

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 Sweden

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Summary

Compared to the EU-25 average, Sweden has an outstanding record of Gross Domestic R&D Expenditures as a percentage of R&D; it was 4.3% in 2001. The Swedish high-technology manufacturing sector embraces most segments of telecommunications and pharmaceuticals. In recent years, however, weak economic performance has led to questions about whether the returns on Swedish R&D investments have been lower than expected. As a consequence, a new research agency structure was implemented in 2001, with the aim to promote collaboration between research and development and to improve the dissemination of research outputs. This reorganisation created a set of new agencies, such as the Swedish Research Council (VR), the Swedish Council for Working Life and Social Research (FAS), the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS), and the Swedish Agency for Innovation Systems (VINNOVA).

The Swedish biotechnology industry was ranked amongst the top five in Europe in 2000, and biotechnology has been defined as one of the priority growth areas by VINNOVA, which is the main policy agency to support problem-oriented research in the country. Over the period 2002-2005 Sweden invested 145.5M EUR in biotechnology related research, 48% of which has been channelled through non-policy-directed instruments. Policy-directed instruments are mainly generic, and represent an investment of 75.9M EUR in biotechnology, 31% of which was related to commercialisation activities.

VINNOVA and SSF (The Swedish Foundation for Strategic Research) have been the most important agencies supporting biotechnology related research in Sweden and have invested 72M EUR within the period 2002-2005 (both agencies investing about 36M EUR each). VINNOVA's most important instruments were the Research Programmes and VINNVAXT; while SSF's most important instruments were the Strategic Research Centres and the Network Programmes. These programmes are briefly summarised as follows:

VINNOVA's Research Programmes is a biotech-specific instrument calling for research proposals in the following areas: (i) New concepts in small biotech companies; (ii) Innovation in foods; (iii) Green materials; and (iv) Pharmaceutical and diagnostics.

VINNOVA's VINNVAXT is a generic innovation programme aiming to promote collaboration in functional (rather than administrative) regions between companies, research institutions and public organisations.

SSF's Strategic Research Centres is a generic instrument, to establish settings in universities for interdisciplinary research of the highest international standard and of strategic relevance for present and future industry.

SSF's Network Programmes is a generic instrument that funds networks of research groups across Swedish universities, involved in large-scale, long-term research projects and the training of graduates and post-graduates.

Regarding biotechnology application areas, health biotech received almost 40% of research funding and basic biotechnology research accounted for 20%. Support for

industrial biotechnology and, to a lesser extent, plant biotechnology was also significant, but other areas received comparatively less.

Sweden's biotechnology performance is very strong and well above the EU-25 average for its knowledge base, for knowledge transmission and application, for industrial development (where its biotech start-ups per million capita out-perform the US) and for market conditions.

1. Introduction and background

1.1 General introduction

Sweden has a population of 8.9 million people, with a GDP per capita of 29,890 (current) euros in 2003. Swedish manufacturing production is relatively large and knowledge-intensive by international standards, and its share of the high and medium-high-technology manufacturing industry (relative to the size of the economy) has ranked among the top five countries in the OECD for many years (Marklund *et al.*, 2003).¹ Moreover, the Swedish high-technology manufacturing sector has a very broad scope, embracing most segments of telecommunications and pharmaceuticals. The relative weight of knowledge-intensive services is slightly lower relative to some OECD leading economies. Another two distinctive features of the Swedish economy are the dominant role played in manufacturing employment and R&D by a small number of large national industrial groups, and the fact that the Swedish economy is largely driven by exports (which in 2002 accounted for 43% of GDP), with non-electrical machinery, motor vehicles, pulp and paper and telecommunications as the leading exporting sectors in terms of volume (Marklund *et al.*, 2003).

Over the period 2001-2003 growth rates of GDP have been low causing a fall in GDP per capita (in PPS) relative to EU-25, from 119 in 2000 to 114 in 2003, though recovery in 2004, with a GDP growth rate of 3.5, has pushed the ratio up to 116. Despite the fact that Sweden remains well above OECD average levels of GDP per capita, some concerns have been raised due to the fact that over the period 1970-2003 Sweden has fallen from fourth to fifteenth place in the OECD's rankings (Marklund *et al.*, 2003). This weak long-term economic performance has led to questions about whether the returns on Swedish R&D investments have been lower than expected and whether R&D institutions in Sweden are able to transform effectively the knowledge generated into activities that generate growth.

Regarding its R&D efforts, Sweden is outstanding for a variety of reasons. First, Sweden has steadily increased its gross domestic R&D expenditures (GERD) as a percentage of GDP since the early 1990s (2.7% in 1991, rising to 4.27% by 2001), and has been the top EU country for GERD as a percentage of GDP since the early 1990s. Second, Sweden has also led OECD rankings in terms of business expenditures on R&D (BERD) relative to GDP, and the percentages grew from 1.9% in 1991 to 3.3% in 2001. The business sector in Sweden plays a key role in the country's R&D efforts, responsible for 72% of GERD by source of funding, while the public sector contributes only 21% (OECD, 2005). This contrasts with EU-25 figures, where the percentages are 55% and 35%, respectively. Thirdly, Sweden has a comparatively large percentage of business R&D expenditures from foreign-owned firms, indicating that Sweden is an attractive location for large multinational manufacturing groups (Marklund *et al.*, 2003: 32). Finally, the current structure of the Swedish innovation system is largely dependent on a few large corporations that are responsible for nearly 70% of the business R&D investment (Ministry of Industry, Employment and Communications, 2004). This

¹ For instance, by 2000 the percentage of high-technology manufacturing employment relative to total manufacturing employment was around 44% in Sweden, above that of US, Japan, France and Netherlands (Marklund *et al.*, 2003: 14).

feature makes the Swedish innovation system relatively vulnerable to the international strategies of local groups regarding their R&D investments.²

1.2 Characteristics of national S&T and innovation system

In Sweden, the concept of innovation policy was more or less absent from political rhetoric until the end of the 1990s, although the importance of innovation and production of knowledge for economic growth has been widely recognised. The policy agenda was mainly developed along two strands, economic growth and research (Thorslund *et al.*, 2004: 6).

A clear expression of the importance attached to research policy is the fact that Sweden's investments in education have long been among the largest in the world relative to the size of the economy: in 2001, Sweden's investments in R&D and education were the highest in the world relative to the GDP. This investment explains why Sweden is among the countries with a highest proportion of the labour force in knowledge intensive jobs (EIS, 2004) and why it is also at the top of OECD rankings in terms of scientific publications in relation to population size (particularly in medical sciences, natural sciences and engineering) (Marklund *et al.*, 2004).

To achieve a stronger organisation for financing research, the Swedish Parliament took a decision in 2000 to establish a new research agency structure, which was implemented in 2001. The aims of the new organisation were to provide scope for focusing efforts on important scientific areas, promote collaboration between research and development, and improve the dissemination of information about research. This reorganisation created a set of new agencies, such as the Swedish Research Council (VR), the Swedish Council for Working Life and Social Research (FAS), the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS), and the Swedish Agency for Innovation Systems (VINNOVA) (Ministry of Industry, Employment and Communications (2004).

With the establishment of VINNOVA in 2001, the Government moved towards creating a national innovation policy. Alone or together with other research organisations, VINNOVA has been in charge of a number of initiatives to support innovation. This includes a programme launched in 2002 to stimulate the development of a regional system of innovation (i.e. VINNVAXT programme) and a joint programme, together with the Swedish Foundation for Strategic Research (SSF), to allocate grants for research projects conducted in collaboration between researchers at Swedish universities or research institutes and high-tech SMEs (i.e. VINST programme).

Over the period 2002-2005, some concerns have been raised about whether Sweden is sufficiently well positioned to face the future challenges of an increasing global economy. For instance, Marklund *et al.* (2004) have identified some weaknesses of the Swedish innovation system that clearly demand a defined innovation policy that aims: to enhance industrial renewal through the creation of knowledge-intensive start-ups and innovative SMEs; to secure the supply and mobility of highly qualified people; to find new routes for public-private partnerships; to increase the proportion of mission-

² For instance, over the period 2001-2003 business sector R&D fell by nearly 10%, but mainly occurred in the telecommunication sector. Other sectors maintained their R&D investments. (Sandgren, 2005)

oriented research conducted by the Swedish research system; and to generate centres of excellence for research and innovation.

The announcement of a strategy for innovation in 2004 was an important milestone in establishing an explicit innovation policy in Sweden (Sandgren, 2005). This strategy, entitled Innovative Sweden, was presented jointly by the Minister for Industry, Employment and Communications and the Minister for Education and Science. The strategy prioritises four areas:

- Knowledge base for innovation: this priority area emphasises that Sweden must ensure that Swedish education and research are world class (through the promotion of lifelong learning and the encouragement of international mobility for students and researchers, among other initiatives) and concentrate efforts on a number of areas with significant future prospects.
- Innovative trade and industry: indicating that the innovative capacity of SMEs must be strengthened (through collaborations between large and small enterprises and between companies and higher education institutions), and that the commercialisation of research results should increase (via, among other initiatives, the promotion of the use of intellectual property rights and increasing financing at early stages of business development).
- Innovative public investment: emphasising that the public sector is an engine for sustainable growth and that renewal and efficiency must be promoted in the public sector.
- Innovative people: emphasising the need to stimulate entrepreneurship and enterprise (through the creation of a climate that facilitates starting and running people's own businesses) and to create a climate where employees renew their skills.

While Innovative Sweden does not explicitly single out any specific industry, sector or scientific field, it clearly expresses that, when allocating research funds, there should be more cooperation between the agencies in charge of funding research as well as with other stakeholders in order to identify priority areas, and also that “strategic programmes based on technological areas or industries should be introduced” (Ministry of Industry, Employment and Communications, 2004).

1.3 National support and framework conditions for biotechnology

By 2000, the Swedish biotechnology industry was ranked fourth in Europe and ninth in the world in terms of the number of companies (with 179 companies). Moreover, the number of biotech companies increased from 135 in 1997 to 183 in 2001, with employment of 2677 in 1997, rising to 3975 by the end of 2001 (Sandstrom and Norgren, 2003).

Over the period 2002-2005, the creation of VINNOVA was the main policy support for biotechnology. While the overall mission of VINNOVA is to promote sustainable growth by means of problem-oriented research and effective innovation systems, VINNOVA has established a strategic plan for the period 2003-2007 in which 18 priority growth areas have been identified. A growth area is defined by VINNOVA as a sectoral innovation system in which initiatives can have a significant impact on growth

(VINNOVA, 2002). Of these priority growth areas, at least five are intimately linked to the field of biotechnology, while the others correspond to ICT, services, manufacturing, materials and transport. All VINNOVA's initiatives, regardless of whether they involve the development of national or regional innovation systems, focus primarily on the prioritised growth areas.

