratorium on the cultivation of transgenic plants and the use of transgenic livestock.

The mechanisms of the Swiss referendum democracy entail specific effects with regard to public opinion and, in consequence, public policy concerning science and technology. Arguably, as the Swiss voters are periodically invited to debate and decide upon complex political issues, stake holders are prompted to present their arguments and put them under public scrutiny to a larger degree than in representative democracies. Moreover, policy-makers tend to be more sensitive to public opinion. With regard to life sciences and biotechnology, the Swiss experience suggests that ample public deliberations can contribute to the reduction of unfounded scepticism and help to separate irrational from justified fear.

23 Bodenmüller, K. (2005) Research per Referendum, Conflict between Science and Society in the Direct Democarcy, BIOforum Europe, 6/2005, p. 26f.
24 European Commission (2005) Social Values, Science and Technology (Special Eurobarometer 225/Wave 63.1 – TNS Opinion & Social, Brussels, Directorate General Press and Communication.

1.4 Main biotechnology research actors in Switzerland

Biotechnology in Switzerland is well established both as an area of basic scientific research as well as a thriving industry. Scientific research is clearly the domain of the universities and federal institutes of technology. In international comparison, only a small number of non-university institutes conduct research in noteworthy quantities. However, these few research establishments, such as the Friedrich Miescher Institut (FMI), are recognised for their scientific excellence. The private sector's research activity is the second important pillar in Switzerland's biotechnology scene. To some extent, industry also participates in public biotechnology programmes. The picture is complemented by the existence of well functioning networks in the biotechnology sector. Among the most prominent professional networks are the Swiss Biotech Association, the Swiss Coordination Committee for Biotechnology (Schweizerische Koordinationsausschuss für Biotechnologie, SKB) and the Swiss Academy of Engineering Sciences (Schweizerische Akademie der Technischen Wissenschaften, SATW).

Universities

Switzerland's federal structure is reflected in the university landscape. The federal level is responsible for the ETH-domain with its two technical institutes in Lausanne and Zurich and the four Annex institutes. The regular universities fall under the responsibility of the cantons, but receive additional funding from the federal government as well. The responsibilities for the newly established universities of applied science are shared between the two levels of government.

Both federal institutes of technology are internationally renowned for their research activities in the area of biotechnology and related domains. Moreover, patterns of close scientific cooperation between the ETHs and the universities in the Zurich area as well as in the Lake Geneva region can be observed. These networks belong to the most important players in biotechnology research in Switzerland.

The universities of Bern, Geneva, Fribourg, Lausanne, Lugano, Neuchâtel and Zurich offer extensive curricula in life sciences and biotechnology, contributing to the availability of human resources in the area of biotechnology and life sciences. Moreover, the University of Basel participates in the successful tri-national biotechnology scientific training programme run by the Ecole Supérieur de Biotechnologie Strasbourg. Each year, a total of 40 students are admitted to the programme. One half of the students is selected in Strasbourg, the other half by the universities of Basel, Freiburg and Karlsruhe.

In addition, five of the seven universities of applied science are very active in the biotech sector. Horizontally, these institutions closely interact in BioteCHnet, a competence network of the universities of applied science.

Table 1.2: Swiss universities and universities of applied science conducting biotechnology research

Location	University
Canton of Basel	– University of Basel – Fachhochschule beider Basel
Canton of Bern	– University of Bern – Berner Fachhochschule, Burgdorf
Canton of Fribourg	– University of Fribourg
Canton of Geneva	– University of Geneva
Canton of Vaud	– EPF Lausanne – University of Lausanne
Canton of Neuchâtel	– University of Neuchâtel
Canton Ticino	– University of Lugano
Caton of Valais	– Haute École Valaisanne, Sion
Canton of Zurich	– ETH Zurich – University of Zurich – Hochschule Wädenswil – Zürcher Hochschule Winterthur

Source: BioPolis Research

Non-university research

The most prominent non-university institutes conducting research in fundamental biotechnology is the Friedrich Miescher (FMI) Institute. The private FMI, located in Basel, is devoted to biomedical research, mainly in the areas of epigenetics, growth control and neurobiology. The institute and its 250 employees are primarily financed by the Novartis Research Foundation; additional support is generated through project grants from research promotion agencies.

The public Paul Scherrer Institute (PSI) is active in a large number of scientific fields, ranging from material to nuclear sciences. With regard to biotechnology, the PSI concentrates its resources mainly on cancerous diseases. Organisationally, the institute is part of the ETH-domain. Other Annex institutes within the ETH-domain that perform biotechnology-related research to some extent are selected laboratories of the Federal Institute for Materials Science and Technology (EMPA) and the Swiss Federal Institute of Aquatic Science and Technology (Eawag).

A fairly new player in the biotechnology research scene is the Institute for Research in Biomedicine (IRB) in Bellinzona. Thematically, the institute deals with different aspects of molecular and cellular immunology. The IRB is funded by the city of Bellinzona, the Canton of Ticino, the Swiss Confederation, from private sources as well as from funding agencies. The Helmut Horten Foundation is its major sponsor.

The largest industrial research centre in Switzerland is the Novartis Institute for Biomedical Research, (NIBR) located in Basel. With roughly 1.500 employees, the NIBR Basel is the largest institute of this international Novartis research network. The Novartis re-

searchers focus on a number of different biomedical topics. Other notable industrial research is conducted, for instance, by the research laboratories of Roche and Serono.
Two private organisations are active in the area of biosafety and risk assessment that are neither linked to a university nor part of the government owned research infrastructure. The Center for Biosafety and Sustainability (Zentrum für Biosicherheit und Nachhaltigkeit, BATS) in Basel, which emanated from the SPP BioTech in the 1990s, performs contracted research. The Biosafety Institute b-safe is engaged in scientifically oriented biosafety education and training.

The private Foundation Risk Dialogue (Stiftung Risiko-Dialog) in St. Gallen is engaged in bringing together stake holders and citizens to inform about and discuss risks and chances with regard to controversial technology fields. In the past, biotechnology-related issues – mainly genetics – have repeatedly been on the foundation's agenda.

Ressortforschung

As presented above, the federal administration contributes to the Swiss biotechnology landscape through its own research activities (Ressortforschung), which are partly carried out by the federal administration's own research infrastructure.

Within the realm of the Federal Office for Agriculture (BLW), three public agricultural research stations "Agroscopes" are active in biotechnology-related areas.[25]

Table 1.3: Non-university biotechnology R&D

Research institutes (public and private)
Agroscopes (federal administration: BLW)
Biosafety Institute, b-safe, Bern
Centre for Biosafety and Sustainability (BATS), Basel
Federal Institute for Materials Science and Technology (EMPA), Dübendorf, St. Gallen, Thun (ETH-domain)
Friedrich Miescher Institute (FMI), Basel
Institute for Research in Biomedicine (IRB), Bellinzona
Institute of Virology and Immunoprophylaxis, IVI (federal administration: BVET)
Labor Spiez (federal administration: VBS)
Novartis Institute for Biomedical Research (NIBR), Basel
Paul Scherrer Institute (PSI), Villingen (ETH-domain)
Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf (ETH-domain)

Source: BioPolis Research

The Swiss Federal Veterinary Office (BVET) operates the Institute of Virology and Immunoprophylaxis (IVI). The IVI conducts research in areas such as the molecular basis of

25 The Agroscope Changins-Wädenswil concentrates on farming and forage. The Agroscope Liebefeld-Posieux carries out research in the area of food of animal origin with the aim to secure and enhance the quality of foodstuffs. And the Agroscope Reckenholz-Tänikon aims to contribute to the development of environmentally compatible and economically competitive farming. See: http://www.blw.admin.ch/agroscope/index.html?lang=en.

viral diseases, develops methods for the diagnosis of highly infectious animal diseases and investigates the immune response to viral animal disease pathogens.

The Spiez Laboratory, which is attached to the Federal Department of Defence (VBS), deals with protection from nuclear, biological, and chemical threats and risks. Hence, biotechnology-related research is mainly conducted in the areas of diagnostics and risk assessment.

Geographic concentration of biotechnology activities

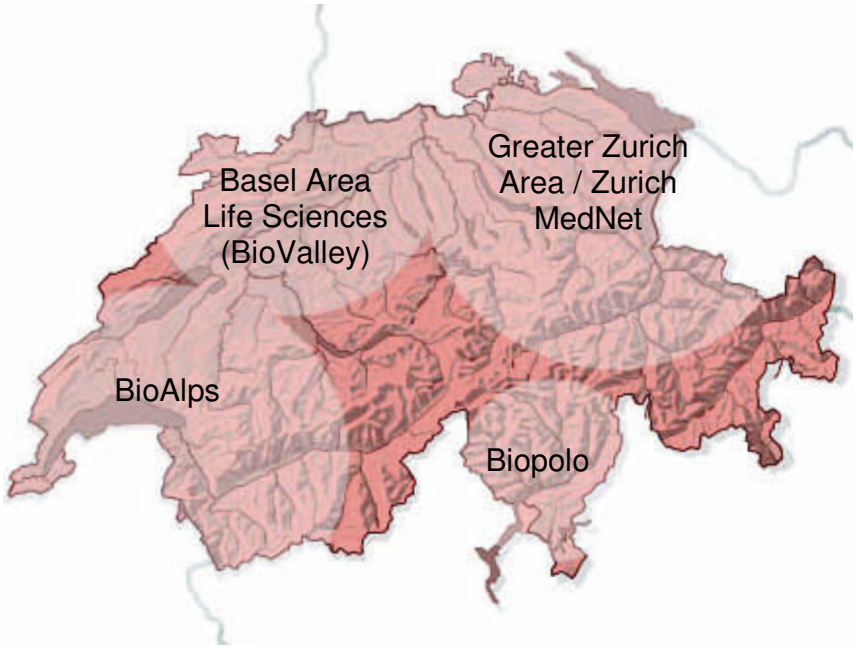
Geographically, the most prominent centres for biotechnology research and the biotech industry by and large correspond to the regional concentrations of the leading universities in this technology. The biotech "hot spots" are clearly the areas around the cities of Basel, Geneva and Zurich. Over 80% of all Swiss biotech companies are located in one of these three regions (Veraguth 2004: 21). In addition, the Canton of Ticino has made some inroads into the sector in recent years (see Figure 1.2).

Organisationally, the relevant actors in each of the four regions have developed and institutionalised quite successful networks:

- BioAlps is an association of the five western Swiss cantons Geneva, Fribourg, Neuchâtel, Valais and Vaud. This life science and biotechnology cluster draws together numerous stakeholders in the Lake Geneva region. The academic foundation of the region is composed of the world-class universities such as the Federal Institute of Technology Lausanne and the University of Geneva. The scientific landscape is complemented by the Swiss Institute for Cancer Research (ISREC) and the Swiss Institute for Bioinformatics. According to BioAlps, more than 250 biotechnology and life science companies are located in the region.
- Biopolo is the youngest and smallest of the four major Swiss biotechnology clusters. The cluster initiative for the canton Ticino was set up to become a one-stop shop for life science research and commercialisation in the region in 2003. Biopolo is funded mainly by federal and cantonal sources. Biotechnology-related activities within the region are mainly performed by the pharmaceutical industry and to some extent by the hospitals; the most prominent research institute is the Institute for Research in Biomedicine (IRB) in Bellinzona.
- Basel Area Life Sciences/BioValley Platform Basel is the Swiss partner in the trinational initiative BioValley. The trans-border biotech cluster, involving representatives from France, Germany and Switzerland, was created 1996. The Swiss pillar of the initiative is financed by a number of institutions in the north-western part of the country, including local and cantonal governments, the Swiss federal government, non-profit organisations and industry. Since 2005, the Swiss part of the cluster has been increasingly operating under the name Basel Area Life Sciences. The main scientific institutions involved are the University of Basel with its well-known Biozentrum, the University of Applied Science Basel, the FMI and the Basel Computational Biology Center.
- Greater Zurich Area (Zurich MedNet) is the biotechnology and medical cluster in the Zurich Area. The scientific foundation of the region is largely based on the research

activities of the ETH Zurich and the University of Zurich. The close scientific cooperation is represented, for instance, by the Functional Genomics Research Center Zurich (FGCZ), which has been jointly set up by the ETH Zurich and the University of Zurich in 2005. According to Zurich MedNet, approximately 400 medical and biotech companies are located in the region.

