OECD BIOTECHNOLOGY STATISTICS - 2006

By Brigitte van Beuzekom and Anthony Arundel

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FOREWORD

The *OECD Biotechnology Statistics – 2006* edition brings together the latest available economic and activity data on biotechnology and innovation, collected by OECD member and a number of non-member countries.[1] The report builds on the extensive work of the OECD and national experts to improve the comparability of biotechnology statistics. The results should provide a valuable source of information on biotechnology for policy makers, academics and business managers.

The first OECD collection of biotechnology indicators was published in 2001[2] and provided data for 21 OECD member countries and 1 observer country. However, comparable data across countries was only available for biotechnology patents, bibliometrics, venture capital, GM crop hectares, and GM field trials. Data were also available for up to 16 countries for employment, business R&D, and turnover for biotechnology firms, but the comparability of these indicators was limited by the lack of clear definitions of 'biotechnology' and a 'biotechnology firm'.

Improving the comparability of biotechnology indicators – and their collection – has posed several major challenges for national statistical systems. Unlike ICT or other technologies, there is no single biotechnology 'sector' that can be quickly identified and surveyed. Instead, biotechnology consists of a collection of related technologies with pervasive applications in many different economic sectors, including agriculture, forestry, aquaculture, mining, petroleum refining, environmental remediation, human and animal health, food processing, chemicals, security systems, and many different industrial processes. It is precisely the range of current and potential applications of biotechnology, together with their economic, environmental and social impacts, that creates a policy interest in obtaining high quality economic and innovation indicators for biotechnology.[3]

The current edition of *OECD Biotechnology Statistics* includes data for 23 OECD countries and 2 observer countries, plus China (Shanghai) and takes a major step forward in improving the comparability of biotechnology indicators between countries. The improvement in both data collection and comparability has been made possible by the work of the OECD and national experts to develop both a definition of biotechnology and the *Framework for Biotechnology Statistics*,[4] which provides guidance for the collection of data on biotechnology. The OECD definition of biotechnology was used in 15 countries.

Comparable indicators are given for the number of biotechnology firms, business expenditures on biotechnology R&D, biotechnology R&D in the public sector, biotechnology employment, and sales of biotechnology goods and services, plus patents, venture capital, GM crop hectares, and GM field trials. In addition, the indicators for the number of firms, R&D, employment and sales are also provided for three main application fields: health, agro-food, and industry-environment.

Separate country pages provide additional details. These are not intended to cover all available indicators at the national level, but provide additional methodological information for comparable

[1] Consulting firms when no national statistical data were available.

[2] van Beuzekom, Brigitte (2001), "Biotechnology Statistics in OECD Member Countries: Compendium of existing national statistics," *STI Working Paper 2001/6*, OECD, Paris, September.

[3] Arundel, A. (2003), "Biotechnology Indicators and Public Policy", *STI Working Paper 2003/5*, OECD, Paris, June.

[4] OECD (2005), *A Framework for Biotechnology Statistics*, http://www.oecd.org/dataoecd/5/48/34935605.pdf, OECD, Paris.

indicators and highlight interesting indicators that are only available for a single country or for a small number of countries.

Challenges to developing full comparability of indictors still remain, however. The first is due to methodological factors, such as differences in the definition of biotechnology, of a biotechnology firm, sampling frames, response rates etc. Second, countries use different definitions of characteristics of interest, such as firm size categories or the application field. Third, many indicators are often missing for specific countries because they are not included in national reports, even though the necessary data to construct the indicator has been collected. For example, some of the studies based on R&D surveys did not provide data on the number of employees in biotechnology firms, even though this information would have been available. When possible, the OECD Secretariat contacted national representatives to obtain indicators that were not provided in national reports, or requested revisions to data analysis to improve comparability.

In the near future, several additional steps need to be taken to improve international comparability. Perhaps the easiest step is to address each of the three factors discussed above. This would require national experts to discuss and reach agreement on the most useful and practical biotechnology indicators. It would also be worthwhile to have more countries participating and to improve the timeliness of the data and the speed with which it can be processed.

We hope that the necessary steps to continue to improve biotechnology indicators will be taken by the OECD member countries over the coming years, so that the next edition of *OECD Biotechnology Statistics* will be even better.

Structure of the document

This document is divided into two parts. Part one provides data that allow international comparisons between as many countries as possible. The second part is dedicated to country profiles. These profiles are by no means exhaustive. Rather, they are intended to display the range of data available in different countries.