The relevance of biotechnology within VINNOVA's strategic plan is also shown by its Biotechnology Department in charge initiatives in the area of life sciences and biotechnology. In addition, VINNOVA explicitly considers biotechnology as a knowledge platform, since it is a generic technical field that is expected to play an important role in a number of growth areas and industrial sectors.

The five prioritised growth areas in relation with biotechnology are indicated below. VINNOVA's initiatives in all five areas are focused on problem-oriented research that brings together medicine, biology, IT and engineering, and in all cases target the development and growth of small and medium-sized R&D intensive companies.

- *Pharmaceuticals and diagnostics* initiatives focus on the development of new analytical tools for exploiting post-genomics, the development of strategies and structures for bioinformatics and systems biology, initiatives in medicine technology, and initiatives to stimulate growth in small and medium-sized enterprises.
- *Biotech supply – biotechnologies for research and production* initiatives focus on the development of bio-analytical methods, bio-informatics, IT integration and new technologies for biotechnical production ranging from the research level to industrial scale.
- *Biomedical Engineering* initiatives focus on stimulating R&D cross cooperation between scientific disciplines within the fields of implant biomaterials and tissue engineering, and to promote and encourage new developments in biomedical technology linked to IT and needs in extended home healthcare.
- *Innovation in Foods* initiatives focus on the promotion of cross-disciplinary scientific research aimed at improving the use of medical, biological and biotechnological knowledge in the food industry and food research institutions.
- *Green materials from renewable resources* initiatives focus on stimulating multi-disciplinary research in order to establish platforms within the area of composite and fibre technology, enzyme technology and biopolymers.

VINNOVA also considers that strong regional innovation environments and close cooperation between the research community, business and government are essential prerequisites for sustainable national growth. Consequently, VINNOVA has launched a programme – VINNVAXT – to promote growth in a number of regions and is committed to give support to a new generation of Competence Centres, VINN Excellence Centers.

A survey of attitudes to new technologies in Europe Eurobarometer (2005) found that the Swedish public is slightly more receptive (70%) than the EU-25 average (65%) in expectations about the positive effects of biotechnology and genetic engineering on our way of life in the next 20 years. However the Swedish public is less receptive to most applications of cloning than the EU-25 average, except for cloning human stem cells to make cells and organs to treat people with diseases. Sweden would approve it if highly

regulated and controlled (55%), compared to the EU-25 average of 41%). It also had a higher disapproval rate than the EU-25 average for various applications of genetics (including genetic testing, genetic treatments or storing the population's genetic data to aid either catching criminals or to study the causes of disease).

In Sweden, surplus embryos from fertility projects may be used for human embryonic research (HES) cell research, though it requires a specific consent from the gamete donors and regulatory approval. Sweden forbids the creation of embryos for research purposes, including the procurement of HES cells. However, in Sweden, long-held policy positions with respect to embryo research are being debated and new regulatory regimes may contemplate to permit HES cell research to move forward. For instance, in early 2003, the Committee on Genetic Integrity published a consultation document that included the recommendation that the creation of embryos by fertilization or by somatic cell nuclear transfer (SCNT) for research purposes would not be specifically prohibited, though it recommended that reproductive cloning be unequivocally banned. In short, Sweden, where more liberal policies are being instituted, is likely to join UK and Israel in terms of permissive regulatory environment for HES cell research (Knowles, 2004).

1.4 The main biotech policy and research actors

There are four main categories of public actor in the Swedish innovation system (Sandgren, 2005).

Actors involved in general policy making: The direction of Swedish innovation policy is influenced by up to nine ministries, but the three most influential, in terms of allocation of public funds for research, are: the Ministry of Education, Research and Culture, the Ministry of Industry, Employment and Communications and the Ministry of Defence. These 3 ministries allocate some 85% of the public R&D funds (in 2005, this amounted to 21 000M SEK, around 2 280M EUR) (Sandgren, 2005). The Ministry of Education is responsible for universities and for research policy. It allocates more than 50% of the public R&D budget and has an overall responsibility for the coordination of research. The Ministry of Industry is responsible for creating the conditions for improved welfare and growth, and distributes nearly 15% of the public R&D budget. Finally, the Ministry of Defence controls some 20% of the public R&D budget.

Actors in charge of management and implementation of research and innovation activities: Three main actors are responsible for administering funds for research and innovation activities: the research councils, the mission-oriented agencies and the semi-public foundations.

The research councils base their activities on an approach where scientists decide the direction of research, with research proposals coming mainly from university-based investigators in response to an open call for research applications. There are currently three major public research councils in Sweden. The largest is the *Swedish Research Council* (VR), which is responsible for funding research in the humanities and social sciences; natural sciences and engineering; and medicine. VR distributes some 10% of the total public R&D budget (around 271M EUR – SEK 2500M in 2005) and reports to the Ministry of Education.

The *Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning* (Formas) supports research related to sustainable development, distributing about 2% of total public R&D expenditures in 2005 (about 54.3M EUR – SEK 500M) and reports to the Ministry of Agriculture and the Ministry of Sustainable Development. Finally, the *Swedish Council for Working Life and Social Research* (FAS), has the mission to promote the accumulation of knowledge in matters relating to working life and the understanding of social conditions and processes, distributing about 1% of the total public R&D budget, and reporting to the Ministry of Industry.

Among the agencies supporting mission-oriented R&D, the *Swedish Agency for Innovation Systems* (VINNOVA) is the most influential in terms of the scope of sectors covered and in terms of its total budget. VINNOVA allocates around 5% of total Government funding of R&D (2005) – around 120M EUR (SEK 1100M) – and it is accountable to the Ministry of Industry.

Other important actors with a clear mission-oriented approach are the Swedish National Space Board, responsible for national activities related to space and remote sensing; the Swedish Energy Agency, responsible for transforming the Swedish energy system into an ecological and economically sustainable system; and the Swedish Defence Material Administration, responsible for the development of advanced military technology. These agencies report to the Ministry of Industry, the Ministry of Sustainable Development, and the Ministry of Defence, respectively (Sandgren, 2005).

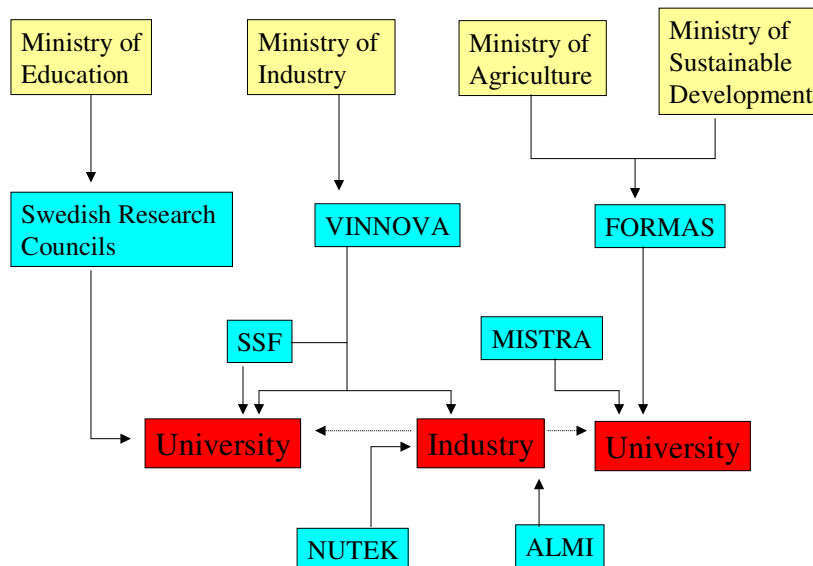
Finally, there are semi-public research foundations, which have a high degree of independence from the Government regarding the direction of their R&D (regardless of the fact that their management board is appointed by the Government). Overall, they allocate around 163M EUR (SEK 1500M) for R&D (2005). There are currently six national semi-public foundations, among which the *Knowledge Foundation* (KKS) and the *Swedish Foundation for Strategic Research* (SSF) are of particular importance in terms of their share of all the R&D investments made by the foundations. The KKS promotes a broad use of IT in society and supports research at Swedish universities, while SSF supports strategic research in natural sciences, engineering and medicine. Another foundation that is relevant in the context of support for biotechnology research is the *Foundation for Strategic Environmental Research* (MISTRA) aimed at supporting research related to environmental problems (see Sandgren, 2005, and Thorslund *et al.*, 2004).

Actors involved in performing R&D: Most publicly financed R&D is performed by universities and financed by the Ministry of Education. The Swedish universities receive around 1,196M EUR (SEK 11,000M) for R&D from public funding (in 2005) and focus mainly on curiosity-driven research. The institute sector, which has a focus on mission-oriented R&D is marginal in Sweden. This means that Swedish universities are supposed to take responsibility for mission oriented R&D, as well as being active in the transfer of knowledge to Swedish society (Sandgren, 2005).

Actors with a focus on commercialisation and entrepreneurship: The most important actors benefiting from public financing (under the Ministry of Industry) in order to promote entrepreneurship are: the National Agency for Swedish Agency for Economic and Regional Growth Development (NUTEK), ALMI Business Partner (ALMI), the

Innovation Bridge, and the Invest in Sweden Agency (ISA). NUTEK's mission changed in 2001 when a large portion of its former responsibilities were transferred to VINNOVA. Since then it has been responsible for promoting entrepreneurship, co-ordinating the work of the regional growth programmes, and guiding entrepreneurs regarding business activities. ALMI's mission is to provide market oriented advice and financing to help during the different phases of a business (particularly, innovative SMEs). It consists of a parent company, owned by the government, and 21 regional ALMI offices. The Innovation Bridge was established in 2005 as a national state-owned consortium with regional offices with the objective of providing management and seed capital in order to improve the survival rate among high-tech start-ups. Finally, ISA assists and informs foreign investors about business opportunities in Sweden (Sandgren, 2005).

Figure 1 The Swedish national system of biotechnology research funding



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

2.1 Introduction

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

Policy-directed funding includes funding which is 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 *et cetera*. 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 system of research councils are included.

This chapter presents the funding of biotechnology research through policy and non-policy-directed instruments and of biotechnology commercialisation through policy-directed instruments. Data were collected through desk research (publications, documents, websites of national and regional public funding organisations and/or governmental departments), surveys completed by 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 websites of the funding organisations and their programs and the names of contact persons that participated in the survey and/or who 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 an important role in funding of biotechnology research in some countries; they will be addressed in section 2.4. The final section provides a short overview of the European funding of biotechnology research in Sweden through the 6th Framework Program.

2.2 Non-policy-directed funding of biotechnology research

Table 2.1 summarises the funding organisations responsible for non-policy-directed funding for biotechnology research. In the period 2002-2005 they allocated 69.6M EUR to this research. The biotech research activities of each of the organisations concerned is discussed in more detail below.