Figure 1.2: Swiss biotechnology clusters



Source: Based on Swiss Biotech Report (2006: 4), BioPolis Research

Swiss biotech industry profile

Switzerland is home of some of the world's largest pharmaceutical companies. This, in addition to the excellent research base, a highly educated workforce, proximity to European markets, the availability of financial resources and a favourable tax environment all contribute to an attractive location for biotech companies.

Switzerland's biotechnology industry is thriving, especially in the areas surrounding the pharmaceutical giants. The CTI estimates that roughly 8 000 persons were employed in the sector, which equals about 0.2% of the workforce. By comparison, the Swiss chemical and pharmaceutical industry accounts for 2% of the workforce. The biotech industry is dominated by SMEs: 88% of all biotech companies employ ten or fewer people, about 10% employ between 11 and 49. Only 2% are considered to be larger (Veraguth 2004). With regard to the most important sectors within the field, the Swiss biotechnology industry is predominantly represented in the health domain. Apart from the traditional pharmaceutical and chemical industries, the sector is characterised by the application of genomics and proteomics and other therapeutics. Furthermore, supporting businesses

such as diagnostics and analytical services, bioinformatics and bioelectronics, contract research and manufacturing are available (see Table 1.4).

Table 1.4: Swiss Biotechnology Industry in 2006 – breakdown by subcategories

Total number of biotech companies	293
Other services and suppliers	19%
Diagnostics and analytical services	18%
Pharmaceuticals and chemicals	14%
Therapeutics	12%
Contract research and manufacturing	11%
Environment, agrobio, food	10%
Bioinformatics and bioelectronics	7%
Reagents and compounds	7%
Drug delivery	3%
Genomics and proteomics	2%

Source: Swiss Life Sciences Data Base <http://www.swisslifesciences.com/swisslifesciences/index.php>, 06-06-2006; BioPolis Research.

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

2.1 Introduction

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

Policy-directed funding includes funding which was directed by explicit policy decision making about installing a specific instrument, such as specific R&D programmes, programmes encouraging collaboration, industrial research grants, support for centres of excellence, support for commercialization 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, also including biotechnology. In the BioPolis project, only those generic instruments are included if a reference is made to (the stimulation of) biotechnology activities in the policy of the funding organisation that runs the program, or of the ministry/ government department that funds the funding organisations or that runs the program itself.

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

In this chapter the funding of biotechnology research through policy and non-policy-directed instruments and of biotechnology commercialisation through policy-directed activities are presented. The data were collected through desk research (publications, documents, websites of national and regional public funding organisations and/or governmental departments), surveys of representatives of funding organisations that manage the generic and biotech-specific programs and interviews with representatives of organisations that are involved in non-policy-directed and policy-directed funding. The funding organisations' website addresses and the names of contact persons that have kindly participated in the survey and/or have been 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 a role in funding of biotechnology activities – mainly start-ups – in Switzerland; they will be addressed in section 2.4. The final section provides a short overview over the European funding of biotechnology research in Switzerland through the 6th Framework Program.

2.2 Non-policy-directed funding of biotechnology research

SNF

The Swiss National Science Foundation's (SNF) most important research promotion instrument is the funding of investigator-driven projects (freie Forschung), constituting over 60% of the agency's overall funding. In 2004, the SNF funded individual research projects with a total sum of 164.8M EUR. Based on a competitive open-call system, Swiss scientists of all disciplines and of all areas of research have the opportunity to apply for funding twice a year. The submitted proposals are assessed by the agency's National Research Council, which is composed of 100 scientists who mainly teach at Swiss universities. During the period under review, biotechnology projects worth of more than 38M EUR were supported through this funding instrument. On an annual basis, funding increased by more than 50% since 2002, reaching an annual total of 12.3M EUR in 2005. As the total funding budget made available through the biology and medical department of the SNF remained quite stable between 2002 and 2005, the absolute increase in biotech funding also represents an increase relative terms.

Research on behalf of the federal administration (Ressortforschung)

BLW

The three Agroscope research stations, which are operated by the Federal Office for Agriculture (BLW), constitute an important part of the federal administration's research infrastructure. In addition to many other research fields covered by the Agroscopes – such as the development of environmentally friendly production methods – biotechnology-related research is conducted as well. The institutes, which are financed by the BLW, aim to contribute to safe and sustainable production of food supplies and perform numerous administrative tasks on behalf of the BLW. Between 2002 and 2005, the annual budget dedicated for biotechnology was 1.05M EUR or roughly 1.5% of the total annual budget allocated for the Agroscopes.

Table 2.1 Non-policy-directed funding of biotechnology research

Funding organisation	Public Research Institutions / Response Mode programs	Period	Funds in M EUR
SNF	Open Project Funding	2002-2005	38.7
Bundesamt für Landwirtschaft (BLW)	Agroscope research institutes (biotechnology part)	2002-2005	4.2
Total			**42.9**

Source: BioPolis Research

2.3 Policy-directed funding of biotechnology research and commercialisation

2.3.1 Instruments of the Swiss National Science Foundation (SNF)

Switzerland's chief funding agency in the area of basic research, the Swiss National Science Foundation (SNF), supported scientific activities with a total amount of 275M EUR in 2004 (SNF 2006: 21). During the period under review, the agency was not operating any programmes specifically designed to promote biotechnology. The last major biotechnology-specific programme was the SPP Biotech (see section 1.2.1), which had been terminated in 2001. The SNF supported biotechnology-related activities with a total sum of 79M EUR between 2002 and 2005 (not included: non-policy-directed funding).

Generally, the agency's research promotion programmes fall into three main categories: (1) promotion measures for the benefit of independent scientific research without a predefined theme, (2) programmes supporting targeted research on a predefined theme within the context of coordinated inter- or transdisciplinary research programmes. And finally, (3) the SNF also has a number of instruments such as fellowships and awards, conference and publication grants at its disposal. The first and largest category in terms of funding volume – independent scientific research – is dealt with in the previous section 2.2 (non-policy-directed funding) as project funding is based on an open call system.

Instruments that fall into the category of targeted research constitute the SNF's second largest pillar. In 2004, 54.4M EUR or 20% of the agency's total funds allocated for the promotion of science were spent in this category (SNF 2006: 21). The funds are distributed between two programme lines: National Research Programmes (NFP) and National Centres of Competence in Research (NCCR). While the NFPs have the purpose to generate knowledge to contribute directly to the solution of current problems in Switzerland, the NCCRs focus on Switzerland's research and science scene in order to stimulate research fields of strategic importance and to generate new scientific topics.

NFP

The National Research Programmes (NFP), which exist since 1975, are supposed to contribute to the solution of problems that are considered to be of national importance. Compared to traditional bottom-up project funding, NFPs are politically more "charged". Hence, the federal government plays a crucial role in selecting and defining the thematic orientation of the NFPs, whereas the SNF is responsible for the execution of the programmes. The process of setting the thematic agenda however, which usually takes place every four years, is time consuming and highly complex, involving numerous stake holders. A typical NFP runs between three and five years and is supported with 5 to 8M EUR. In 2004, the SNF spent 11.3M EUR for the NFPs or about 4% of its annual research promotion budget (SNF 2006: 21). Once the thematic scope of a NFP is defined and developed, open calls are issued.

During the period under review, two NFPs were supported which related to biotechnology.[26] Of the total sum of 9.3M EUR for NFP 46 – Implants and Transplants, 8.45M EUR or 91% were directed towards biotechnology, overwhelmingly in the area of health. Within NFP 49 – Antibiotic Resistance, only 88 044 EUR of the overall programme budget of 627 230 EUR was directed towards biotechnology-related activities.

NCCR

The NCCRs were introduced in 2001. Compared to its predecessor, the SPP, the decisions about strategic research priorities are grounded more thoroughly on the input of the scientific community. Scientific excellence is guaranteed through peer review and other quality-enhancing mechanisms. Nevertheless, the federal government is involved in the process of setting strategic priorities as well. An important innovation within the NCCR framework in contrast to the SPPs is that participating universities and other partners are required to commit themselves with substantial contributions of normally 50% of the total budget. It is hoped that this approach serves as an additional reality check with regard to the significance of the research objective and prevents a collapse of research activities once federal funding is phased out.

Each NCCR consists of a competence centre (leading house) and a network of partners and institutes. The availability of adequate infrastructure and personnel provided by the performers is a prerequisite of funding. The maximum running time is twelve years (SNF 2005a)[27].

Of the currently 20 NCCRs, four are thematically located in the area of biotechnology.[28] Between 2002 and 2005, the NCCRs were supported with a total amount of 163M EUR, 43M EUR were spent in favour of activities in the area of biotechnology. The most important application areas have been basic biotechnology research and health-related projects.

SNF Professorships

In order to support the academic careers of promising young scientists, the SNF offers SNF-funded professorships (Förderprofessuren). Funding is open to all scientists with a Swiss citizenship, a Swiss academic degree (or a several-year affiliation with a Swiss university or an ETH) who are interested in conducting research at a Swiss university or ETH. Applicants should be younger than 40 years of age, have demonstrated scientific excellence and have several years of research experience. The National Research Council is responsible for the selection of the candidates.

---

26 NFP 46 – Implants and Transplants and NFP 49 – Antibiotic Resistance.

27 SNF (2005a) Guide2005, National Centers of Competence in Research, Bern, Swiss National Science Foundation

28 The following NCCRs have been taken into consideration on the advice of SNF: NCCR Genetics, NCCR Molecular Oncology, NCCR Neuro, and NCCR Structural Biology. The NCCR Plant Survival, NCCR Nanosclae Science, and NCCR CO-ME were not included due to their low share of genuine biotechnology research.

Successful candidates can expect a salary comparable to that of an assistant professor, a research grant and contributions to overhead costs. The funding runs for four years and can be renewed for additional two years. Approximately 30 new SNF professorships are being granted each year. Between 2002 und 2005, the SNF spent a total amount of 114M EUR for the programme, 34.4M EUR or 30% in favour of scientists working in biotechnology-related fields. The bulk of the research conducted by these professors was basic biotechnology research.

Gene ABC

A unique activity funded through the SNF was the development of an internet-based information and education portal dealing with genetics. The aim of the website Gene ABC[29] is to improve public knowledge and understanding of genetics in an entertaining and comprehensible way. In total, the project was supported with 444 000 EUR between 2002 and 2005.

2.3.2 Instruments of the Innovation Promotion Agency (CTI)

The Innovation Promotion Agency (CTI) is Switzerland's most prominent public actor with regard to the valorisation of scientific knowledge. As already mentioned (see section 1.2.2), the bulk of the agency's funding activities follow an open-call, bottom-up approach. The CTI was able to support projects at the interface of science and industry with 46.5M EUR in 2004. As industry partners are required to cover at least 50% of the costs, the total value of these projects added up to 113.9M EUR (KTI 2005: 6). The application and selection procedure for most of the promotion activities follows the following pattern: together with partners, the applicant is required to develop a project or business plan, including the financial details. Based on the proposal, the CTI experts evaluate and discuss the application. In case of a positive decision, a contract is concluded. Apart from direct financial support, the CTI also provides a broad range of consulting and other services to its customers.

Of the CTI's seven main programme lines, three were relevant for biotechnology activities during the period under review.

CTI Biotech

Within the programme line CTI Life Sciences, the Innovation Promotion Agency offers project funding explicitly for biotechnology. With its instrument CTI Biotech, which was introduced in 2003, the agency aims to support the Swiss biotech industry by encouraging technology transfer and through targeted promotion of new biotechnology companies. CTI Biotech has to be seen in the context of the decision to establish a special support unit for biotechnology in 2002, which, in turn, was part of the federal government's special efforts to support the dynamic of this technology field (Bundesrat der Schweiz 2002: 2430).