Acknowledgements

This edition of the *OECD Biotechnology Statistics – 2006* was prepared by Brigitte van Beuzekom of the OECD's Directorate for Science, Technology and Industry and Anthony Arundel of UNU-MERIT. Many other people contributed, including the delegates involved in the OECD *Ad hoc* Meeting on Biotechnology Statistics as well as delegates to the Working Party of National Experts on Science and Technology Indicators (NESTI), without whose help this edition would not have been possible. We also thank Catalina Bordoy of UNU-MERIT for providing the GM field trial results.

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METHODOLOGY

This report provides statistics on biotechnology activities in up to 23 OECD countries and 2 observer countries, plus China (Shanghai), based on the results of 33 separate studies. The main methodological challenges concern the production of comparable statistics across countries that have used different definitions and survey designs. Table 1 summarises the main methodological characteristics of the studies of biotechnology in each country.

Biotechnology is used for producing existing products in new ways, identifying new product opportunities (as in drug discovery), and for producing new products that could not be commercially produced before (as with many large molecule therapeutics and some GM plant varieties). The wide range of uses for biotechnology means that it is a generic technology with applications in many different economic sectors. Biotechnology is also better described as a group of related biotechnolog*ies.*

The diverse types of biotechnologies and the range of possible applications create two main challenges for developing comparable biotechnology statistics: how to define biotechnology and how to define a biotechnology firm.

Definition of biotechnology

The OECD has developed both a single definition of biotechnology and a list-based definition (see Box below) of different types of biotechnology. The single definition defines biotechnology as *"the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services."*

The OECD list-based definition, or close variants, were used in surveys in 15 countries, but different definitions of biotechnology were used in the other 11 countries: 7 studies limit biotechnology to 'modern' or third-generation biotechnologies that are similar to the OECD list-based definition in practice, 2 studies use mixed definitions that include second generation biotechnologies (Japan and South Africa), and 2 do not define biotechnology, but leave it to the survey respondent to decide if their firm is active in biotechnology. As the latter two studies cover Denmark and Sweden, a large majority of the respondents are likely to interpret biotechnology as modern biotechnology.

OECD list-based definition of biotechnology techniques

DNA/RNA: Genomics, pharmacogenomics, gene probes, genetic engineering, DNA/RNA sequencing/synthesis/amplification, gene expression profiling, and use of antisense technology.

Proteins and other molecules: Sequencing/synthesis/engineering of proteins and peptides (including large molecule hormones); improved delivery methods for large molecule drugs; proteomics, protein isolation and purification, signaling, identification of cell receptors.

Cell and tissue culture and engineering: Cell/tissue culture, tissue engineering (including tissue scaffolds and biomedical engineering), cellular fusion, vaccine/immune stimulants, embryo manipulation.

Process biotechnology techniques: Fermentation using bioreactors, bioprocessing, bioleaching, biopulping, biobleaching, biodesulphurisation, bioremediation, biofiltration and phytoremediation.

Gene and RNA vectors: Gene therapy, viral vectors.

Bioinformatics: Construction of databases on genomes, protein sequences; modelling complex biological processes, including systems biology.

Nanobiotechnology: Applies the tools and processes of nano/microfabrication to build devices for studying biosystems and applications in drug delivery, diagnostics etc.

Definition of a biotechnology firm

The definition of a biotechnology firm is partly linked to the method used in each country to sample firms. Three definitions are in common use. Two different methods are used in separate studies in Finland, Korea, New Zealand, Spain, Sweden and the United States.

Data are only available for 'core' biotechnology firms for seven countries. The definition of a core biotechnology firm varies, but in most countries a core biotechnology firm must perform R&D in biotechnology and biotechnology must be its principal activity. The latter requirement often limits core biotechnology firms to those with less than 500 employees.

At least some of the data for the remaining 19 countries cover all firms with some biotechnology activities, even if biotechnology is only a small part of its total activity. In 13 countries biotechnology firms are identified through a positive response to a question on conducting biotechnology-related R&D in the national R&D survey. In nine countries all biotechnology firms were surveyed (core firms plus other firms with some biotechnology activities). No information on the definition of a biotechnology firm is available for Poland.

In 20 countries at least one survey is limited to firms that develop biotechnology innovations. For four countries, the only available survey includes firms that use biotechnology but do not necessarily perform biotechnology R&D. No data are available for Belgium and China on this issue.

Sampling frame

Two main methods are used for identifying biotechnology firms. Eighteen surveys use secondary sources to identify biotechnology firms. These include industry association membership lists, participants in government programmes to support biotechnology, stock market listings, patent records, information provided by venture capital firms, and any other possible source for identifying a biotechnology firm. Thirteen surveys use the national R&D sampling frame. The survey in Korea is based on activity in specific sectors, while no information is available for Poland.