Table 2.1 Non-policy-directed funding of biotechnology research (M EUR)

Funding organisation	Public Research Institutions / Response Mode programs	Period	Funds
Swedish Research Council	Response mode project grants	2002-05	51.8
Swedish Research Council	Infrastructure / equipment grants	2002-05	12.1
MISTRA	Open calls	2002-05	5.7
Total			69.6

Source: BioPolis Research

2.2.1 Swedish Research Council (VR)

The Swedish Research Council (VR) is the most important contributor to non-policy-directed funding for biotechnology research in Sweden. Based on information provided by the Swedish Research Council for research funding commitments on projects initiated over the period 2002-2005 within the areas of Natural & Engineering Sciences and Medicine we have estimated that about 51.8M EUR (476M SEK) were devoted to research projects related to biotechnology.³

In addition to these project grants, the Swedish Research Council also provided funding support for infrastructure and equipment grants in the area of biotechnology. This instrument represented an expenditure of 12.1M EUR (111M SEK).

2.2.2 Swedish Foundation for Strategic Environmental Research (MISTRA)

The Swedish Foundation for Strategic Environmental Research (MISTRA) supported research in biotechnology through an open call system, amounting to 5.7M EUR over the period 2002-2005. This investment was distributed across four projects: Microbial Activity for a Sound Environment (MASE) and Microbial Antagonism; DOM; BIOSINGAL; and Marine Paint.

2.3 Policy-directed funding of biotechnology research and commercialisation

Policy-directed funding of biotechnology research is carried out at the national level by the generic instruments of four organisations: SSF, VINNOVA, FORMAS and MISTRA. SSF and VINNOVA. Table 2.2 summarises the instruments used and the budgets allocated by each of these instruments. No information was available about any

³ This estimate is based on information at project level provided by keywords and project summaries. Most of the projects classified as biotechnology belong to the scientific areas of Bioteknik (in Natural and Engineering Sciences) and Genetik (in Medicine). However, a large proportion of the projects came from a wide range of scientific areas such as: Cell and molecular biology, Biochemistry and Biophysics, Ecology and diversity, Biochemical Structure and Metabolism, etc.

regional policy-directed instruments. Note that the majority of funds (over 70%) are allocated through generic programmes.

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

Instrument	Funding organisation	Budget (M EUR)	% of total	Use of DF/SF
National				
<i>Generic</i>				
Network Programmes	SSF	9.9	13.1	None
Strategic Research Centres	SSF	13.7	18.1	None
Individual Grants	SSF	6.5	8.6	None
International Collaborations	SSF	2.5	3.3	None
Competence Centres	VINNOVA	9.0	11.9	None
VINNVAXT	VINNOVA	10.9	14.4	None
VINST Programme	VINNOVA - SSF	2.0	2.6	None
Sub-Total		54.5	71.8	
<i>Biotech specific</i>				
Risk Assessment	FORMAS	1.3	1.7	None
Biotech. for the Environment	MISTRA	2.0	2.6	None
Framework Grants	SSF	3.3	4.4	None
Research Programmes	VINNOVA	14.8	19.5	None
Sub-Total		21.4	28.2	
Total		75.9	100	

Source: BioPolis Research

2.3.1 The Swedish Agency for Innovation Systems (VINNOVA)

The Swedish Agency for Innovation Systems, VINNOVA, is a government agency with the mission of promoting sustainable growth in Sweden by means of problem-oriented research and the development of effective innovation systems. In VINNOVA's strategic plan for the period 2003-2007, biotechnology is identified as one of four knowledge platforms of significance for sustainable growth. Furthermore, VINNOVA has identified a number of priority areas for sustainable growth, several of which involve biotechnology: pharmaceuticals and diagnostics, industrial biotech, innovation in foods, green materials from renewable resources, and biomedical engineering. In the rest of this section describes the main initiatives from VINNOVA to support research in biotech. VINNOVA also jointly supports VINST with SSF (described in section 2.3.3 below).

- Research Programmes

VINNOVA has been running a set of biotech-specific programmes that make calls for research proposals in the following areas: (i) Examination of ideas for new concepts in small biotech companies (New Concepts); (ii) Innovation in foods; (iii) Green materials; and (iv) Pharmaceutical and diagnostics.

New Concepts is directed to small biotech companies wanting to broaden their product portfolio. The programme has been running since 2003 and has provided funding for over 20 projects with an approximate overall budget for the period 2003-2005 of 2M EUR (approximate 2M EUR - SEK 18M). The main policy goals covered by this programme are: the adoption of biotechnology for new industrial applications and to

promote business investments in R&D. Most of the companies supported by this programme are in the area of pharmaceuticals and diagnostics.

Innovations in Foods launched in 2003, supports contributions to medical, biological and biotechnological knowledge that stimulate the development of innovations in the food industry. Calls are made for co-operative proposals from researchers, companies and other actors that will contribute multi-disciplinary knowledge required for the development of innovative food products with health-promoting characteristics. Industrial partners must participate in these projects and contribute 20-50% of the total budget. Between 2003 and 2004, 9 projects have been selected representing a total budget of 4.4M EUR (SEK 40M). Four main policy goals are covered in this programme: the support of high level industry-oriented research, transmission of knowledge from academia to industry, the adoption of biotechnology for new industrial applications, and the promotion of business investment in R&D. The majority of the projects funded in this programme are in the areas of food biotechnology and health biotechnology.

Green Materials aims to encourage research that shows the potential to produce innovative materials, products and manufacturing processes from trees and crops. An initial call for proposals took the form of a Demonstrator-Programme in 2003. Another call was made in 2004. Seven projects have been funded accounting for a budget of 3.2M EUR (SEK 35M). The projects require active co-operation between academia and companies. Four main policy goals are covered in this programme: the support of high level industry-oriented research, transmission of knowledge from academia to industry, the adoption of biotechnology for new industrial applications, and the promotion of business investment in R&D. The application areas of most of the projects funded within this programme are environmental biotechnology and plant biotechnology.

Pharmaceutical and Diagnostics, launched in 2004, aims to link different scientific disciplines, i.e. medicine, biology, IT and engineering, and requires a clear indication of the commercial potential of the research and co-financing from industry of 20-50% of the total budget. The objective is to support research collaboration between academia and companies in pharmaceuticals and diagnostics, for projects involving a minimum of three different scientific disciplines and at least one company. Nine projects were accepted in 2004, accounting for a budget of 5.2M EUR (SEK 48M). Four main policy goals are covered in this programme: the support of high level industry-oriented research, transmission of knowledge from academia to industry, the adoption of biotechnology for new industrial applications, and the promotion of business investment in R&D. The application areas of the projects fall almost entirely in health biotechnology. Table 2.3 summarises the information provided above.

Table 2.3 Total allocated budgets for projects funded in VINNOVA's Biotech-related Programmes (2002-05) (M EUR)

	Total Budget
New Concepts 2003 – 05	2.0
Innovations in Foods 2003-04	4.4
Green Materials 2004	3.2
Pharmaceuticals & Diagnostics 2004	5.2
Total	14.8

Source: BioPolis Research based on data provided by K. Nordqvist (VINNOVA)

- Competence Centres

The Competence Centres programme is a long-term generic effort to strengthen the link between university and industrial research in Sweden. The aim is to achieve a stronger industrial impact and concentration of resources by creating multidisciplinary academic research environments in which industrial companies participate actively. The initiative was first proposed to the Government in 1992 by the former NUTEK (Swedish National Board for Industrial and Technical Development). In 1993, the Government commissioned NUTEK to make a call for proposals to universities, and clearly stated that a main selection criterion was the number of industrial partners financially supporting and actively participating in the proposed Centre's activities. This led to the first generation of the programme, comprising 28 Competence Centres, which started their activities in 1995. The programme will end during 2006. Since January 2001 the programme has been jointly managed by VINNOVA and the Swedish Energy Agency. Several evaluations of the Competence Centre initiative found it to be successful. As a result, VINNOVA intends to establish 25 new Centers, under the new brand VINN Excellence Centers, and made a call for proposals in mid 2005; 3 to 5 of the new Centers are expected to conduct research in biotech-related fields.

Among the 28 Competence Centres in existence, 7 have a strong focus on biotechnology. They are: Centre for Bioprocess Technology (CBioPT), Centre for BioSeparation (CbioSep), Research Centre for Radiation Therapy, Competence Centre for Non-Invasive Medical Measurements (NIMED), Centre for Surfactants based on Natural Products (SNAP), Centre for Amphiphilic Polymers from Renewable Resources (CAP) and Wood Ultrastructure Research Center (WURC). Table 2.4 lists the 7 competence centres, the main area of biotech research conducted in each centre and the total funding contributed by VINNOVA per year. While CbioPT and CbioSep could be considered as fully focused on biotechnology, all the others consider biotechnology as part of their research objectives (around 25-33% of their overall research activities). Taking this into account, Table 2.2 indicates that VINNOVA's contribution to biotechnology research in Competence Centres amounts to around 9M EUR (SEK 83 millions) over the period 2002-2005.

Table 2.4 Competence Centres in Biotechnology-related areas

Competence Centres	Main application areas	Annual VINNOVA funding (M EUR)
CbioPT	Industrial Biotech	0.65
CbioSep	Industrial Biotech	0.65
NIMED	Health Biotech	0.65
Research Centre for Radiation Therapy	Health Biotech	0.65
SNAP	Basic Biotech. / Environmental Biotech.	0.65
CAP	Basic Biotech. / Environmental Biotech.	0.65
WURC	Basic Biotech. / Environmental Biotech.	0.65

Source: BioPolis Research based on data provided by K. Nordqvist (VINNOVA).

These Centres have met a broad range of policy goals. They combine a high level of biotechnology research with industry-oriented research. The number of joint papers with industry and records of new firm creation show that transmission of knowledge from academia to industry, business investment in R&D, and creation of new firms have also been policy goals well covered by this initiative (see Sandgren, 2005). Many

application areas are covered by the Centres: basic and industrial biotechnology, together with health and environmental biotechnology.

- VINNVAXT Programme

VINNVAXT, a generic regional innovation programme (complementary to the Government's Regional Growth Programmes) was introduced in 2002. Its objective is to promote efficient collaboration in functional (rather than administrative) regions between companies, research institutions and public organisations. VINNVAXT is built around the idea of stimulating regional growth through dynamic innovation systems.

Four regional bio-related initiatives have been granted financing for 10 years.

Uppsala Bio: Uppsala has achieved a unique position in the world within biotechnology, leading to innovations in the areas of pharmaceuticals, diagnostics and biomedical technology. VINNOVA's funding should support the provision of skills, an innovative environment and the region's visibility in order to enhance the opportunities faced by Uppsala to become one of the world innovative leaders in biotech and to stimulate regional growth.

Innovation Gransland: the objective of this initiative is to increase the return on investment in the food sector enhancing the development of knowledge and competence in areas such as: food and health, international consumer marketing, innovative convenience food systems, etc.