29 See http://www.gene-abc.ch/index.html.

Between 2003 and 2005, the CTI Biotech funded projects with the total amount of 13.8M EUR.

CTI Start-up

CTI Start-up intends to promote the creation and establishment of enterprises in the high-tech sector. The focus of the instrument, which was introduced in 1996, is put on the especially difficult start-up phase of a company. The initiative rates the prospects of the underlying business ideas of the new enterprises. In this respect, CTI Start-up has become an advantageous quality seal for the acquisition of venture capital and other forms of financial support.

CTI Start-up offers a broad set of non-financial support opportunities for prospective entrepreneurs, including training, consulting and networking opportunities. During the period under review, the programme had a total budget of 9M EUR with an upward tendency. Support for biotechnology-related start-ups added up to 20% of this amount.

Research Promotion of FH

In order to support the newly established system of universities of applied sciences in Switzerland, the CTI set up a unit focussing on the special needs of this sector within the country's R&D system in 1997. Between 1998 and 2004, the CTI programme to promote research at the universities of applied sciences mainly made available project funding. In total, 45M EUR were channelled into the FH system. Biotechnology-related research activities were funded with 3.3M EUR.

2.3.3 Research on behalf of the federal administration (Ressortforschung)

BAG

The Federal Department of Health (BAG) is required by law to test and verify genetically modified foodstuffs with regard to potential heath risks and other aspects of consumer protection. Products containing GMOs need the authorisation of the BAG if there are to be sold on markets. In order to perform this mandate, the federal department assigns various scientific studies to assess the risks of GMOs, and to generate the appropriate expert knowledge. Between 2002 and 2005, 0.62M EUR were allocated in biotechnology-related research areas, mainly risk assessment.

BAFU

The Federal Office for the Environment (BAFU) is operating a research programme in the area of non-human genetic engineering. The programme consists of four modules addressing the following issues: Monitoring of GMO in the environment, ethical approach to risk analysis, effects on the soil ecosystem and risks for non-target organisms. During the review period, a total sum of 0.98M EUR was allocated for this research programme.

2.3.4 Biotechnology promotion at the sub-national level

Most of the 26 Swiss cantons and many of the larger municipalities actively contribute to the national innovation system in numerous ways. The bulk of these regional efforts focus on the valorisation of scientific knowledge by the means of advice, assistance in the process of business development and similar activities. However, direct financial support of R&D is mostly made available only by the larger cantons.

With regard to biotechnology, the most notable support from the regional level is directed towards the four Swiss biotechnology/life science clusters (see section 1.4). In most of these regional initiatives, more than one canton is involved; moreover, additional support from the federal level and private sources plays a certain role as well. Direct financial support to companies is rather the exception than the rule, as it is indicated by the quite low annual budgets of the cluster initiatives.

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

Instrument	Funding organisation	Budget in M EUR	% of total	Use of DF/SF
National				
Generic				
NCCR	SNF	43.3	38.45	
NFP 46	SNF	8.4	7.46	
NFP 49	SNF	0.08	0.07	
SNF Professorships	SNF	34.4	30.54	
CTI Start-up	CTI	1.8	1.60	
Research Promotion FH	CTI	3.3	2.93	
Biotech specific				
Gene ABC	SNF	0.444	0.39	
CTI Biotech	CTI	13.9	12.34	
Contracted Research	BAG	0.62	0.55	
Biosafety in Non-Human Genetic Engineering	BAFU	0.98	0.87	
Regional				
Biotech specific				
BioAlps	Cantons of Geneva, Fribourg, Neuchâtel, Valais, Vaud	0.79	0.70	
Biopolo	Canton of Ticino	0.43	0.38	
Basel Area (BioValley)	Cantons of Baselstadt, Baselland, Solothurn, Aargau, Jura	1.56	1.39	
Greater Zurich Area/ Zurich MedNet	Greater Zurich Area	2.62	2.33	
Total		**112.624**	**100**	

Source: BioPolis Research

2.4 Charities

Compared to other sources of funding – venture capital and public promotion activities –, private foundations contribute only very low amounts of funding. Nevertheless, charities do play a complementary role in the Swiss R&D promotion and valorisation landscape by fulfilling functions such as publicising successful business plans or orchestrating public deliberations.

None of the numerous Swiss charities has a specific focus on biotechnology. The most important non-profit sources for biotechnology funding are the W.A. de Vigier Stiftung and the Gebert Rüf Stiftung.

W.A. de Vigier Stiftung

Since 1987, the de Vigier Foundation awards up to five prizes for promising and innovative business ideas. Each winner receives 64 599 EUR. Apart from the financial support, the successful candidates may also benefit from additional publicity generated by the public relations activities of the foundation. During the review period, five start-ups in the area of biotechnology were announced.

Gebert Rüf Stiftung

The purpose of the Gebert Rüf Foundation is to enhance Switzerland as a commercial centre by supporting projects for education, teaching and research, in all specialties and areas of knowledge, in particular, at public and private universities, technical colleges and other centres of higher education throughout the country. The foundation particularly supports projects that assist well-qualified, future academics who follow individual and innovative paths. Between 2002 and 2005, biotechnology-related projects were funded with 4.4M EUR.

Stiftung Risiko Dialog

The private Foundation Risk Dialogue (Stiftung Risiko-Dialog), which is engaged in bringing together stake holders and citizens to inform about and discuss risks and chances with regard to controversial technology fields, was operating the programme GenRisk between 1999 and 2004. The activities of GenRisk consisted of research and conflict diagnoses, stakeholder dialogues and consulting focussed on genetic engineering and biotechnology. During the review period, GenRisk was funded with the amount of 491 800 EUR.

Table 2.3 Overview of biotechnology stimulating instruments by charities

Instrument	Charity	Starting date	Duration	Budget
Prize monies for start-ups	W.A. de Vigier Stiftung	2002		0.32
Wissenschaft Bewegen	Gebert Rüf Stiftung	1997		4.3
GenRisk	Stiftung Risiko-Dialog	1999	6	0.48

Source: BioPolis Research

2.5 Participation in the Sixth Framework Programme

Swiss researchers were actively involved in the biotechnology/life science-related projects funded through the Sixth Framework Programme. The bulk of the Swiss involvement was concentrated in the life sciences, genomics and biotechnology for health category (382 projects and 13 project coordination actions). As this involvement represents 4.5% and 1.7% of the European totals in this thematic area, the data suggests that Switzerland seems to have been a bit underrepresented in the Sixth FP if the Swiss strength and excellence in this sector are taken into account.
The other two areas listed clearly have been less prominent.

Table 2.4: Swiss involvement in biotechnology/life sciences programmes of the Sixth Framework Programme

Sixth Framework Programme[1] Thematic priority	**Participations as coordinator**	**Participations as member of the project team**[2]
1. Life sciences, genomics and biotechnology for health	13 (1.7%)	382 (4.5%)
2. Nanotechnologies, section bionanotechnology	1 (8.3%)	7 (6.6%)
5. Food quality and safety	0	33 (2.1%)

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

Source: BioPolis Research

3. Performance of the national biotechnology innovation system

3.1 Introduction

This chapter analyses the performance of the Swiss 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. In order to avoid capturing erratic trends, each time period includes several years. National trends are benchmarked against the performance of the EU Member States and the US.

The presentation of the performance is structured along the 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 are shown for a number of different indicators for Switzerland, the USA and EU25 (or EU15). The EU-values have been chosen as reference in each indicator. The absolute figures that are 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 and provides additional background information.

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

With regard to biotechnology publications pMC, Switzerland is at the forefront not only within Europe, but also compared to the USA. During all three time periods covered, the country took the leading position in Europe, followed by Sweden and Denmark. Despite the increasing absolute number of publications (from 5 522 in 1994-1996 to 7 582 in 2002-2004), the country's leading margin slowly decreased in relative terms due to higher growth rates in the number of biotechnology publications in other countries. Nevertheless, compared to the EU15, Switzerland still holds a very comfortable lead (Switzerland: 1 030, EU15: 363 biotechnology publications pMC in 2002-2004).

Switzerland's excellent performance is even more outstanding with regard to the data on biotechnology publications per public R&D expenditures (in M Ecu, 1994-1998). In this category, the country outperforms the EU15 by factor nine. Only Italy fares better than Switzerland with 167 compared to 152 biotechnology publications per public R&D expenditure. The impressive performance rate points to the high efficiency of the Swiss system of research funding. Moreover, an additional factor seems to be Switzerland's comparatively high share of the private sector expenditure's in R&D which might also contribute to some of the publication activities.

Biotechnology accounts for 14-15% of Switzerland's total scientific publications. This share is slightly higher than the comparable data for the USA (at least during the first two

time periods) and the EU25, but lower than Europe's top performers such as Finland (16% in 2002-2004), Iceland (20% in 1998-2000) and Luxembourg (21% 1998-2000). The slight downward trend across the three time periods indicates a slower growth rate of the Swiss biotechnology publication activities relative to EU25.

Judging from the citation rates, the quality of Swiss biotechnology publications is excellent. Swiss biotechnology publications clearly outperform both EU25 and the USA. Within Europe, Switzerland ranks third after the two top performers Iceland and Ireland (comparison based on time period 2000-2004). However, across the two time periods, Swiss performance once again shows a slight downward trend. In the case of Switzerland, this indicator should be interpreted with some caution as the applied calculation method tends to depreciate large countries with a high number of total publications, resulting in a so-called "small country effect". [30]

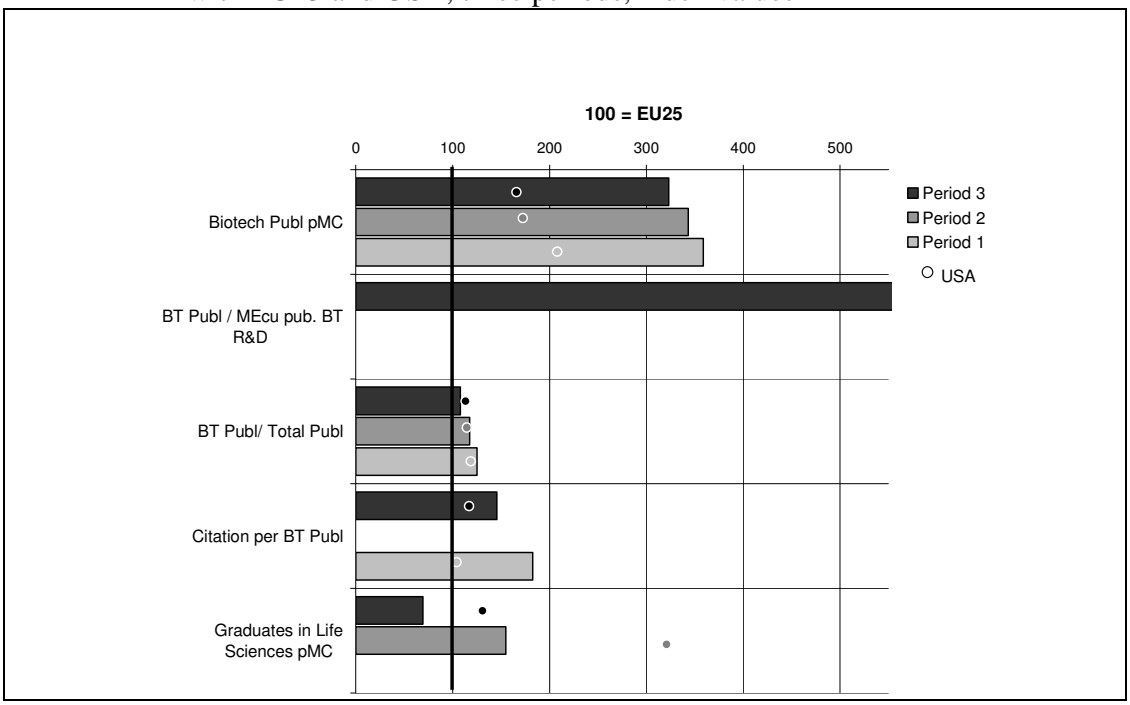
With regard to the number of graduates in life sciences (pMC), Switzerland shows a mixed picture. The absolute number of graduates remained stable during the two periods covered (934 and 947, respectively). In relative terms however, Swiss performance in this area of human resources fell below the EU25 in 2002 due to notable growth rates in this reference region. Switzerland now holds a medium position in Europe, ranking ninth after top performers such as the UK, Ireland or France.