Accuracy of the results

Table 1 includes three characteristics that could influence the accuracy of the biotechnology statistics: the organisation conducting the survey (Source), the response rate (RR), and whether or not results were imputed to account for non-respondents, or if a random survey, extrapolated to the total population (Extrapolation).

Twenty of the 33 studies were conducted by government agencies (GOV), 6 by non-profit organisations acting at the request of a government agency (NP-GOV), and 7 by a consulting agency (name given in Table 1). Generally, governments have the most resources to conduct a full survey of biotechnology and consequently the data quality should be better than the results obtained by consulting agencies, although this might not always be the case.

Data accuracy is strongly dependent on a high response rate, which will reduce possible biases due to differences in the types of biotechnology firms that choose or do not choose to respond to a survey and include most firms active in biotechnology. Low response rates could result in serious underestimates of the number of biotechnology-active firms or biotechnology activities such as R&D.

Surveys were not used in six studies, so the response rate is not relevant. Out of the 27 surveys, 14 had high response rates above 80%, while 4 had low response rates (50% or less). When the response rate is not 100%, the results can be extrapolated to estimate biotechnology activity in the estimated number of biotechnology firms that did not respond to the survey. However, the accuracy of extrapolation depends on having good information on the number of eligible non-respondent firms. It is also possible that this number is zero, for example if firms that were not active in biotechnology did not answer the questionnaire because they did not consider it relevant to them.

The combination of low response rates and no extrapolation is likely to notably underestimate biotechnology activity by firms in five countries: Belgium, China (Shanghai), Italy, Poland, and the United States (2001 survey only). Moderate underestimating is possible in Japan and South Africa.

Cross-country results for employment, R&D and sales

Different definitions of biotechnology activities create problems for comparing employment, R&D and sales across countries.

Most consulting reports are limited to total employment and total R&D employment in core biotechnology firms. The advantage of some of the Government-supported surveys is that they cover all biotechnology-active firms and include questions that can differentiate between employees with and without biotechnology-related responsibilities. These types of studies, as in Canada and the United States, provide the most reliable estimates of biotechnology employment. In Canada, total employment among biotechnology-active firms is 75,448 in 2003, but only 11,863 of these employees (15.7%) have biotechnology responsibilities (including biotechnology-related R&D, management, production, and administration). The gap between biotechnology-active employment and total employment increases with firm size, as larger firms are more likely to have diversified activities. The 2001 American survey finds that less than 20% of employees in biotechnology-active firms with over 2,500 employees have biotechnology-related responsibilities, compared to 60% of employees in biotechnology firms with 51 to 500 employees and approximately 70% of employees in biotechnology firms with less than 50 employees.

These differences in study design can result in both over- and underestimates of biotechnology employment. Studies limited to core biotechnology firms will underestimate biotechnology employment by failing to account for biotechnology employment in large firms. This probably explains why the Critical I estimate of total employment in core biotechnology firms in Belgium is only 2,676 employees, while the survey of all biotechnology-active firms estimates total employment of 11,137, of which 4,261 have biotechnology-related responsibilities. Conversely, studies that assume that all employment in biotechnology firms is 'biotechnology' employment can produce overestimates, since an unknown percentage could be involved in activities that do not involve biotechnology.

The most comparable estimate between studies that only provide data for total employment in core biotechnology firms, and studies of all biotechnology-active firms, is to use counts of biotechnology-active employees from the latter type of study. For the two countries (Germany and Belgium) where both types of data are available, the number of biotechnology-active employees is greater than total employment in core biotechnology firms. This suggests that using total employment in core biotechnology firms is more likely to underestimate than overestimate total biotechnology employment, although there could be exceptions. Critical I probably overestimates Danish biotechnology employment because it assigns all Danish employment in one or more large pharmaceutical firms to biotechnology. For this reason, some of the Critical I results for Denmark are not included in this report.

The same problem as described above for employment also applies to statistics for biotechnology R&D and sales of biotechnology products. Several countries collect data that differentiates between biotechnology R&D and other types of R&D, and between sales of biotechnology products and sales of other products. Studies of core biotechnology firms usually assume that all R&D performed by these firms is biotechnology R&D and all sales are of biotechnology products.

The study from Canada shows that not all sales and R&D concern biotechnology. Biotechnology revenues in Canada in 2003 were only 12.5% of total revenues of biotechnology-active firms. The share of biotechnology R&D was higher however, at 65% of total R&D expenditures by these firms.