Livets Nya Verktyg: the New Tools for Life initiative attempts to make the region of Ostergotland a major international player in the development of individually designed, innovative health products related to distributed care, personal care, personal health and sport.

Biomedical development in Western Sweden (Goteborg Bio): the aim of the project is to create a solid base for long-term growth in the biomedical field within the region of Goteborg. The project has four focused areas: support business involved in R&D within biomaterials, cell therapy, and cardiovascular and metabolic diseases; educate and train future leaders in advanced business development within the biomedical field; develop and reinforce the infrastructure for the commercial development of projects within the biomedical field; and attract expertise and capital to the biomedical field within the region.

These initiatives have been in place either from 2003 or 2004, as Table 2.5 indicates. The overall amount of funding channelled through VINNVAXT for bio-related initiatives is approximately 11M EUR (SEK 100M). The policy goals covered include availability of human resources, the adoption of biotechnology for new industrial applications, encouraging business investment in R&D and transmission of knowledge from academia to industry.

Table 2.5 VINNVAXT Biotech Initiatives

VINNVAXT winners	Main application areas	Annual VINNOVA funding (M EUR)
Uppsala Bio (2003)	Health Biotech.	1.1
Innovation Gransland (2003)	Food Biotech.	1.1
Livets NYA-VERKTYG (2004)	Health Biotech.	1.1
Goteborg Bio (2004)	Health Biotech.	1.1

Source: BioPolis Research based on data provided by K.Nordqvist (VINNOVA).

2.3.2 The Swedish Foundation for Strategic Research (SSF)

The SSF's current programme structure is based on a strategic plan adopted in 2001, and consists of three main policy instruments for funding research: (1) Strategic Research Centres; (2) Framework Grants; and (3) Individual Grants. SSF has also continued to support its Network Programmes. All these instruments were initiated well before 2001. SSF has no specific initiative that targets biotechnology research; however, its research strategy aims to support strategic areas such as biotechnology, materials research and IT. For this reason we consider all biotech research supported by SSF through their research programmes as policy-directed, generic funding.

- Network Programmes

Network Programmes funds networks of research groups across Swedish universities, involved in large-scale, long-term research projects and the training of graduates and post-graduates. Within life sciences, the Network Programmes that are connected to research in biotech are listed in Table 2.6. Regarding the budget of each programme, the table reports the actual amount of funding allocated to each programme on an annual basis for the period 2002-2005. This shows a total of about 9.9M EUR (SEK 90.9 millions) allocated by SSF to Network Programmes, over the period 2002-2005.

Table 2.6 shows that about two-thirds of the funding is allocated to programmes in basic research. health biotech, plant biotech, and non-technical biotech account for the rest of the Network Programmes funded.

Table 2.6 Network Programmes: overall budgets (SEK M) and areas of application

Network Programme	2002	2003	2004	2005	Total Budget **	Total Budget SEK M	Application area
Biocompatible Materials 1996-2003	3	8	---	---	11	1.2	Basic/ Health
Cell Factory Functional Genomics 1998-03	4.5	3	---	---	7.5	0.8	Basic
Developmental Biology 1997-2003	9	5	---	---	14	1.5	Basic
ELSA 1999-present *	6	3	1	---	10	1.1	Non-tech
Gene Therapy 2000-present	0	3	3	0	6	0.7	Health
Genome Research 1998-present	19.5	3	0	0	22.5	2.4	Basic
Molecular & Cellular Plant Biotech. 2002-05	1	1.5	1.5	1.5	5.5	0.6	Plant
Nucleic Acid Research 1998-2003	6	6	---	---	12	1.3	Basic
Structural Biology 1996-present	2.4	0	0	0	2.4	0.3	Basic
Total	51.4	32.5	5.5	1.5	90.9	9.9	

* Ethical, Legal and Social Aspects of Genome & Gene Technology Research

** Total Budget for the period 2002-2005

Source: BioPolis Research based on data provided by I. Florin (SSF).

- Strategic Research Centres

Strategic Research Centres have been established in universities to provide settings for interdisciplinary research of the highest international standard and of strategic relevance for present and future industry.

Table 2.7 shows the Research Centres in Life Sciences that conduct research in the field of biotech, and the funding of the Research Centres by SSF over the period 2002-2005. While the first three Research Centres in Table 2.7 conduct almost 100% of their research in the biotechnology area, in the other two, biotechnology research represents about a third of their research activities. An estimate of the total budget for biotech research through this programme, is 14M EUR (SEK 126 millions) for the period 2002-2005.

Table 2.7 Research Centres: biotech budgets and areas of application (SEK M)

Name of Research Centres in Biotech-related areas	2003	2004	2005	Total 2002-05	Application area
Developmental Biology 2003-08	12	14	14	40	Basic/Health
Developmental Biology of Plants 2003-08	12	14	14	40	Plant/Industrial
Stem Cell Biology & Cell Therapy 2003-08	8	10.5	10	28.5	Basic /Health
Centre for Infectious Medicine 2003-08	10	10	10	30	Health
Rational Approaches to Pathogen Inhibitor Discovery 2003-2008	9	5.5	10	24.5	Basic/Health
Total	51	54	58	163	

Source: BioPolis Research based on data provided by I.Florin (SSF).

- Framework Grants

Framework Grants support university researchers to undertake limited research initiatives in strategically important areas, and their duration is often about 3 years. The grants are for smaller projects than those funded by Network Programmes and Strategic Research Centres. SSF makes calls for research proposals in specific topics. In the Life Sciences, this included a call in the area of Comparative functional genomics in 2002. Grants of 0.33M EUR (SEK 3M) each for the period 2004-2006 were made to ten applications in the areas of basic, health, animal and plant biotechnology. Over the period 2004-2005 the actual expenditure for these ten Framework Grants amounted to 1.2M EUR (SEK 10.9M).

- Individual grants

SSF supports two types of individual grants: Individual Grants for Advancement of Research Leaders (INGVAR) and Senior Individual Grants. The objective of INGVAR is to identify, support and promote younger scientists expected to become future scientific leaders in academic and industrial research. The first year of operation of this programme was 2001 (with a total budget of 34.9M EUR - SEK 321M). The value of an individual grant is 1.1M EUR (SEK 10M) over six years. The value of INGVAR grants in the biotech area for the period 2002-2005 was 3.1M EUR (SEK 28.1). The Senior Individual Grants programme, which started in 1997, aims to stimulate the research and education of postgraduates by prominent researchers. The value of Senior Individual Grants in the biotech area for the period 2002-2005 was 3.4M EUR (SEK 31.3). Individual grants are mainly in the areas of Industrial Biotech and Health Biotech, and their policy goals are to support high-level biotech research and the availability of human resources. Over the period 2002-2005, SSF provided 6.5M EUR (SEK 59.4M) for individual grants in biotech-related research to support

- Grants for International Collaboration

Grants for International Collaboration is a policy instrument that started in 2001. It aims to maintain and strengthen research quality; in other words it seeks to achieve a high level of research. In the period 2002-05 grants for biotech research included six grants for collaboration with *Genome Canada* totalling around 1.6M EUR (SEK 15M), and five grants totalling 0.9M EUR (SEK 8M) within the programme *Microbes and Man* (MICMAN) - a bilateral collaboration with the Academy of Finland. The projects granted through this scheme can be classified in health, basic and plant biotechnology and the total amount for biotech in the period amounted to 2.5M EUR.

2.3.3 SSF/VINNOVA: VINST Programme

In 2001, the SSF and VINNOVA jointly launched the programme VINST, Researchers in Collaboration with Smaller High-tech Companies to promote economic growth. The first grants were awarded during 2002. Projects must be conducted in collaboration between researchers at Swedish universities (or research institutes) and companies with research and/or advanced development activities. The programme is jointly managed and funded by SSF and VINNOVA; each has allocated 3.3M EUR (SEK 30M) to this programme.

The maximum amount awarded to each grant is 0.44M EUR (SEK 4M) and they generally run for 3 years. Twenty-one proposals have been approved by this programme so far, and around 6.5M EUR (SEK 59M allocated). Six of these projects are for research in the area of biotechnology, and the overall budget awarded to them in the period 2002-2005 amounts to 2M EUR (SEK 18.7M). All the focus on health applications.

2.3.4 The Swedish Foundation for Strategic Environmental Research (MISTRA)

MISTRA funds and organises research aimed at solving strategic environmental problems and judges research programmes a success when scientifically advanced research has been put to practical use in companies. The majority of its research is non-policy-directed (see section 2.2. above). However it also funds research through calls for specific programmes.

In 2001 MISTRA introduced a programme Biotechnology for the Environment, and selected the project *Greenchem* from the proposals submitted. It was awarded a budget of 2.6M EUR (SEK 24M) for the period 2003-2006, or 2M EUR (SEK 18M) for the period 2002-2006. *Greenchem* is in the area of environmental biotechnology, and addresses policy goals of a high level of biotechnology research and the availability of human resources.

2.3.5 The Swedish Research Council for Environmental, Agricultural and Spatial Planning (FORMAS)

FORMAS is a research funding agency related to several ministries: the Ministry of Sustainable Development, the Ministry of Agriculture, Food and Consumer Affairs, and the Ministry of Education, Research and Culture. It encourages and supports scientific research related to sustainable development in a wide range of approaches from basic to

applied research, as well as demonstration and experimental projects. Research support is given to universities, university colleges and research institutes in Sweden. Swedish authorities with research undertakings and their own research staff may also be considered.

The priorities of FORMAS are reflected in special Key Action Areas. In 2001, FORMAS announced the decision to give priority to research interaction between different scientific fields and disciplines in three areas. One of these areas was Risks and Risk Assessment: Developments in Biology and the Land-Based Industries. Approved proposals were supported for a maximum of 4 years and commenced in mid 2002, and launched a call for projects under the title. Four biotech projects have been funded. This programme has the policy objectives of contributing to a high level of biotechnology research, knowledge flow and collaboration among scientific discipline and risk assessment. It covers plant, animal, environmental and food biotechnology and projects were allocated a total budget for the period 2002-2005 of 1.3M EUR (SEK 12M).

2.4 Charities

In Sweden there are a number of charities which support research in the biomedical field. The three most relevant charities are: the Cancerfonden (The Swedish Cancer Foundation), the Hjärt-och Lungfonden (Swedish Heart and Lung Foundation) and the Knut and Alice Wallenberg Foundation (KAW). KAW supports research in areas other than biomedical research, such as natural science and the humanities. Data on research funding was not available for the period considered (2002-2005). According to information on charities reported in the Inventory Report (1999), Swedish charities' share of total biotechnology research funding was about 27%. Following the approach of the Inventory report, it could be estimated that Swedish charities' contribution to biotech-related research is about 40M EUR (370M SEK) over the entire period considered.