All in all, Swiss performs extremely well in creating a sound knowledge base in the area of biotechnology and life sciences. The indicators presented in Chart 3.1 by and large confirm the country's outstanding reputation as one of the world's leading locations for science and technology. Regardless of this appraisal, the data also point to downward tendencies. Four of the five indicators show that Switzerland's leading position is still impressive, but other players are gradually catching up.

The analysis of Swiss publication activities clearly indicates that health and generic biotechnology are the by far most important application areas in the Swiss research scene. Between the two time periods covered (1994-1996 and 2002-2004), the share of health biotechnology publications slightly increased from 55 to 57%; generic biotechnology, however, dropped from 31 to 29% of all biotechnology publications. The relative strength of all subfields remained largely unchanged over the two time periods. Compared with the two reference regions, Swiss publication activities by and large correspond to the US and EU25 patterns. In the area of health biotechnology, Switzerland slightly lags behind the US and EU25 performance; whereas with regard to generic biotechnology, Swiss scientists publish somewhat more than their colleagues from the reference regions.

30 See Annex 5, indicator 5.

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

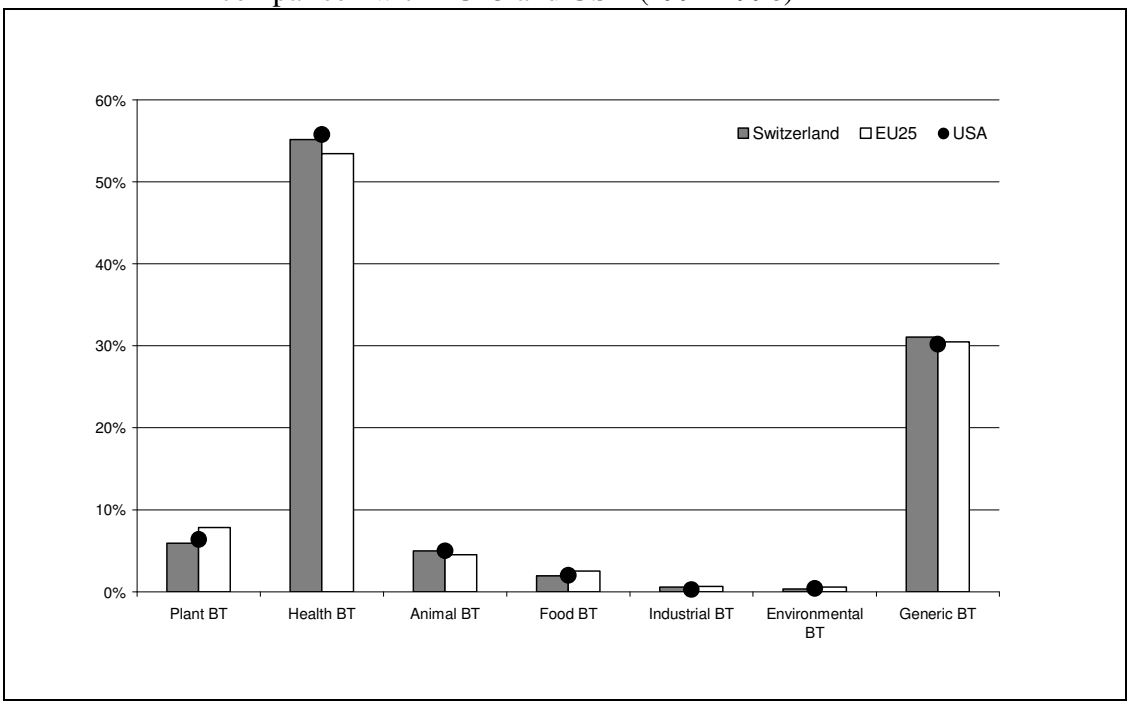


Source: BioPolis Research

Data: Science Citation Index

Note: The European reference region for indicator 2 (BT Publ./M Ecu pub. BT R&D) is EU15.

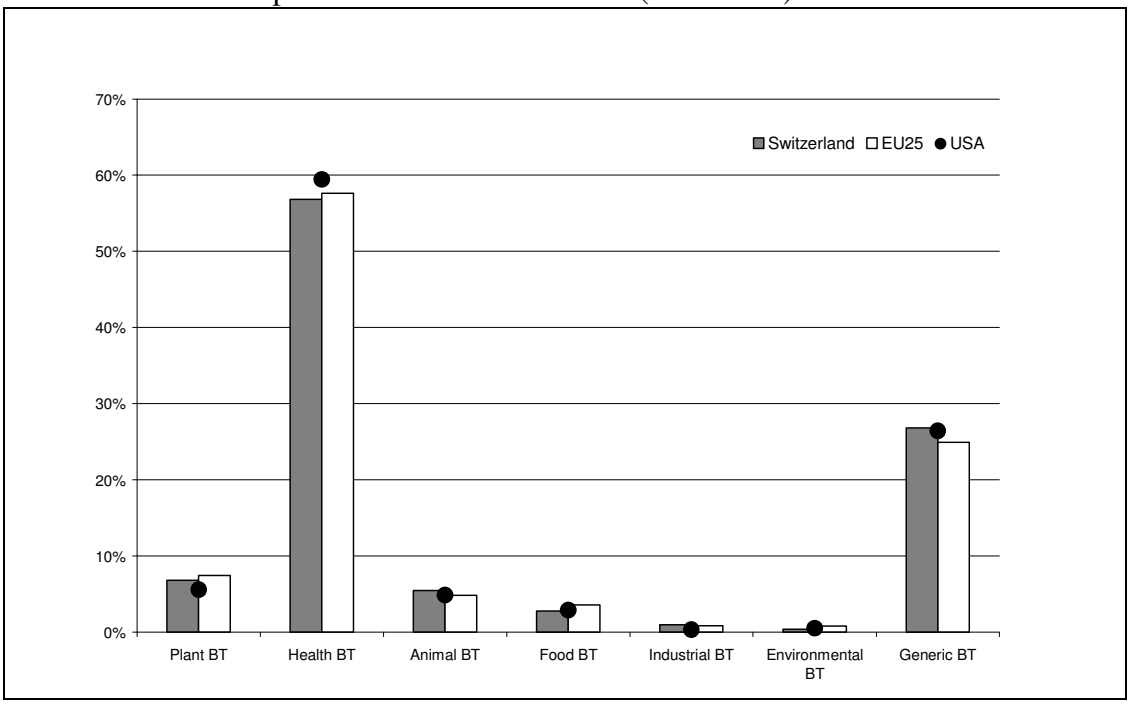
Chart 3.2.1: Share of subfields (in%) of total biotechnology publication for Switzerland in comparison with EU25 and USA (1994-1996)



Source: BioPolis Research

Data: Science Citation Index

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

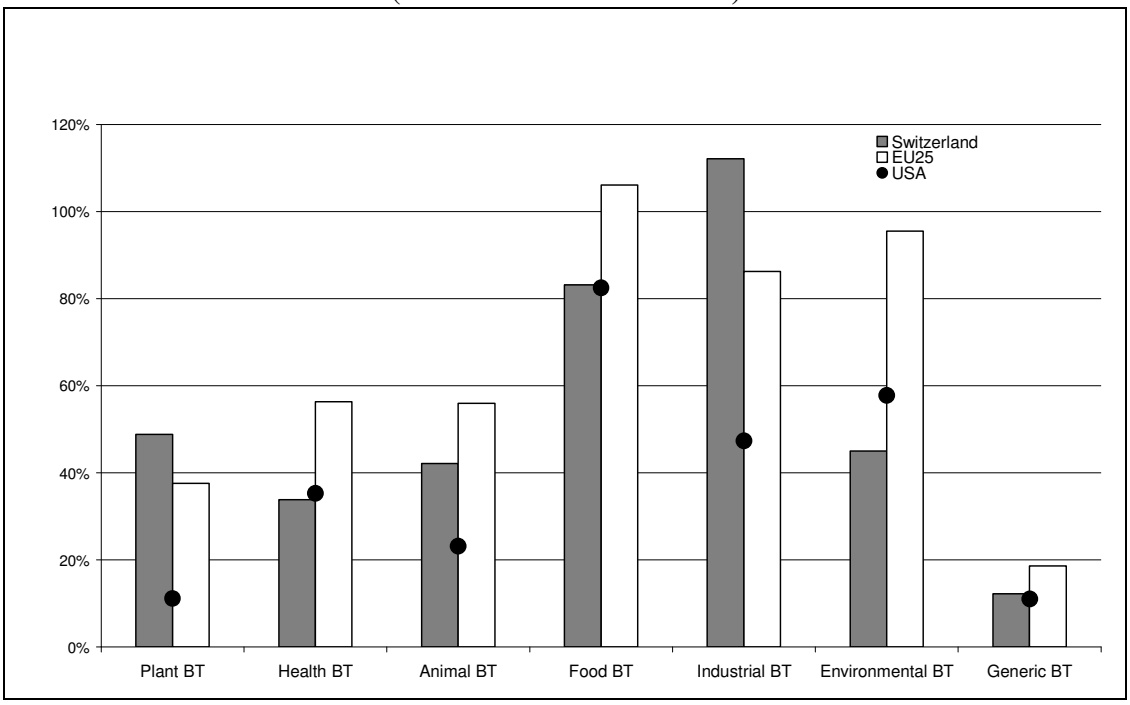


Source: BioPolis Research

Data: Science Citation Index

Between 1994-1996 and 2002-2004, Switzerland displayed the most impressive increases of publication activities in the subfields of industrial (+112%) and food (+83%) biotechnology. However, this growth occurred on the basis of nearly negligible starting points. In the first period, the total number of industrial publications was 33, in the second period the number went up to 70. In the area of food biotechnology, publications increased from 113 to 201. The already very dominant health subfield experienced an increase from 3 180 to 4 255 publications over the two periods, putting the growth of the emerging fields into perspective. Compared to the reference regions, Switzerland deviated notably in some areas. For instance, in the EU25, the areas with the strongest growth rates were food (+106%), environmental (+95) and health (+89) biotechnology. These areas were also on the rise in Switzerland, but clearly to a lesser extent (+83%, +45% and +34%, respectively).