2.5 Participation in 6th FP and use of development funds

Table 2.8 Involvement of Sweden in biotechnology/life sciences programmes of the 6th Framework Program

Sixth Framework Programme	Participation as project manager in # of projects (% of total)	Participation as member of the project team (% of total)
Nanobio	3 (25)	6 (5.7)
Life Sciences for Health	52 (6.9)	465 (5.4)
Food Quality and Safety	3 (3.3)	57 (3.6)

Source: BioPolis Research

Sweden acted as the coordinator of 58 European Commission 6th Framework Programme projects: it was coordinator of 52 projects in the Life Sciences for Health thematic priority, 3 projects in Nanobio and 3 projects in the Food Quality and Safety. It provided six partners to projects under the Nanobio thematic priority, 465 partners to Life Sciences for Health, and 57 partners to Food Quality and Safety. In all cases,

Swedish participation is above its demographic weight compared to EU total population, and very much above it in terms of the management of Nanobio projects.

3. Performance Indicators

3.1 Introduction

This chapter analyses the performance of the Swedish biotechnology innovation system for two or three time periods (depending on data availability) as shown by a range of indicators for scientific and commercialisation performance. Each time period includes several years, to avoid capturing erratic trends. National trends are benchmarked against the performance of the EU-25 Member States and the US.⁴ Indicators show a very strong biotechnology innovation system that performs above or at the European average in most instances.

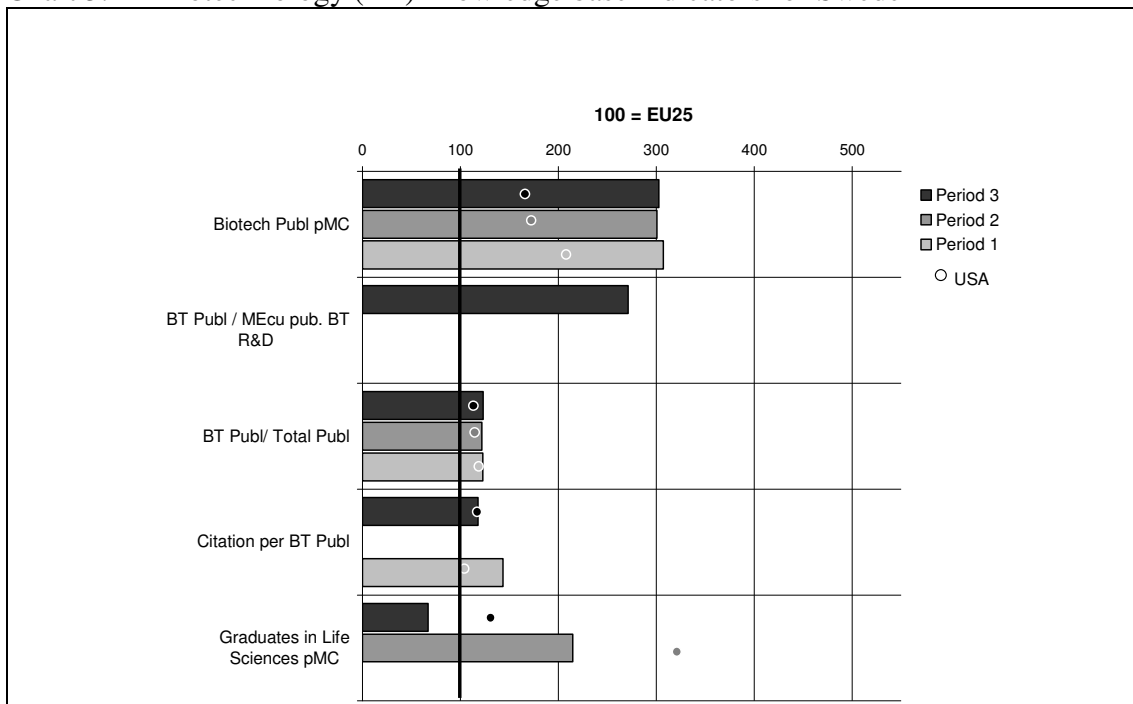
The presentation of performance is structured along the four main areas of the Innovation System: the knowledge base, processes of knowledge transmission and application, industrial development and markets for biotechnology based products. For each area a comparison of a number of different indicators for Sweden, the USA and EU25 is shown. To establish a comparison, the values of EU25 have been chosen as a reference for each indicator. The absolute figures that are used to calculate the values for the indicators presented in this chapter and the sources for the data can be found in Annex 5. The periods chosen can vary considerably between the indicators; table A.5.1 presents the specific years of each period for each indicator.

3.2 Creating a knowledge base and supporting the availability of human resources

As Chart 3.1 shows, Sweden has a very strong knowledge base; it is well above the EU-25 average for most of the biotechnology knowledge base indicators, with the exception of ratio of graduates per million capita (in the period 2002-04). Sweden remains very well positioned regarding its performance in the generation of biotechnology publications. It is above the EU-25 average both in the quality of its publications, as measured by citations to biotech publications and in terms of the proportion of biotech publications relative to total publications.

⁴ For a detail discussion on the strengths and limitations of science and technology indicators see Moed et al (2004).

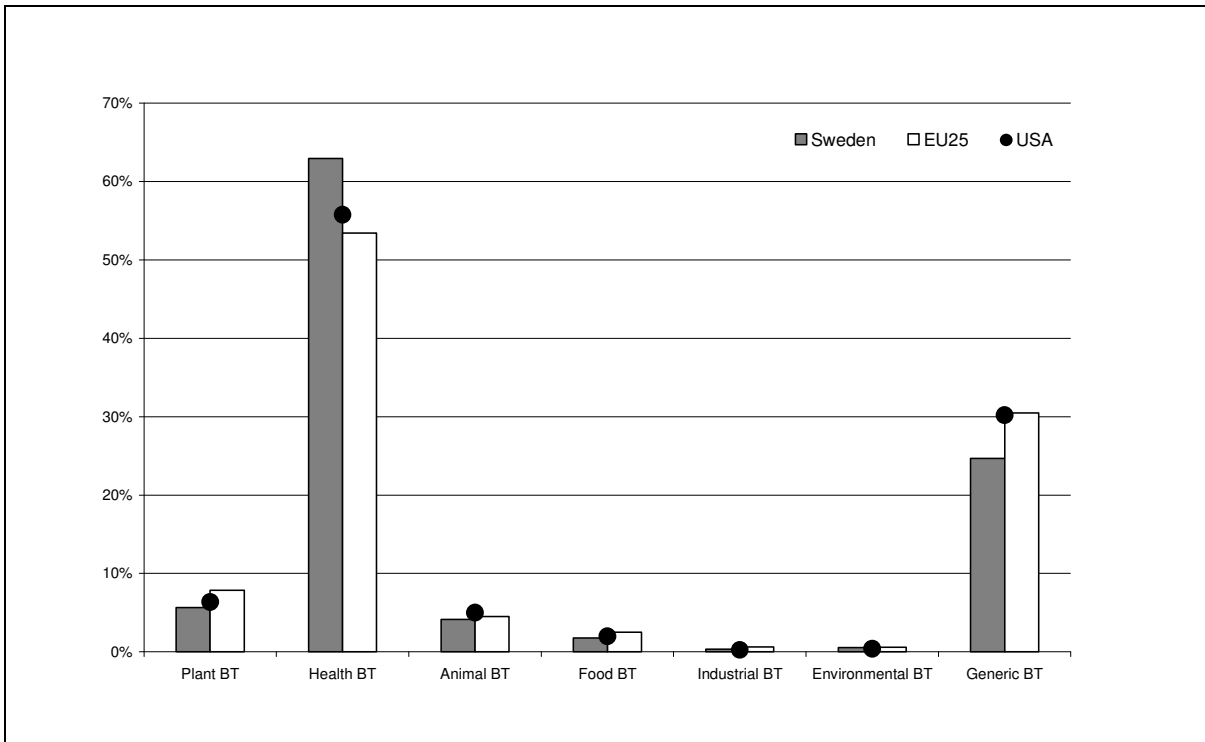
Chart 3.1 Biotechnology (BT) knowledge base indicators for Sweden



Source: BioPolis Research

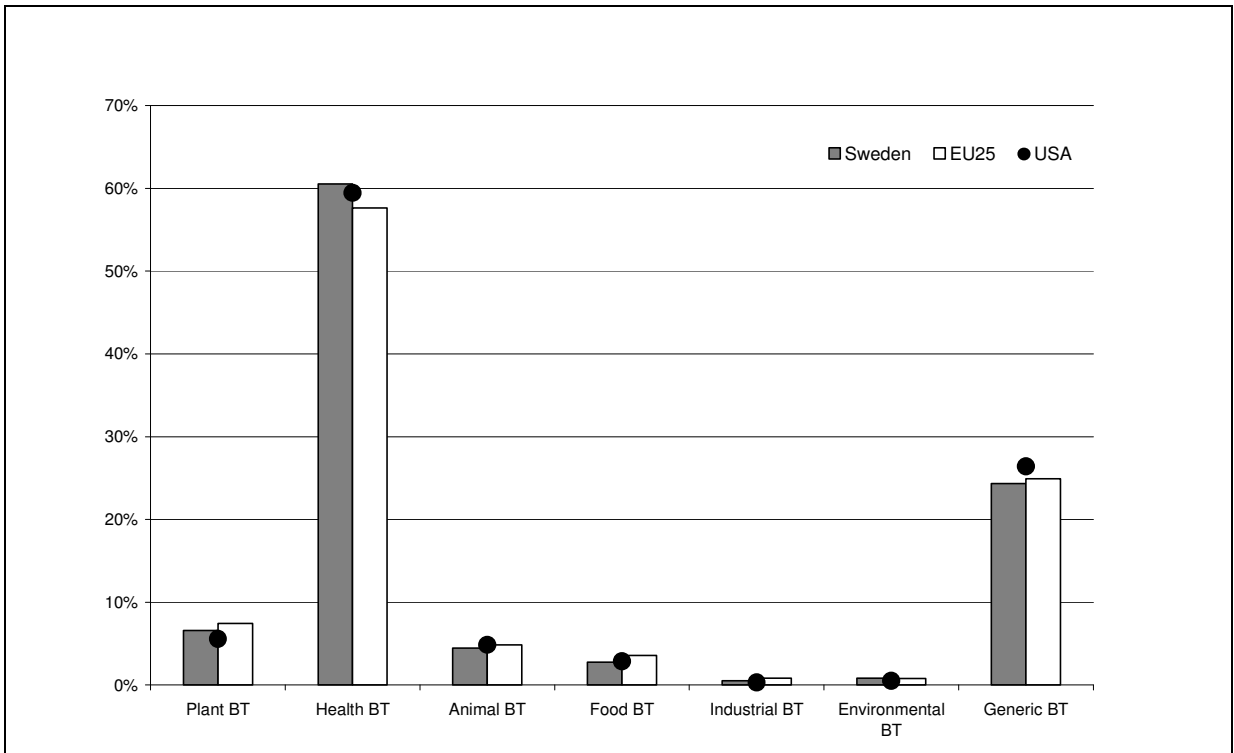
Charts 3.2.1 and 3.2.2 show that health biotech and generic biotech account for the largest share of publications in both periods. Swedish biotechnology publications display a similar distribution across biotech fields compared to the average EU-25 and US. However, Swedish indicators of biotechnology publications show higher growth rates in almost all biotechnology fields, with the main exception of health biotechnology and, to a lesser extent, in animal biotech, as shown in Chart 3.3.