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



Source: BioPolis Research

Data: Science Citation Index

3.3 Performance in knowledge transmission and application

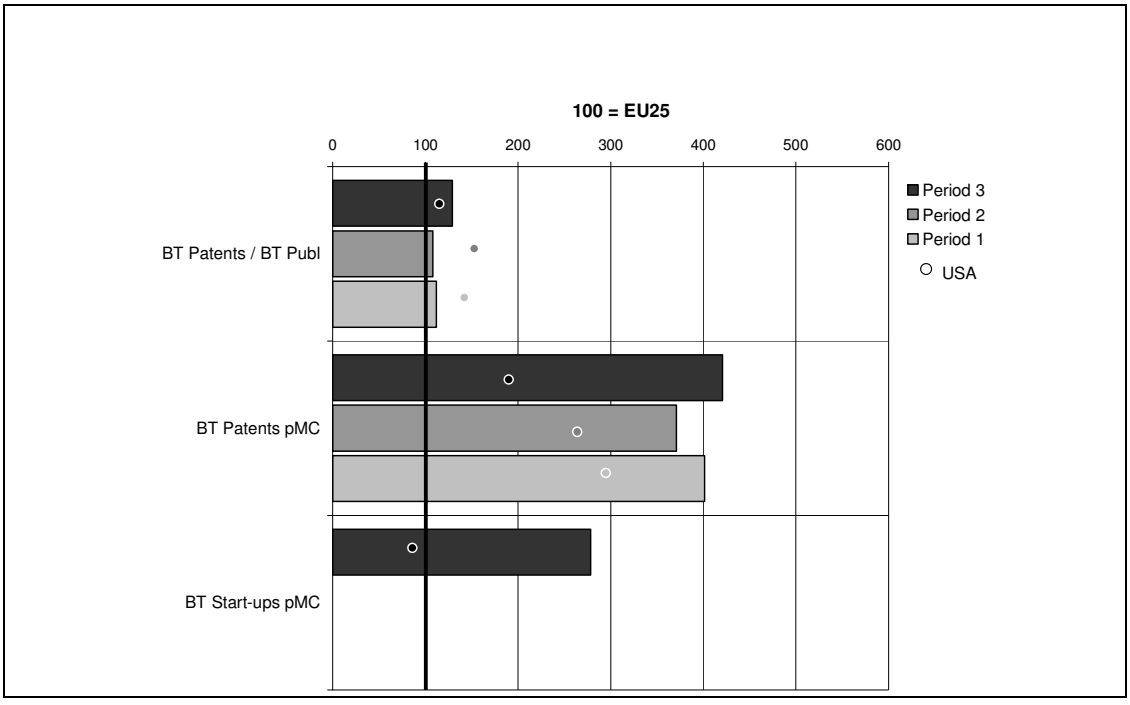
The first of the three indicators which inform about a country's performance with regard to knowledge transmission and application – biotechnology patents per biotechnology publications – shows that Switzerland ranged above the EU25 level during all three pe-

riods covered. In absolute terms, the patents-publications ratio increased continuously over the three time periods (from 0.06 in 1994/96 to 0.09 in 2001/2003). In relative terms the country's leading margin slightly decreased in the second period, but regained momentum in the third one, clearly outperforming the US level. Within Europe, Switzerland ranks fourth after the top performers Iceland, Denmark and Germany during the period 2001-2003.

Swiss performance with regard to the second indicator in the category of knowledge transmission and application is very impressive. In terms of biotechnology patents pMC, the country ranks third after Iceland and Denmark throughout the later two time periods and even second best after Denmark during the first time period. Moreover, Switzerland not only outperforms the EU25 level by factor four, but also fares much better than the US. The number of biotechnology patents pMC steadily increased from 44 (1994-96), to 73 (1998-2000) and finally reached 94 (2001-03).

Between 2001 and 2003, 29 newly established biotechnology start-ups were reported for Switzerland. If population size is accounted for, with 4 start-ups pMC the country ranked second best after Denmark which reported 8.4 start-ups pMC. Other European top performers were Sweden (3.2 pMC), the Netherlands (2.8 pMC) and Ireland (2.3 pMC). Just as in the case of the other two indicators in the category of knowledge transmission and application, Switzerland not only outperformed the reference region Europe, but also the US (1.2 start-ups pMC). As the number of new start-ups reported during the time period 2001-2003 is very low, this indicator should be interpreted with some caution.

Chart 3.4: Performance indicators for biotechnology knowledge transmission and applications, three periods, Switzerland in comparison with EU25 and USA



Source: BioPolis Research

Data: Database of European Patents (Host Questel Orbit, EPPATENT), Database of International Patent Applications (WOPATENT), EuropaBio

Note: The European reference region for indicator 11 (number of biotech start-ups pMC) is EU15.

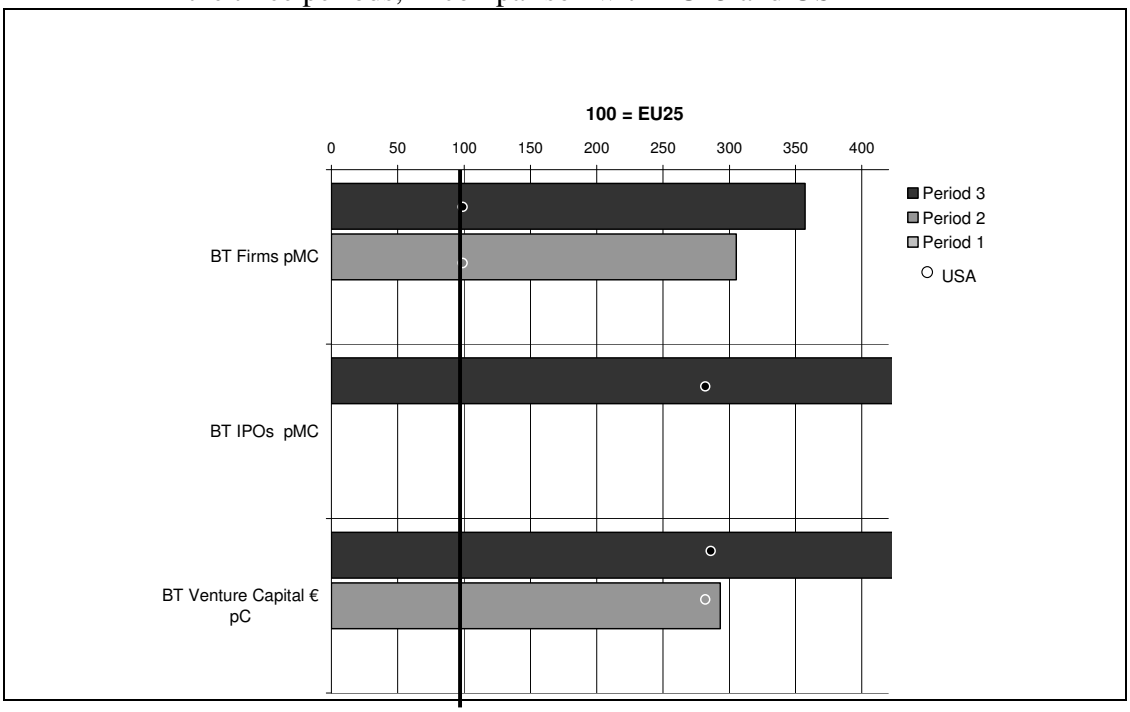
3.4 Industrial development

The first of the three indicators dealing with industrial development – biotechnology companies pMC – underscores that the Switzerland has a thriving biotechnology industry. In terms of biotechnology companies relative to population size, Switzerland outperforms the EU25 level by factor three. In 2001, Switzerland reported 15.7 firms pMC. Three years later, the performance increased, now reaching 17.79 biotechnology firms pMC. By comparison, the reference regions Europe (data available for 12 countries) and the US reported about five companies pMC. Other European top performers in 2004 were Sweden (19.83 pMC), Denmark (14.82 pMC) and Finland (13.22 pMC).

The situation with regard to biotechnology IPOs pMC follows the same general pattern. This indicator shows that Switzerland clearly outperforms both the EU25 (only twelve countries reported IPOs between 2002 and 2005) and the US. However, a closer look at the data reveals that only three IPOs were issued during the time period under consideration. In EU25, a total of 29 IPOs were reported. Again, due to the small number of cases, this indicator has to be interpreted with some reservation.

The same caution should also be applied to the third indicator, biotechnology venture capital pC. Data was available only for eleven European nations. Within this group, Switzerland performed best in all three years covered (2002-2004). Moreover, a consistent upward trend – from 8 EUR pC in 2002 to 17 EUR pC in 2004 – over all three years could be observed. Other European top performers in 2004 were Denmark (10 EUR pC) and the UK (6 EUR pC). Switzerland was also able to clearly strengthen its position relative to the US.

Chart 3.5: Performance indicators for Switzerland's industrial development for the three periods, in comparison with EU25 and USA



Source: Benchmarking of public biotechnology policy 2005, Biotechnology Innovation Scoreboard 2002, BioPolis Research

3.5 Market conditions

To date, indicators for biotechnology market conditions are not available for Switzerland.

4. Conclusions

4.1 Introduction

This concluding chapter provides an overview over the main characteristics of the policy-directed instruments that have been operated by the Swiss governments 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 the types of policy instruments used, the policy goals addressed, the research application areas funded and the activities that are stimulated. It also provides a comparison with the period 1994-1998 which has been analysed in the Inventory Report (European Commission 1999a, b)[31].

Table 4.1 summarises the public expenditure totals for the period 2002-2005 by two main categories (research and commercialisation). In addition, totals for sub-categories such as generic and specific funding schemes operated by the national and regional levels, respectively are listed. The ensuing Table 4.2 provides information about the main recipients of the promotion activities and general co-financing requirements. Tables 4.3 through 4.5 give overviews over the policy goals, the biotechnology application areas and the activities covered by each of the policy instruments that have been relevant for biotechnology promotion activities between 2002 and 2005. While the shown funding patterns for the policy goals, application areas and activities deliver useful indications of priorities, promotional styles and perhaps certain lacunae, the aggregated budgets for each of the categories should be interpreted with due caution. In most instances, the reported budget shares had to be based on informed approximations of the programme officers of the funding agencies and ministries because the BioPolis classifications are not in accordance with the internal accounting and budgeting systems of the institutions providing the funding data. Furthermore, particularly with regard to Table 4.5 (coverage of biotechnology activities), the reported funding totals tend to be sketchy because making coherent assignments of specified budgets for individual activities was not always feasible.

4.2 Public funding of biotechnology through policy instruments

Between 2002 and 2005, public sources promoted biotechnology-related activities in Switzerland with a total sum of 155.6M EUR. 77M EUR or nearly half of the total funds were spent through policy-directed generic instruments targeting research. Non-policy-directed research funding accounted for the second largest single entry, constituting

31 European Commission, DG Research, RTD actions - Biotechnology (DG XII/E.1) et al. (1999a) Inventory of public biotechnology R&D programmes in Europe: Volume 1: Analytical Report, Office for Official Publications of the EC, Luxembourg, (European Commission: Studies).
European Commission, DG Research, RTD actions - Biotechnology (DG XII/E.1) et al. (1999b) Inventory of public biotechnology R&D programmes in Europe: Volume 2: National Reports (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland), Office for Official Publications of the EC, Luxembourg, (European Commission: Studies).

27.5% of the total public expenditures. Biotechnology-specific instruments only covered a comparatively small share of the overall research promotion activities (4.5% of the total). Commercialisation was promoted with 26M EUR or 16.7% of the total.

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

	Total
RESEARCH	
1. *Non-policy-directed*	
Public Research Institutions	4.2
Response Mode	38.7
Total	42.9
2a. *Policy-directed Generic*	
National	76.74
Regional	
Total	76.74
2b. *Policy-directed Biotech-specific*	
National	5.66
Regional	1.34
Total	7
COMMERCIALISATION	
1a. *Policy-directed Generic*	
National	14.23
Regional	
Total	14.23
1b. *Policy-directed Biotech-specific*	
National	8.26
Regional	3.55
Total	11.81
OTHER	
National	2.45
Regional	0.51
Total	2.96
GRAND TOTALS	**155.64**

Source: BioPolis Research

4.3 Specific features of the instruments

Table 4.2 indicates that Swiss funding activities promoting biotechnology – both generic and specific instruments – do not only cover public research organisations (PROs), but are also made available to recipients in the business sector.

On the national level, four of the nine instruments support at least one further type of recipient in addition to PROs. Four of the national instruments are exclusively directed towards public research institutions, whereas only one is designed to promote innovation in the private sector.

Moreover, four national instruments demand a financial contribution to the total project budget from the participating industry partner. The required share is usually 50%.