Chart 3.2.1 Share of Swedish publications across biotechnology sub-fields 1994-1996



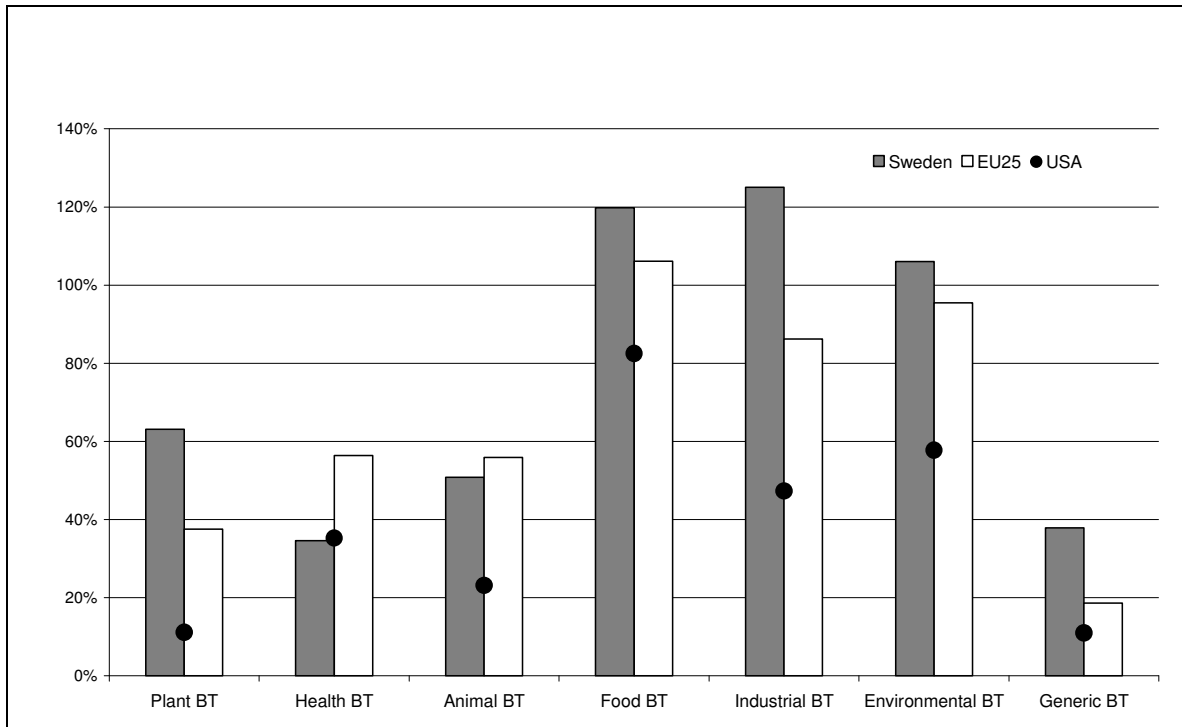
Source: BioPolis Research

Chart 3.2.2 Share of Swedish publications across biotechnology sub-fields 2002-2004



Source: BioPolis Research

Chart 3.3 Biotechnology subfields: growth rates of Swedish publications between 1994/96 and 2002/04

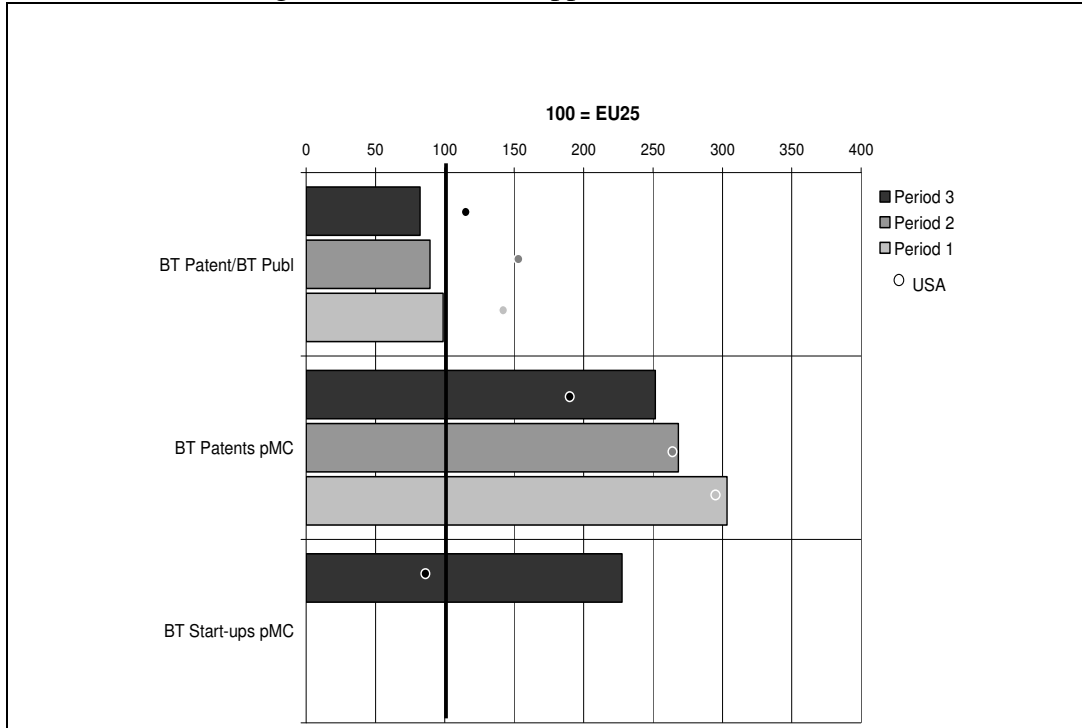


Source: BioPolis Research

3.3 Performance in knowledge transmission and application

For all indicators regarding knowledge transmission and application, Sweden's performance indicators are above the EU-25 average, as shown by Chart 3.4. However, there is a decreasing trend in biotech patenting both in terms of biotech publications and per million capita. Swedish start-ups per million capita are outstandingly high compared to the EU-25 average and US (i.e. in the period 2001-2003 there were 29 biotech start-ups in Sweden).

Chart 3.4 Knowledge transmission and application: Sweden

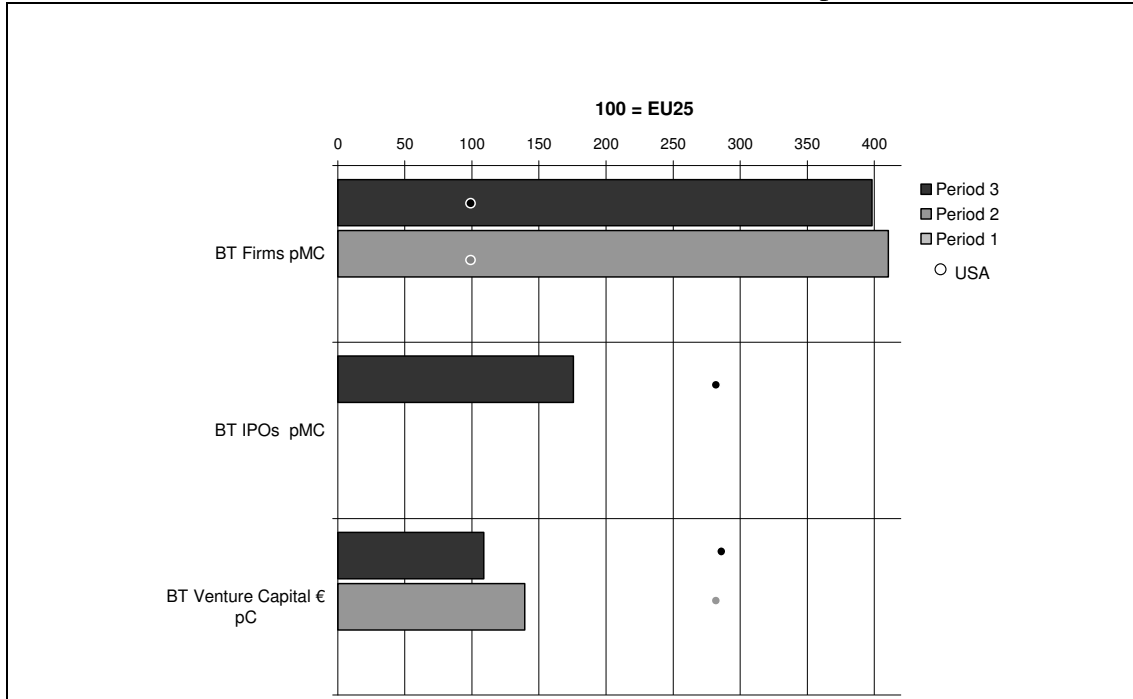


Source: BioPolis Research

3.4 Industrial development

The industrial development performance indicators in Chart 3.5 show that Sweden performs well above the EU-25 average in both the number of biotech firms and biotech IPOs per million capita. However, Sweden is just at the EU-25 average in terms of biotech venture capital per million capita, and is far below the US.

Chart 3.5 Performance Indicators Sweden's Industrial Development

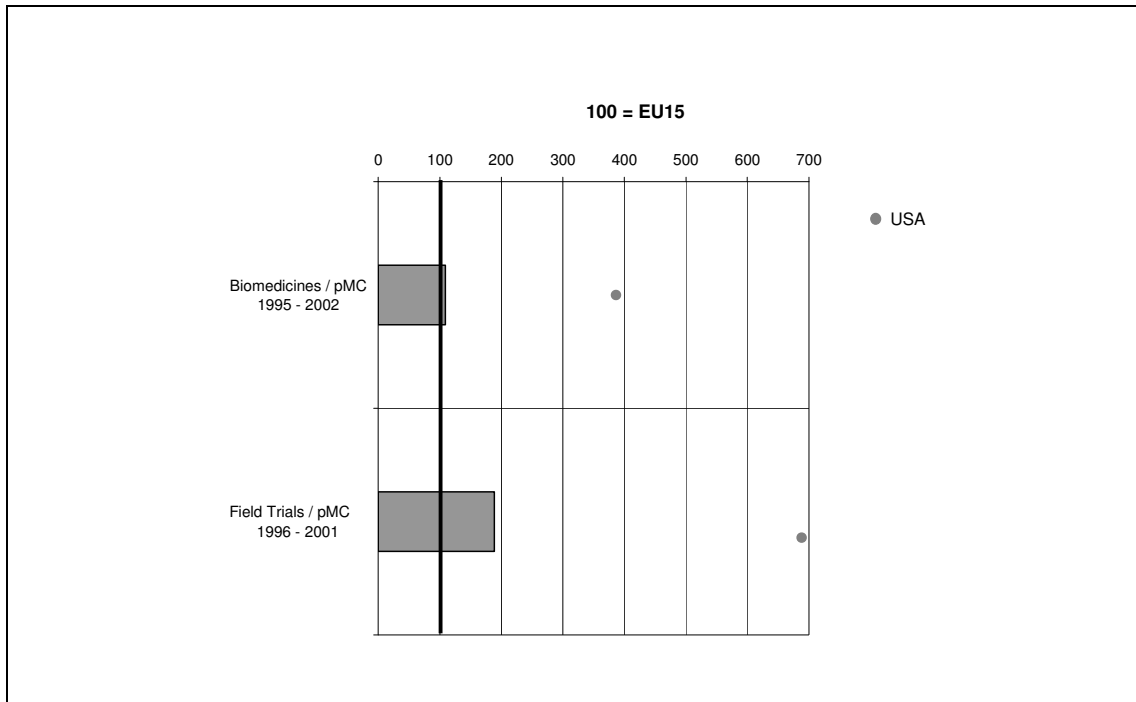


Source: BioPolis Research

3.5 Market conditions

Regarding indicators for market conditions, the number of biomedicines approved by the European Agency for the Evaluation of Medicinal Products (EMA), that originated in Sweden per million capita corresponds to the EU-25 average for which the index has been set at 100. Additionally, Sweden, with an index of 188 for field trials of GM crops is well above the EU-25 average.

Chart 3.6 Performance Indicators Sweden Market Conditions



Source: BioPolis Research

4. Conclusions

4.1 Introduction

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

4.2 Public funding of biotechnology through policy instruments

Table 4.1 shows that almost half the 145.5M EUR funding for biotechnology research in the period 2002-2005 came from non-policy-directed instruments. Moreover, the majority of funding for policy-directed instruments was from generic programmes (more than two-thirds) and biotech-specific instruments account for only 14.7% of all biotech funding.

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

	2002	2003	2004	2005	Total
RESEARCH					
1. Non-policy-directed					
Response Mode	-	-	-	-	57.5
Infrastructure/equipment Grants	-	-	-	-	12.1
Total	-	-	-	-	69.6
2a. Policy-directed Generic					
National	-	-	-	-	41.5
Regional	-	-	-	-	-
Total	-	-	-	-	41.5
2b. Policy-directed Biotech-specific					
National	-	-	-	-	9.6
Regional	-	-	-	-	-
Total	-	-	-	-	9.6
COMMERCIALISATION					
1a. Policy-directed Generic					
National	-	-	-	-	12.9
Regional	-	-	-	-	-
Total	-	-	-	-	12.9
1b. Policy-directed Biotech-specific					
National	-	-	-	-	10.5
Regional	-	-	-	-	-
Total	-	-	-	-	10.5
OTHER					
1a. Policy-directed Generic					
National	-	-	-	-	0.1
Regional	-	-	-	-	-

	2002	2003	2004	2005	Total
Total	-	-	-	-	0.1
1b. Policy-directed Biotech-specific					
National	-	-	-	-	1.3
Regional	-	-	-	-	-
Total					1.3
GRAND TOTALS	-	-	-	-	145.5

Source: BioPolis Research

4.3 Specific features of the instruments

Table 4.2 provides further information about the organisations responsible for specific instruments and, where relevant, whether the recipients of grants or other public authorities are required to contribute a proportion of the costs.

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

Instrument	Funding agency	Participants/Recipients			Financial contribution required (%)	
		PROs	SMEs	LFs	Recipients	Other Public authorities
National						
<i>Generic</i>						
Network Programmes	SSF	√				
Strategic Research Centres	SSF	√				
Individual Grants	SSF	√				
Competence Centres	VINNOVA	√	√	√		
VINNVAXT	VINNOVA	√	√	√		
VINST Programme	VINNOVA - SSF	√	√			
International Collaborations	SSF	√				
<i>Biotech specific</i>						
Risk Assessment	FORMAS	√				
Biotech. for the Environment	MISTRA	√				
Framework Grants	SSF	√				
Research Programmes	VINNOVA	√	√	√	√	

Source: BioPolis Research

4.4 Policy goals

Table 4.3 shows the policy goals that are covered by directed instruments and funding by policy goal for the period 2002-2005. The majority of funding is allocated to achieving a high level of biotechnology research.

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

	1*	2	3	4	5	6	7	8	9	10
National										
<i>Generic</i>										
Competence Centres	√	√			√		√		√	
VINNVAXT				√	√	√			√	
Network Programmes	√		√	√				√		
Strategic Research Centres	√	√	√	√	√					
Individual Grants	√			√						
VINST Programme	√	√			√				√	
International Collaboration	√		√							
Total	17.5	5.5	7.3	11.4	5.8	2.2	1.0	0.1	3.8	0.0
<i>Biotech specific</i>										
Research Programmes		√		√	√	√			√	
Framework Grants	√			√						
Biotech. for the Environment	√	√				√				
Risk Assessment			√							√
Total	3.7	3.6	0.0	2.1	1.6	4.7	0.0	0.0	4.2	1.3
Grand Total	21.2	9.2	7.3	13.5	7.4	6.9	1.0	0.1	8.0	1.3
% of GrandTotal	27.9	12.1	9.6	17.8	9.7	9.1	1.3	0.1	10.5	1.7

*1 = High level of biotechnology research

2 = High level of industry-oriented (and applied) research

3 = Knowledge flow and collaboration among scientific disciplines

4 = Availability of human resources

5 = Transmission of knowledge from academia to industry and its application to industrial resources

6 = The adoption of biotechnology for new industrial applications

7 = Firm creation

8 = Social acceptance of biotechnology

9 = Business investment in R&D

10= Bio-safety, Risk assessment

Source: BioPolis Research

4.5 Biotech research application areas

Table 4.4 shows the application areas of biotechnology funded by each policy instrument as far as this information was provided. Only four application areas are funded and basic biotechnology and health biotechnology research receive higher proportions of this funding than either plant or animal biotechnology.

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)

	Biotech application areas								
	1*	2	3	4	5	6	7	8	9
National									
<i>Generic</i>									
Network Programmes	√			√			√	√	
Strategic Research Centres	√			√		√	√		
Individual Grants				√		√	√		
Competence Centres			√	√		√	√		
VINNVAXT				√	√				
VINST Programme				√		√			
International Collaboration	√			√			√		
Total	5.3	0.0	1.2	19.7	1.5	11.1	14.5	1.1	0.0
<i>Biotech specific</i>									
Risk Assessment			√					√	
Biotech. for the Environment			√						
Framework Grants	√	√		√			√		
Research Programmes	√		√	√	√				
Total	2.5	0.9	4.5	9.9	2.2	0.0	0.8	0.7	0.0
Grand Total	7.8	0.9	5.7	29.6	3.7	11.1	15.3	1.7	0.0

*1 = Plant biotechnology

2 = Animal biotechnology

3 = Environmental biotechnology

4 = Health biotechnology

5 = Food biotechnology

Source: BioPolis Research

6 = Industrial biotechnology

7 = Basic biotechnology

8 = Ethical, legal, social aspects of biotechnology

9 = General

4.6 Stimulation of biotech activities through the instruments

Table 4.5 shows the type of activities that were stimulated for the period 2002-2005 through the various policy-directed instruments. There are many activities that can be stimulated by policy instruments, mentioned below the table. Table 4.5 shows only the activities that were stimulated by Swedish policy instruments in the period. In the period, none of the instruments supported technology transfer offices, the protection of IPR in PROs, or stimulated the creation of start-ups (instruments 10-15) or public discourse activities (instrument 19).

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

Funding instruments	1	2	3	4	5	6	7	8	9	16	17	18
National												
<i>Generic</i>												
Network Programmes	√			√	√	√						
Strategic Research Centres	√	√	√			√						
Individual Grants	√					√						
Competence Centres							√	√	√			
VINNVAXT						√		√		√		√
VINST Programme							√	√			√	
International Collaboration	√				√	√						
<i>Specific</i>												
Risk Assessment	√	√										
Biotech. for the Environment	√	√										
Framework Grants	√	√				√						
Research Programmes		√						√				

Many different types of activities are supported by biotech instruments:

- | | |
|---|--|
| 1 Basic research | 11 Science and technology park |
| 2 Applied research | 12 Protection of IPR in public research organisations |
| 3 Centres of excellence | 13 Financial support for start-ups |
| 4 Research network | 14 Non-financial support for start-ups |
| 5 Mobility of researchers among disciplines | 15 Creation of incubators |
| 6 Biotechnology training | 16 Awareness of biotech by companies not yet active in it. |
| 7 Mobility of researchers between academia and industry | 17 Grants for industrial research |
| 8 Collaborative research between industry and public research organisations | 18 Other incentives for business investment |
| 9 Set up research institute/centre of industrial interest | 19 Support for public discourse activities |
| 10 Technology transfer office | |
- Source: BioPolis Research

4.7 Dynamics: comparison with 1994-1998

Table 4.6 suggests that there has been slightly lower annual funding for biotechnology research in Sweden during the recent period than during 1994-98. In both periods (i.e. 1994/98 and 2002/05) health biotech was the most important area of biotechnology research (accounting for 39% in the second period), followed by basic biotechnology research (which in the second period represents about 20% of research funding). As in 1994/98, research support for industrial biotechnology and, to a lesser extent, plant biotechnology was also significant, but other areas received comparatively less support.

Table 4.6 Comparison of biotechnology research 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	39.3M ECU	36.4M EUR
Regional	-	-
Total	39.3M ECU	36.4M EUR

Source: BioPolis research

Table 4.7 shows that Sweden's policy-directed instruments in the period 2002-2005 continued to cover the same range of policy goals as in the earlier period.

Table 4.7 Coverage of policy goals by 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	√	√	√	√
	3. To support knowledge flow and collaboration among scientific disciplines	√	√	√	√
	4. To assure availability of human resources	√	√	√	√
2. Knowledge transmission and application	5. To facilitate transmission of knowledge from academia to the industry and its application for industrial purposes	√	√	√	√
	6. To stimulate the adoption of biotechnology for new industrial applications	√	√	√	√
	7. To assist firm creation	√		√	
3. Market	8. To monitor and improve the social acceptance of biotechnology	√		√	
4. Industrial development	9. To encourage business investment in R&D	√	√	√	√

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

Source: BioPolis Research

5. Future developments

During 2005 there were a number of initiatives seeking to strengthen innovation policy. These included a government bill entitled Research for a Better Life. While the bill aims to provide additional investment in R&D to promote research of high scientific quality, it also indicates that special initiatives will be undertaken in medicine, technology and sustainable development. The bill identifies medical and technological research as one of the high-priority research fields, and proposes that research allocations in this field should increase by 43.5M EUR (SEK 400M) over the period 2005-2008. The bill also allocates 32.6M EUR (SEK 300M) for the establishment of centres of excellence in order to better combine fundamental research and mission-oriented research.