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

Instrument	Funding agency	Participants/Recipients			Financial contribution required (%)	
		PROs	SMEs	LFs	Recipients	Other public authorities
National						
Generic						
SNF Professorships	SNF	√				
NCCR	SNF	√	√	√	√	
CTI Start-up	CTI		√		√	
Research Promotion for Universities of Applied Sciences	CTI	√			√	
NFP 46 - Implants and Transplants	SNF	√	√			
NFP 49 - Antibiotic Resistance	SNF	√				
Biotech specific						
CTI Biotech	CTI	√	√	√	√	
Contracted Research of the federal Office for Public Health	BAG	√				
Biosafety in Non-Human Genetic Engineering	BAFU	√	√			
Regional						
Biotech specific						
BioAlps	Cantons of Geneva, Fribourg, Neuchâtel, Valais and Vaud	√	√			
BioValley Interreg IIIA Programme	Cantons of Baselstadt, Baselland, Solothurn, Aargau, Jura; EVD	√	√			
Associazione Biopolo Ticino	Canton of Ticino, EVD	√	√	√	√	
Greater Zurich Area/ Zurich MedNet	Greater Zurich Area	√	√			

Note: the public information activity Gene ABC, which was implemented by the SNF, is not included in Table 4.2 because the instrument did not make available funding to biotechnology actors.

Source: BioPolis Research

4.4 Policy goals

Judging from the funding amounts distributed across the ten policy goals, promoting a high level of biotechnology research (policy goal 1) is the by far most important funding priority in the Swiss biotechnology promotion strategy. Nearly 50% of the total expenditures are allocated in favour of this policy goal. The policy goals with the second and third largest allotments are knowledge transmission from academia to industry (5) and knowledge flow and collaboration among scientific disciplines (3), backed with 13.5% and 10.6% of the total expenditures, respectively. The three policy goals with the lowest funding shares are the support of business investment in R&D (9), biosafety and risk assessment (10) and social acceptance of biotechnology (8). Especially the low priority for those activities that have the potential to contribute to informed public debates and increased public awareness about potentials and risks of biotechnology are difficult to understand against the background of the strong plebiscitarian elements in the Swiss political system.

If the individual expenditures for policy goals are grouped into the five policy areas defined by BioPolis[32], policy areas 1 and 2 are supported unevenly. About 72% of the expenditures are directed towards the creation of a knowledge base, whereas policy area 2 (knowledge transfer and application) receives roughly 24% of the funds.

A closer look at the national level reveals that biotechnology-specific instruments place a stronger emphasis on policy area 2 compared to the generic national instruments which focus on policy area 1. A similar pattern can be observed on the regional level where all instruments are biotechnology specific. Here, the promotion activities are concentrated on knowledge transfer and application.

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

	Policy goals									
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
National										
Generic										
SNF Professorships	√									
NCCR	√		√	√	√					
CTI Start-up							√			
Research Promotion for Universities of Applied Sciences		√	√		√				√	
NFP 46 - Implants and Transplants	√							√		
NFP 49 - Antibiotic Resistance	√	√								
Total	53.33	0.98	11.71	10.82	11.61	–	1.84	0.39	0.79	–

32 The policy area 1 "creation of knowledge base and human resources" is composed of policy goals 1 to 4, policy area 2 "knowledge transfer and application" includes policy goals 5 to 7 and 9. The remaining policy goals 8 and 10 constitute policy areas of their own.

	Policy goals									
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Biotech specific										
Gene ABC								√		
CTI Biotech		√	√		√	√	√			
Contracted Research of the federal Office for Public Health										√
Biosafety in Non-Human Genetic Engineering										√
Total	–	2.90	2.75	–	2.75	2.75	2.75	0.45	–	1.61
Regional										
Biotech specific										
BioAlps		√			√		√		√	
Basel Area (BioValley) Interreg IIIA Programme					√		√	√		
Associazione Biopolo Ticino		√	√		√		√			
Greater Zurich Area/ Zurich MedNet		√			√		√			
Total	–	1.23	0.10	–	1.68	–	1.68	0.51	0.20	–
Grand Total	53.33	5.12	14.47	10.82	16.04	2.75	6.27	1.35	0.98	1.61
% of GrandTotal	47.3	4.5	12.8	9.6	14.2	2.4	5.6	1.2	0.9	1.4

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

Note: The figures in this table should be read as merely indicative of the relative expenditure allocated to the various policy goals. Since many goals overlap in one instrument, the split of expenditure between goals is only a rough estimate and/or informed guess. On the other, it is important to bear in mind that instruments of some goals (e.g., social acceptance programmes) may require less expenditure than others even if they are set as a policy priority.

Source: BioPolis Research

4.5 Biotechnology research application areas

Table 4.4 indicates that basic biotechnology research receives the by far most funding – more than 50 % of the total expenditures are directed towards this application area. Heath biotechnology is supported with the second largest share (27.8%). Promotion activities concerning ethical, legal and social aspects of biotechnology are supported with the lowest funding – merely 1.5% is spent in this area. The remaining biotechnology application areas receive funding shares between 2.2% and 4.5%.

This distribution of funds across the application areas confirms the general output performance pattern presented in chapter 3.2.

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

	Biotechnology application areas							
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**
National								
Generic								
SNF Professorships	√	√	√	√			√	
NCCR				√			√	
CTI Start-up				√		√		
Research Promotion for Universities of Applied Sciences								
NFP 46 - Implants and Transplants				√				√
NFP 49 - Antibiotic Resistance				√				
Total	1.97	1.97	1.97	25.46	0.00	0.20	56.07	0.39
Biotech specific								
Gene ABC								√
CTI Biotech	√	√	√	√	√	√		
Contracted Research of the federal Office for Public Health	√							
Biosafety in Non-Human Genetic Engineering			√	√				√
Total	2.92	2.30	2.95	2.61	2.30	2.30	-	0.61
Regional								
Biotech specific								
BioAlps								
Basel Area (BioValley) Interreg IIIA Programme								√
Associazione Biopolo Ticino				√		√		

	Biotechnology application areas							
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Greater Zurich Area/ Zurich MedNet				√				
Total	–	–	–	1.53	–	0.22	–	0.58
Grand Total	4.89	4.26	4.92	29.60	2.30	2.71	56.07	1.58

* Legend:

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

Note: Figures in the table should be understood as rough estimates of expenditure in a given application area.

Source: BioPolis Research

4.6 Stimulation of biotechnology activities through the instruments

According to the data presented in Table 4.5, the top three activities of the instruments covered by BioPolis are the support of basic research (activity 1), biotechnology training (6) and applied research (2). Those activities with the lowest shares of funding are financial support for start-ups (13), non-financial incentives for business investment (18) and support for public discourse activities (19). Ten activities were covered at least to some extent by the instruments included in the BioPolis survey, but exact budget figures for were not available. Activity 17 (grants for industrial research) was not covered by any of the instruments.

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

	Biotechnology activities																		
	1*	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
National																			
Generic																			
SNF Professor-ships	√					√													
NCCR	√		√	√	√		√	√				√							
CTI Start-up														√					
Research Promotion for Universities of Applied Sciences		√		√															
NFP 46 - Implants and Transplants	√	√																	√
NFP 49 - Antibiotic Resistance	√																		
Total *	23.76	5.38	n.a.	1.31	n.a.	14.75	n.a.	n.a.	-	–	–	n.a.	–	n.a.	–	–		–	0.39
Biotech specific																			
Gene ABC																			√
CTI Biotech		√		√			√	√						√		√			
Contracted Research of the federal Office for Public Health	√																		
Biosafety in Non-Human Genetic Engineering		√																	
Total	0.62	0.98	–	0.39	–	–	n.a.	n.a.	-	–	–	–	–	n.a.	–	n.a.		–	0.45
Regional																			
Biotech specific																			
BioAlps		√		√				√			√			√				√	
Basel Area (BioValley) Interreg IIIA Programme				√									√					√	√
Associazione Biopolo Ticino				√						√	√	√		√	√	√			

	Biotechnology activities																		
Greater Zurich Area/ Zurich MedNet		√		√				√			√			√				√	
Total	–	n.a.	–	n.a.	–	–	–	n.a.	-	n.a.	n.a.	n.a.	0.39	n.a.	n.a.	n.a.	-	0.39	0.39
Grand Total	24.38	6.36	n.a.	1.70	n.a.	14.75	n.a.	n.a.	-	n.a.	n.a.	n.a.	0.39	n.a.	n.a.	n.a.	-	0.39	1.23

* Legend:

1 Basic research
2 Applied research
3 Centres of excellence
4 Research network
5 Mobility of researchers among disciplines
6 Biotechnology training
7 Mobility of researchers between academia and industry
8 Collaborative research between industry and public research organisations
9 Set up research institute/centre of industrial interest
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 in it.
17 Grants for industrial research
18 Other incentives for business investment
19 Support for public discourse activities

Note: Figures in the table should be understood as rough estimates of expenditure for a given activity.

Source: BioPolis Research

4.7 Dynamics: comparison with period 1994-1998

A comparison of public funding expenditures between the two time periods 1994-1998 (European Commission 1999a,b or "Inventory") and 2002-2005 (BioPolis) has to be carried out with great caution as the data collection criteria between the two periods changed considerably. This is not only the case for the decisive factors concerning which public funding activities are to be considered for the analysis in the first place (Table 4.6), but also for the delineation of the different biotechnology application areas. Moreover, the Inventory study did not use the same categorisation of policy goals as is being applied in BioPolis. Thus, the comparison presented in Table 4.7 should be interpreted with caution as well.

Consequently, differences in the amounts of public funds allocated and the distribution pattern of policy goals in Inventory and BioPolis need not necessarily reflect a shift in funding priorities.

Table 4.6 indicates that total expenditures for the promotion of biotechnology have increased significantly between the two time periods. According to the data, the average total funding on the national level in 2002-2005 was nearly four times higher than during the period 1994-1998. However, it should be noted that compared to Inventory, BioPolis collected more generic instruments, resulting in an overall higher amount of expenditures during the latter period.

Table 4.6 Comparison of biotechnology funding through 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	9.96M ECU	37.56M EUR
Regional	n.a.	1.35M EUR
Total	9.96M ECU	38.91M EUR

Note: This table combines total funds of non-policy-directed funding, policy-directed instruments and commercialisation instruments.

Source: BioPolis Research

The comparison of the policy goal coverage by policy-directed programmes and instruments between the time periods of Inventory (1994-1998) and BioPolis (2002-2005) denotes a high degree of policy continuity (see Table 4.7). In both periods, all but two policy goals (6 and 8) are covered at least by one instrument. And in these two cases, the lacunae were closed in the latter period. One of the main differences between the two periods being compared is that the share of policy goals covered by biotechnology-specific instruments increased. This might seem surprising against the background that, in contrast to 1994-1998 period during which the SPP BioTech was being implemented, no major biotechnology-specific programme was being offered in 2002-2005. Apart from a methodological explanation according to which the promotion activities of the cantons –

mainly biotechnology clusters – were not included in the Inventory, the stronger presence of biotechnology-specific instruments is indicative of an improved integration if this technology field in established funding structures and support routines.

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

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

* G = generic instruments; ** S= Biotechnology-specific instruments

Source: BioPolis Research

Funding of biotechnology areas

Keeping the limitations concerning the comparability of the two time periods in mind, the data suggests that public funding of basic biotechnology research increased considerably – from about 18 to 50% of the total. A slight increase since the period 1994-1998 can also be identified in the area of health-related biotechnology. Other application areas such as plant, animal, environmental and industrial biotechnology received less funding compared to Inventory. The public support of research in non-technical areas of biotechnology remained more or less stable.

5. Future developments

Major changes in the Swiss biotechnology landscape do not seem to be on the horizon for the next few years – neither with regard to funding priorities nor processes. Generally, biotechnology has become well integrated into the general public funding schemes, making it less pressing for the affected stakeholders to engage in extraordinary efforts aimed to raise biotechnology's share of funding. Another indication that biotechnology has become well established in Switzerland is the fact that biotechnology-related funding has become thematically more differentiated, as it is reflected by a number of specialised NFPs and NCCRs, but also by the creation of a specialised biotechnology department within the CTI.