In 2005, as part of the initiative to implement the national strategy Innovative Sweden, the Swedish government invited selected high-tech business sector representatives for a direct dialogue about economic competitiveness in Sweden. This dialogue seeks to inform a policy-making process to establish action plans for five priority sectors: automotive; ICT; pharmaceuticals, biotechnology and medical technology; metallurgy (mining and metal), and forest-based and wood industries (including pulp and paper). The resources to be devoted to support the action plans, or the specific initiatives to be implemented are not yet known.

In addition to this, the government has initiated a series of innovation related actions worth 271.4M EUR (SEK 2,000M) (Sandgren, 2005). These include the creation of the Innovation Bridge (Innovationsbron AB), aimed at investing in knowledge-based innovations and start-up companies in an early phase (a development of the previous regional Technology Bridge Foundations into a national organization), and a programme that will be run by NUTEK (budget 14.1M EUR - SEK 130 million) to increase the interest in entrepreneurship among the young.

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Annex 5 Performance data

Introduction

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

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

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

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

	Indicator	Chart	Comments	Time periods
Ind. 1	Biotech publications per million capita (pMC)	3.1	Index: Reference Region EU25 =100 and US data for comparison	(1) 1994-1996, (2) 1998-2000, (3) 2002-2004
Ind. 2	Biotech publications per BT public R&D expenditure	3.1	Only for those countries included in the inventory Index: Reference Region EU25 =100	BT Pub. 2002-2004 / Total Pub. Expenditure 1994-1998 M Ecu
Ind. 3	BT patents / BT publications	3.4	Index: Reference Region EU25 =100 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2001-2003
Ind. 4	BT publications / Total pub.	3.1	Index: Reference Region EU25 =100 and US data for comparison	(1) 1994-1996 (2) 1998-2000 (3) 2002-2004
Ind. 5	Citations to BT publications	3.1	Index: Reference Region EU25 =100 and US data for comparison Small country effect	(1) 1994-1998 (3) 2000-2004
Ind. 6	Graduates in life sciences pMC	3.1	Index: Reference Region EU17 =100 and US data for	(2) 1998 (3) 2002

	Indicator	Chart	Comments	Time periods
			comparison	
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 ⁵	2005
Ind. 16	Biomedicines	3.6	Source: BT Policy Benchmarking 2005 Index: Reference Region EU15 =100 US data for comparison	1995-2002
Ind. 17	Field trials	3.6	Source: Biotechnology Innovation Scoreboard 2002 Index: Reference Region EU15 =100 US data for	1996-2001

⁵ http://europa.eu.int/comm/public_opinion/archives/ebs/ebs_225_report_en.pdf

	Indicator	Chart	Comments	Time periods
			comparison	

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
Sweden	5918	7603	8656	9	9	9
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
Sweden	670	858	964	307	301	303
USA	454	492	529	208	172	166

Source: BioPolis Research

Publications: SCI

Population: EUROSTAT and OECD

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

	BT Publications	Non-policy-directed funding	Policy-directed funding		Total public spending on BT (Mecu)	BT publications/Mecu BT public expenditure	Index
			Biotech specific	Generic			
	2002-2004	1994-1998	1994-1998	1994-1998	1994-1998	2002-2004/1994-1998	
EU25	145646				n.a.		
Sweden	8656	125.5	50.6	22.6	199	44	271
USA	154402				n.a.		n.a.

Source: BioPolis Research

Publications: SCI

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

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

	BT publications			Total publications		
	94-96	98-00	02-04	94-96	98-00	02-04
EU25	97521	128716	145646	860652	1024327	1117392
Sweden	5918	7603	8656	42536	49594	53870
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
Sweden	14%	15%	16%	123	122	123
USA	13%	14%	15%	119	115	113

Source: BioPolis Research
Publications: SCI

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

	Citations to BT publications		Index EU25=100	
	94-98	00-04	94-98	00-04
EU25	6.14	7.28	100	100
Sweden	8.82	8.59	144	118
USA	6.39	8.54	104	117

Source: BioPolis Research
Citations: SCI

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

	Graduates in Life Sciences		Population (million)	
	1998 / 1999	2002	1998 / 1999	2002
EU17	46859**	81316	552**	431
Sweden	1614*	1127	9*	9
USA	75253*	70,50	276*	288
	Graduates pMC		Index EU17=100	
	1998 / 1999	2002	1998 / 1999	2002
EU17	85**	189	100	100
Sweden	182*	126	215	67
USA	273*	246	321	131

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

* data for 1998; ** data for 1999

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

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

	1994-1996							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	100%	8%	53%	5%	3%	1%	1%	30%
Sweden	100%	6%	63%	4%	2%	0%	1%	25%
USA	100%	6%	56%	5%	2%	0%	0%	30%

Source: BioPolis Research
Publications: SCI

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

	2002-2004							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	100%	7%	58%	5%	4%	1%	1%	25%

Sweden	100%	7%	61%	4%	3%	1%	1%	24%
USA	100%	6%	59%	5%	3%	0%	1%	26%

Source: BioPolis Research
Publications: SCI

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

	1994-1996							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	97217	7629	51944	4375	2434	624	576	29635
Sweden	6010	339	3781	248	106	20	33	1483
USA	111686	7118	62274	5580	2230	296	459	33729

Source: BioPolis Research
Publications: SCI

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

	2002-2004							
	Total	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	140984	10494	81220	6821	5017	1162	1126	35144
Sweden	8408	553	5090	374	233	45	68	2045
USA	141680	7910	84234	6872	4070	436	724	37434

Source: BioPolis Research
Publications: SCI

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

	1994-1996/2002-2004						
	Plant	Health	Animal	Food	Industrial	Environmental	Generic
EU25	38%	56%	56%	106%	86%	95%	19%
Sweden	63%	35%	51%	120%	125%	106%	38%
USA	11%	35%	23%	83%	47%	58%	11%

Source: BioPolis Research
Publications: SCI

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

	BT patents			Population (million)		
	94-96	98-00	01-03	1996	2000	2003
EU25	4924	8921	10119	447	451	455
Sweden	295	470	501	9	9	9
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

Sweden	33	53	56	303	268	252
USA	33	52	42	295	264	190

Source: BioPolis Research
Publications: SCI
Patents: Questel Orbit

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

	BT patents			BT publications		
	94-96	98-00	01-03	94-96	98-00	01-03
EU25	4924	8921	10119	97521	128716	140219
Sweden	295	470	501	5918	7603	8442
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
Sweden	0.05	0.06	0.06	99	89	82
USA	0,07	0,11	0,08	142	153	115

Source: BioPolis Research
Publications: SCI
Patents: Questel Orbit

Raw data for Chart 3.5 Number of BT companies pMC for the period 2001-2004: absolute and indexed values

	BT companies				Population in T			
	2001	2002	2003	2004	2001	2002	2003	2004
Europe	1879	1878	1861	1815	452016	452641	454580	456863
EU Available	1643	1650	1782	1605	319337	319484	408602	322210
Sweden	188	179	177	178	8883	8909	8941	8976
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
Sweden	21.12	20.09	19.8	19.83	411	389	454	398
USA	5,11045	5,112158	5,06553	4,95054	99	99	116	99

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

Source: BioPolis Research
Biotech companies: E&Y Beyond Borders 2002, 2003, 2004, 2005; EuropaBio

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

	BT start-ups		Population in T
	2001-2003	2003	2003
Europe (EU 15 - Cyprus - Greece + Norway + Switzerland)	523	132	367051
Sweden	29	7	8941

USA	355	83	290789	
	Biotech start-up/pMC	Index	Biotech start-up/pMC	Index
	2001-2003	2001-2003	2003	2003
Europe (EU 15 - Cyprus - Greece + Norway + Switzerland)	1,4	100	0,36	100
Sweden	3.2	228	0.78	218
USA	1,2	86	0,29	79

Source: BioPolis Research
Start-ups: EuropaBio

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

	BT IPO	Population T				
	2002-2005	2002	2003	2004	2005	2002-2005
EU Available	29	452927	454869	457154	461593	456636
Sweden	1	8909	8941	8976	9011	8959
USA	52	287941	290789	291685	n.a.	290138
	IPO /pMC		Index			
	2002-2005		2002-2005			
EU Available	0.00		100			
Sweden	0.00		176			
USA	0.00		282			

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

IPO data: E&Y 2002-2006, London Stock Exchange, Frankfurt Stock Exchange, Euronext, Nasdaq, Burrill & Company

Source: BioPolis Research

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

	Venture capital in biotechnology companies M€			Population in T		
	2002	2002	2002	2002	2003	2004
Europe	1100	920	2800			
EU Available	890	883	1111	315584	319663	325131
Sweden	35	46	33	8909	8941	8976
USA	2288	2498	2855	287941	290789	291685
	Venture capital in €/pC			Index		
	2002	2003	2004	2002	2003	2004
Europe						
EU Available	2,8	2,8	3,4	100	100	100
Sweden	4	5	4	139	188	109
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
Sweden	1	9	0.11	109
USA	115	289	0,40	387

Note: EU 15 is the result of the sum of the 15 old EU member states

Source: BioPolis Research

Number of medicines: Benchmarking of public biotechnology policy 2005

Raw data for Chart 3.6. Number of field trials pMC

	Field Trials	Population in M	Field Trials pMC	Index
	1996-2001	2001	1996-2001	1996-2001
EU15	1334	379	4	100
Sweden	59	9	7	188
USA	6745	278	24	688

Note: EU 15 is the result of the sum of the 15 old EU member states

Source: BioPolis Research

Field trials: Biotechnology Innovation Scoreboard 2002

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

BT acceptance index 2002		
	Index average	N (sample size)
EU - 15*	100,29	16828
Sweden	100.34	996

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

Source: BioPolis Research

BT acceptance index: Benchmarking of public biotechnology policy 2005

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London Stock Exchange	http://www.londonstockexchange.com/
Frankfurt Stock Exchange	http://deutsche-boerse.com/
Euronext	http://www.euronext.com/
Nasdaq	http://www.nasdaq.com/
Burrill & 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

FAS	Swedish Council for Working Life and Social Research
FORMAS	Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
ISA	Invest in Sweden Agency
KKS	Knowledge Foundation
MISTRA	Foundation for Strategic Environmental Research
NUTEK	Swedish Agency for Economic and Regional Growth and, prior to 2001, Swedish National Board for Industrial and Technical Development
SSF	Stiftelsen for Strategisk Forshning (The Swedish Foundation for Strategic Research)
VINNOVA	Verket for Innovationssystem (Swedish Agency for Innovation Systems)
VR	Swedish Research Council

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