Continuity is also to be expected with regard to the already visible trend towards increasing bottom-up, open-call funding at the expense of policy-directed, vertical instruments. Likewise, the efforts to improve the valorisation side of the innovation process will surely be kept up. An example is the CTI's new initiative to strengthen knowledge and technology transfer (CTI KTT); the activity was officially launched in 2006.

The legislative and political initiatives to reduce the institutional and "cultural" barriers between academic and application-oriented research have to be seen in this context. The FH, which have enjoyed increased appreciation during the last few years, are expected to contribute a growing share to applied research in Switzerland.

Additional project funding will be made available through a new NFP – Risks and Benefits of Releasing GMOs, which was approved of in December 2005. The bio-safety NFP will run for four years and has an over-all budget of 7.75M EUR. Plans are also underway for a NFP focusing on new immunisation strategies.

Under the jurisdiction of the Federal Department of Defence, Civil Protection and Sports (VBS), the Spiez Laboratory deals with the protection from nuclear, biological, and chemical threats and risks, and with technical aspects of arms control and disarmament of nuclear, biological, and chemical weapons (NBC weapons). Within the confines of the laboratory, a modern complex for special pathogens will be established. The total investment will add up to 18M EUR. According to the plans, the new laboratory will be fully functional in 2010. The main fields of activity will be risk assessment, risk prevention and the development of new testing methods with regard to pathogens.

Other important thematic currents and priorities in the years to come are most likely to include stem cell research (with new projects at an early preparatory stage), bio-safety and vaccinology research, antibiotics, bio-nano and industrial biotechnology. Systems biology is also being debated within the community, both with regard to micro-organisms as well as to more complex organisms. The initiative SystemsX, which was jointly established by the ETH Lausanne and Zurich and the Univeristies of Basel and Zurich in 2006, is a first upshot of the scientific communitiy's heightened interest in the scientific subfield of systems biology.

Annex 1 List of tables

Annex 2 List of figures and charts

Annex 3 List of contact persons

Name, first name	Institution	Contact date(s)
Alexakis, Domenico P.	Swiss Biotech Association	14-12-2005
Arndt, R.W.	Stiftung zur Förderung schweizerischer Volkswirtschaft	12-06-2006
Bopp, Martin	CTI	24-02-2006
Bühler, Roland	CTI	08-11-2005
Cerutti, Fabio	BLW	17-11-2005
Christ, Urs	SNF	10-11-2005
Costoya, Javier	BioAlps	30-01-2006
Cuadra, Inés de la	SNF	15-11-2005
Dubois, Véronique	CTI	08-11-2005
Felleisen, Richard	BAG	17-11-2005
Flückiger Schwarzenbach, Barbara	SNF	11-11-2005
Ghisalba, Oreste	Novartis Pharma AG/CTI	05-12-2005
Hägele, Bernd	SBF	04-11-2005
Hosbach, Hans	BAFU	21-11-2005
Käppeli, Othmar	BATS	23-11-2005
Kull, Annette	CTI	08-11-2005
Kuster, Robert	BioAlps	09-06-2006
Kux, Stephan	Canton Zurich	30-01-2006
Läubli, Marlène	BAG	21-11-2005
Meier, Christoph	SNF	29-12-2005
Meier, Katrin	Stiftung Risiko-Dialog	09-06-2006

Räber, Peter	Basel Area Business Development	16-01-2006
Räber, Peter	Basel Area (BioValley)/Basel Area	16-01-2006
Ramseyer, Lorenz	CTI	09-11-2005
Schütz, Martin	Labor Spiez	21-12-2005
Schwarz, Franziska	CTI	08-11-2005
Sommermatter, Kathrin	BVET	22-11-2005
Tomisawa, Sacra	SBF	21-11-2005
Vonmont, Pascale	Gebert Rüf Stiftung	08-06-2006
Weber, Christian	SECO	02-02-2006
Weber, Christian	SECO	02-02-2006
Zingg, Karin	CTI	11-11-2005

Annex 4 References

Bieri, O., Balthasar, A., Feller-Länzlinger, Ruth, Ebersberger, B., Edler, J., Ruhland, Sascha (2005) Evaluation der schweizerischen Beteiligung am 5. und 6. Forschungsrahmenprogramm der Europäischen Union sowie des Informationsnetzwerkes Euresearch, Interface Institut für Politikstudien in Zusammenarbeit mit Fraunhofer-Institut für System- und Innovationsforschung (ISI), Bern, Staatssekretariat für Bildung und Forschung SBF

Bodenmüller, K. (2005) Research per Referendum, Conflict between Science and Society in the Direct Democarcy, BIOforum Europe, 6/2005, p. 26f.

Braun, D. (1999) Bildungs-, Wissenschafts- und Kulturpolitik, in: Klöti, Ulrich et al. Handbuch der Schweizer Politik, Manual de la politique suisse, Zürich, Verlag Neue Zürcher Zeitung, S. 841-879.

Bundesamt für Berufsbildung und Technologie (Hrsg.) (2003) Ressortforschung des Bundes, Forschung im Dienst der Gesellschaft, Konzepte 2004-2007, Staatssekretariat der Gruppe für Wissenschaft und Forschung, Bern, Bundesamt für Berufsbildung und Technologie.

Bundesamt für Statistik (2006) Indikatoren "Wissenschaft und Technologie", F + E der Schweiz, Neuchâtel.

Bundesrat der Schweiz (2002) Botschaft über die Förderung von Bildung, Forschung und Technologie in den Jahren 2004-2007, 29. November 2002.

European Commission (2005) Social Values, Science and Technology (Special Eurobarometer 225/Wave 63.1 – TNS Opinion & Social, Brussels, Directorate General Press and Communication.

European Commission, DG Research, RTD actions - Biotechnology (DG XII/E.1) et al. (1999) Inventory of public biotechnology R&D programmes in Europe, Volume 1: Analytical Report, Luxembourg, Office for Official Publications of the EC, (European Commission: Studies).

European Commission, DG Research, RTD actions - Biotechnology (DG XII/E.1) et al. (1999) Inventory of public biotechnology R&D programmes in Europe: Volume 3: National Reports (Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom), Luxembourg, Office for Official Publications of the EC, 1999 (European Commission: Studies).

Frei, P., Alexakis, D. (2005) Life Sciences in Switzerland, A Branch with Growth Potential, BIOforum Europe, 6/2005, p. 24f.

KTI (2005) Jahresbericht 2004, Bern, Bundesamt für Berufsbildung und Technologie.

Lepori, B. (2006) Public research funding and research policy: a long-term analysis for the Swiss case, Science and Public Policy, Vol. 33, No. 3, pp. 205-216.

Moed, H.F., Glänzel, W., Schmoch, U. (eds.) (2004) Handbook of Quantitative Science and Technology Research. The Use of Publication and Patent Statistics in Studies of S&T Systems., Dordrecht: Kluwer Academic Publishers.

Reiss, T. (1999) National Report of Switzerland. In: Europäische Kommission / GD Wissenschaft, Forschung und Entwicklung / RTD actions - Biotechnology (DG XII/E.1) u.a.: Inventory of public biotechnology R&D programmes in Europe: Volume 3: National Reports (Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom), Luxembourg, Office for Official Publications of the EC (European Commission: Studies), p. CH-1-CH-26.

Reiss, T., Calvert, J., Dominguez Lacasa, I., Enzing, C., van der Giessen, A., Hinze, S., Kern, S., Mangematin, V., Nesta, L., Patel, P., Senker, J. (2003) Efficiency of Innovation Policies in High Technology Sectors in Europe (EPOHITE), EUR 20904 (Final report), EUR 29022 (National Case Studies), September, Luxembourg, Office for Official Publications of the European Communities.

Reiss, T., Corolleur, F., Dominguez-Lacasa, I., Enzing, C., van der Giessen, A., Nesta, L., Senker, J. (2005) Benchmarking of public biotechnology policy, Final report, Brussels, European Commission Enterprise Directorate General.

SNF (2005a) Guide2005, National Centers of Competence in Research, Bern, Swiss National Science Foundation.

SNF (2004) Jahresbericht 2003, Bern, Schweizerische Nationalfonds zur Förderung der wissenschaftlichen Forschung.

SNF (2005b) Jahresbericht 2004, Bern, Schweizerische Nationalfonds zur Förderung der wissenschaftlichen Forschung.

SNF (2006) Jahresbericht 2005, Bern, Schweizerische Nationalfonds zur Förderung der wissenschaftlichen Forschung.

Staatssekretariat für Bildung und Forschung; Bundesamt für Berufsbildung und Technologie (2005) Kosten und Finanzierung der Hochschulen und der Forschung in der Schweiz: Ausgewählte Indikatoren, Bern, Staatssekretariat für Bildung und Forschung; Bundesamt für Berufsbildung und Technologie.

Ernst & Young, SWX Swiss Exchange, Staatssekretariat für Wirtschaft seco, Förderagentur für Innovation KTI/CTI und Swiss Biotech (eds.) (2004) Swiss Biotech Report, Bern.

Ernst & Young, SWX Swiss Exchange, Staatssekretariat für Wirtschaft seco, Förderagentur für Innovation KTI/CTI und Swiss Biotech (eds.) (2005) Swiss Biotech Report 2005, Bern.

Ernst & Young, SWX Swiss Exchange, Staatssekretariat für Wirtschaft seco, Förderagentur für Innovation KTI/CTI und Swiss Biotech (eds.) (2006) Swiss Biotech Report 2006, Bern.

Veraguth, T. (2004) Zukunft der Biotechnologie, BIOforum, 7-8, p. 20-22.

Vock, P. (2002) Swiss Science and Innovation Policies, Recent developments (late 1999-2001), Center for Science and Technology Studies (CEST), February 2002.

Vock, P., Hinrichs, U. (2004) Swiss Science and Innovation Policies, Recent developments 2002-2003, Center for Science and Technology Studies (CEST), June 2004.

Websites:

BLW	http://www.blw.admin.ch/index.html?lang=en
CTI	http://www.bbt.admin.ch/kti/index.html?lang=en
SBF	http://www.sbf.admin.ch/htm/index-e.php
SECO	http://www.seco-admin.ch/index.html?lang=en
SNF	http://www.snf.ch/default_en.asp
Swiss Biotech	http://www.swissbiotech.org/
Swiss Biotech Association	http://www.swissbiotechassociation.ch/
Swiss Federal Statistical Office	http://www.bfs.admin.ch/bfs/portal/en/index.html
Swiss Life Sciences Database	http://www.swisslifesciences.com
SWTR	http://www.swtr.ch/e/index.html

Annex 5 Performance

Introduction

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

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

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

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

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

	Indicator	Chart	Comments	Time periods
	sciences pMC		Region EU17 =100 and US data for comparison	(3) 2002
Ind. 7	BT publications in subfields, as % of total BT publications	3.2.1	Data in % EU25 and US data for comparison	1994-1996
		3.2.2		2002-2004
Ind. 8	Growth rate of BT publications in subfields	3.3	EU25 and US data for comparison Small field effect	Growth rate between 1994-96 (period 1) and 2002-04 (period 3)
Ind. 9	Biotech patent applications pMC	3.4	EU25 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 10	Number of biotechnology companies pMC	3.5	European (data available) and US data for comparison	(2) 2001 (3) 2004
Ind. 11	Number of biotech start-ups pMC	3.4	European (data available) and US data for comparison	(3) 2001-2003 (only one period)
Ind. 12	Number of biotech IPOs pMC	3.5	European (data available) and US data for comparison	(3) 2002-2005
Ind. 13	Venture capital in € pC	3.5	European (data available) and US data for comparison	(2) 2002 (3) 2004
Ind. 14	BT acceptance index	No Chart - Discussed in text of chapter 3	Source: BT Policy Benchmarking 2005. The biotechnology acceptance index is a composite index and draws on questions Q.12, Q.13.1 and Q14.01 and Q14.09 of the Eurobarometer 58.0	2002
Ind. 15	Eurobarometer 225	No Chart - discussed in text of chapter 3	See section 3.3 and sections 3.4.1, 3.4.2, and 3.4.3 of the Special Eurobarometer 225[33]	- 2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100 US data for comparison	1995-2002

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

	Indicator	Chart	Comments	Time periods
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
Switzerland	5522	7013	7582	7	7	7
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
Switzerland	782	979	1030	359	343	323
USA	454	492	529	208	172	166

Source: BioPolis Research
Publication data: Science Citation Index (through online database vendor STN International)
Population data: EUROSTAT and OECD

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

	BT publi-cations	**Non-policy-directed funding**	**Policy-directed funding**		**Total public spend-ing on BT (M Ecu)**	**BT publica-tions/ M Ecu BT public expenditure**	**Index**
			Biotech specific	**Generic**			
	2002-2004	**1994-1998**	**1994-1998**	**1994-1998**	**1994-1998**	**2002-2004/ 1994-1998**	
EU25	145646				n.a.		
Swit-zerland	7582		47.1	2.7	50	152	948
USA	154402				n.a.		n.a.

Source: BioPolis Research
Publication data: Science Citation Index (through online database vendor STN International)
BT public expenditures in research: Inventory Project, Table 3.4 Executive Summary

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

	BT publications			Total publications		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	97521	128716	145646	860652	1024327	1117392
Switzerland	5522	7013	7582	38890	47549	53843
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
Switzerland	14%	15%	14%	125	117	108
USA	13%	14%	15%	119	115	113

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

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

	Citations to BT publications		Index EU25=100	
	94-98	00-04	94-98	00-04
EU25	6.14	7.28	100	100
Switzerland	11.22	10.60	183	146
USA	6.39	8.54	104	117

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

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

	Graduates in Life Sciences		Population (million)	
	1998 / 1999	2002	1998 / 1999	2002
EU17	46859**	81316	552**	431
Switzerland	934	947	7	7
USA	75253*	70950	276*	288
	Graduates pMC		Index EU17=100	
	1998 / 1999	2002	1998 / 1999	2002
EU17	85**	189	100	100
Switzerland	132	131	155	69
USA	273*	246	299	131

Index EU17=100 for 1998 is EU16, because for Portugal no data available
* data for 1998; ** data for 1999
Source: BioPolis Research
Graduates data OECD Education Database
Population source for US is the OECD

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

	1994-1996							
	Total	**Plant**	**Health**	**Animal**	**Food**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Switzerland	100%	6%	55%	5%	2%	1%	0%	31%
USA	100%	6%	56%	5%	2%	0%	0%	30%

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

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

	2002-2004							
	Total	**Plant**	**Health**	**Animal**	**Food**	**Indus-trial**	**Environ-mental**	**Generic**
EU25	100%	7%	58%	5%	4%	1%	1%	25%
Switzerland	100%	7%	57%	5%	3%	1%	0%	27%
USA	100%	6%	59%	5%	3%	0%	1%	26%

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

Raw data for Chart 3.2.1 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
Switzerland	5765	342	3180	287	113	33	20	1790
USA	111686	7118	62274	5580	2230	296	459	33729

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

Raw data for Chart 3.2.1 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
Switzerland	7486	509	4255	408	207	70	29	2008
USA	141680	7910	84234	6872	4070	436	724	37434

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

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

	1994-1996/2002-2004						
	Plant	**Health**	**Animal**	**Food**	**Industrial**	**Environ-mental**	**Generic**
EU25	38%	56%	56%	106%	86%	95%	19%
Switzerland	49%	34%	42%	83%	112%	45%	12%
USA	11%	35%	23%	83%	47%	58%	11%

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

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

	BT patents			**Population (million)**		
	94-96	**98-00**	**01-03**	**1996**	**2000**	**2003**
EU25	4924	8921	10119	447	451	455
Switzerland	312	526	685	7	7	7
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
Switzerland	44	73	94	401	371	421
USA	33	52	42	295	264	190

Source: BioPolis Research
Publication data: Science Citation Index (through online database vendor STN International)
Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

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

	BT patents			**BT publications**		
	94-96	**98-00**	**01-03**	**94-96**	**98-00**	**01-03**
EU25	4924	8921	10119	97521	128716	140219
Switzerland	312	526	685	5522	7013	7341
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
Switzerland	0.06	0.08	0.09	112	108	129
USA	0.07	0.11	0.08	142	153	115

Source: BioPolis Research
Publication data: Science Citation Index (through online database vendor STN International)
Patent data: EPPATENT, WOPATENT (online database vendor Questel Orbit)

Raw data for Chart 3.5. Number of BT companies pMC for 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
Switzerland	113	129	138	131	7204	7256	7314	7364
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
Switzerland	15.7	17.78	18.87	17.79	305	344	433	357
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 data: Ernst and Young 2002-2005, 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 (EU15 - Cyprus - Greece + Norway + Switzerland)	523	132	367051	
Switzerland	29	6	7314	
USA	355	83	290789	
	Biotech start-up/pMC	**Index**	**Biotech start-up/pMC**	**Index**
	2001-2003	**2001-2003**	**2003**	**2003**
Europe (EU15 - Cyprus - Greece + Norway + Switzerland)	1.4	100	0.36	100
Switzerland	0.82	228	4.0	278
USA	1.2	86	0.29	79

Source: BioPolis Research
Start-ups data: EuropaBio

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

	BT IPO	Population T				
	2002-2005	2002	2003	2004	2005	2002-2005
EU Available	29	452927	454869	457154	461593	456636
Switzerland	3	7256	7314	7364	7415	7337
USA	52	287941	290789	291685		290138
	IPO /pMC	Index				
	2002-2005	2002-2005				
EU Available	0.00	100				
Switzerland	0.00	644				
USA	0.00	282				

Note: EU Available is the result of the sum of available EU member states
IPO data: Ernst and Young 2002-2006, 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 biotechnol-ogy companies M EUR			Population in T		
	2002	2002	2002	2002	2003	2004
Europe	1100	920	2800			
EU Available	890	883	1111	315584	319663	325131
Switzerland	60	93	122	7256	7314	7364
USA	2288	2498	2855	287941	290789	291685
	Venture capital in EUR/pC			Index		
	2002	2003	2004	2002	2003	2004
Europe						
EU Available	2.8	2.8	3.4	100	100	100
Switzerland	8	13	17	293	460	486
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
Switzerland	n.a.	n.a.	n.a.	n.a.
USA	115	289	0.40	387

Note: EU15 is the result of the sum of the 15 old EU Member States
Source: BioPolis Research
Number of medicines: Benchmarking of public biotechnology policy 2005

Raw data for Chart 3.6. Number of field trials pMC

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

Note: EU15 is the result of the sum of the 15 old EU Member States
Source: BioPolis Research
Field trials: Biotechnology Innovation Scoreboard 2002

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

BT acceptance index 2002		
	Index average	N (sample size)
EU15*	100.29	16828
Switzerland	n.a.	n.a.

*Weighted Average according to the weight "W13" of the Eurobarometer 58.2, which considers population differences among countries and corrects for inconsistencies in the national samples
Source: BioPolis Research
BT acceptance index: Benchmarking of public biotechnology policy 2005

References:

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

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

Ernst & Young (2002, 2003, 2004) Beyond Borders - The Global Biotechnology Report, Cambridge, Ernst & Young Global Health Sciences.

Reiss, T. et al. (2005) Benchmarking of public biotechnology policy 2005, European Commission Enterprise DG. 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

BAFU	Bundesamt für Umwelt	Swiss federal Office for the Environment
BAFU	Bundesamt für Umwelt	Federal Office for the Environment FOEN
BAG	Bundesamt für Gesudheit	Swiss Federal Office of Public Health
BATS	Zentrum für Biosicherheit und Nachhaltigkeit	Centre of biosafety and sustainability
BBT	Bundesamt für Berufsbildung und Technologie	Federal Office for Professional Education and Technology (OPET)
BfE	Bundesamt für Energie	Swiss Federal Office of Energy
BFT	Botschaft über die Förderung von Bildung, Forschung und Technologie	Education-Research-Technology-Message
BLW	Bundesamt für Landwirtschaft	Swiss Federal Office for Agriculture
BUWAL	Bundesministerium für Umwelt, Wald und Landschaft	Federal Office for the Environment
BVET	Bundesamt für Veterenärwesen	Swiss federal veterinary office (SFVO)
CEST	Zentrum für Wissenschafts- und Technologiestudien	Centre for Science and Technology Studies
CRUS	Conférence des Recteurs des Universités Suisses	Rectors' Conference of the Swiss Universities
CTI	Kommission für Technologie und Innovation	Innovation Promotion Agency
Eawag	Wasserforschungs-Institut des ETH-Bereichs	Swiss Federal Institute of Aquatic Science and Technology
ECU		European Currency Unit
EDI	Eidgenössisches Departement des Innern	Federal Department of Home Affairs (DFI)
EFP	Ecole Polytechnique Fédérale Lausanne	University of Lausanne
EMPA	Eidgenössische Materialprüfungs- und Forschungsanstalt	Swiss Federal Laboratories for Materials Testing and Research
EPF	École Polytechnique Fédérale	Swiss Federal Institutes of Technology
ETH	Eidgenössische Technische Hochschule	Swiss Federal Institutes of Technology
ETH-Rat	Rat der Eidg. Technischen Hochschulen	Council of the Federal Institutes of Technology
EU	Europäische Union	European Union
EVD	Eidgenössisches	Federal Department of Economic

	Volkswirtschaftsdepartement	Affairs (DFE)
FAL	Forschungsanstalt für Landwirtschaft und Natur	Research for Agriculture and Nature
FAT	Forschungsanstalt für Agrarwirtschaft und Landtechnik	Swiss Federal Research Station for Agricultural Economics and Engineering
FAW	Forschungsanstalt für Obst, Wein und Gartenbau	
FH	Fachhochschule	University of applied science
FMI	Friedrich Miescher Institute	Friedrich Miescher Institute
FN		footnote
GMO		genetically modified organism
IVI	Institut für Viruskrankheiten und Immunprophylaxe	Institute of Virology and Immunoprophylaxis
KTI	Kommission für Technologie und Innovation	Innovation Promotion Agency
KTT	Wissens- und Technologietransfer	Knowledge and technology transfer
n.a.		not available
NCCR	Nationale Forschungsschwerpunkte	National Centers of Competence in Research
NFP	Nationale Forschungsprogramme	National Research Programmes NRP
NFS	Nationale Forschungsschwerpunkte	National Centres of Competence in Research NCCR
NIBR		Novartis Institute for Biomedical Research
pMC		per million capita
PRO		public research organisation
PSI	Paul Scherrer Institute	Paul Scherrer Institut
RAC	Station fédérale de recherches agronomiques de Changins	
SATW	Schweitzerische Akademie der Technischen Wissenschaften	Swiss Academy of Engineering Sciences
SBF	Staatssekretäriat für Bildung und Forschung	State Secretariat for Education and Research (SER)
SECO	Staatssekretariat für Wirtschaft	State Secretariat for Economic Affairs
SKB	Schweitzerische Koordinationsausschuss für Biotechnologie	Swiss Coordination Committee for Biotechnology
SNF	Schweizerischer Nationalfonds	Swiss Federal Science Foundation (SNSF)
SPP	Schwerpunktsprogramme des Bundes	Swiss Priority Program
SWTR	Schweizerischer Wissenschafts- und Technologierat	Swiss Science and Technology Council

TA-SWISS	Zentrum für Technologiefolgen-Abschätzung des Schweizerischen Wissenschafts-und Technologierates	Technology Assessment Swiss
US(A)		United States (of America)
UVEK	Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation	Federal Department of Environment, Transport, Energy and Communications
VBS	Eidgenössisches Departement für Verteidigung, Bevölkerungsschutz und Sport	Federal Department of Defence, Civil Protection and Sports
WBK	Kommission für Wissenschaft, Bildung und Kultur	Committee for Science, Education and Culture