Conclusions

Although every effort has been made to maximise comparability across countries, caution must be used in comparing biotechnology activities between countries when the data are obtained from studies with very different methodologies. This particularly applies to differences between studies of core biotechnology firms only versus studies of all biotechnology-active firms. Other factors, such as differences in the definition of biotechnology, whether or not all firms must innovate, and low response rates in some countries, will also reduce comparability.

In general, the results in this document (for all countries combined) for the number of biotechnology firms, employment, R&D and sales are more likely to underestimate the true values than to overestimate them. This is primarily caused by the reliance for several countries on studies limited to core biotechnology firms and the low response rates in several studies.

As a final caution, some of the results for specific countries vary, depending on the data source. For example, the 2001 Department of Commerce survey estimates total biotechnology R&D of USD 16,834 million, while the 2003 R&D survey for the United States estimates total biotechnology R&D of USD 14,232 million and is used on page 17. The difference is not likely to be due to the different years but to the different methodologies. The 2003 results are likely to be more accurate, but they are not available by application field. Consequently, the 2001 results are used on pages 31 to 33 and in Table 2 on page 41, which provide R&D expenditures by application. Similar discrepancies occur for a few other countries with multiple data sources, including when Critical I data are used in some cases and survey data in other cases. In all cases, the selection of which data source to use is based on the best available data quality, with preference given to survey research with high response rates. We apologise to the reader for any confusion that this may cause.

Methodology

Table 1. **Characteristics of biotechnology data sources**

	Year	Biotech Definition	Biotech firm Definition	All Firms Innovate?	Sample Frame	Source[7]	RR	Extrapolation
Australia	2003-04	OECD	R&D	Yes	R&D	GOV	86%	Partial[1]
Austria	2003	Modern	Core	Yes	Secondary	Critical I[2]	NR	Partial[1]
Belgium	2003	OECD	All	..	Secondary	NP-GOV	31%	No
Canada	2003	OECD	All	Yes	Secondary	GOV	80%	Yes
China (Shanghai)	2003	Modern	All	..	Secondary	GOV	39%	No
Denmark	2003	None given	R&D	Yes	R&D	NP-GOV	63%	Yes
Finland	2003	OECD	R&D	Yes	R&D	GOV	83%	Yes
Finland	2003	Modern	Core	..	Secondary	NP-GOV	71%	Partial[1]
France	2003	OECD	R&D	Yes	R&D	GOV	72%	Yes
Germany	2004	OECD	All	No	Secondary	GOV	65%	Yes
Iceland	2003	OECD	R&D	Yes	R&D	NP-GOV	100%	NR
Ireland	2003	Modern	Core	Yes	Secondary	Critical I[2]	NR	Partial[1]
Israel	2002	OECD	All	No	Secondary	GOV	96%	Yes
Italy	2004	OECD	R&D	Yes	R&D	GOV	50%	No
Japan	2003	Mixed[5]	All	No	Secondary	JBA	76%	No
Korea	2004	Modern[6]	All	..	Sector	GOV	100%	NR
Korea	2004	..	R&D	Yes	R&D	GOV	76%	..
Netherlands	2003	Modern	Core	Yes	Secondary	Critical I[2]	NR	Partial[1]
New Zealand	2004	OECD	All	No	Secondary	GOV	94%	No
New Zealand	2004	OECD	R&D	Yes	R&D	GOV	84%	Yes
New Zealand	2005	OECD	All	No	Secondary	GOV	93%	No
Norway	2003	OECD	R&D	Yes	R&D	GOV	95%	Yes
Poland	2004	OECD	..	Yes	..	GOV	34%	No
Portugal	2003	Modern	Core	Yes	Secondary	Critical I[2]	NR	Partial[1]
South Africa[3]	2002-03	Mixed	All	No	Secondary	EgoliBio	72%	No
Spain	2004	OECD	All	..	Secondary	*Genoma E.*	NR	..
Spain	2004	OECD	R&D	Yes	R&D	GOV	86%	Yes
Sweden	2003	None given	R&D	Yes	R&D	GOV	94%	Yes
Sweden	2003	..	Core	..	Secondary	NP-GOV	..	..
Switzerland	2004	OECD	R&D	Yes	R&D	GOV	81%	Yes
United Kingdom	2003	Modern	Core	Yes	Secondary	Critical I[2]	NR	Partial[1]
United States[4]	2001	OECD	All	No	Secondary	GOV	61%	No
United States	2003	OECD	R&D	Yes	R&D	GOV	81%	Partial[1]

NR = not relevant; Information not available = ..

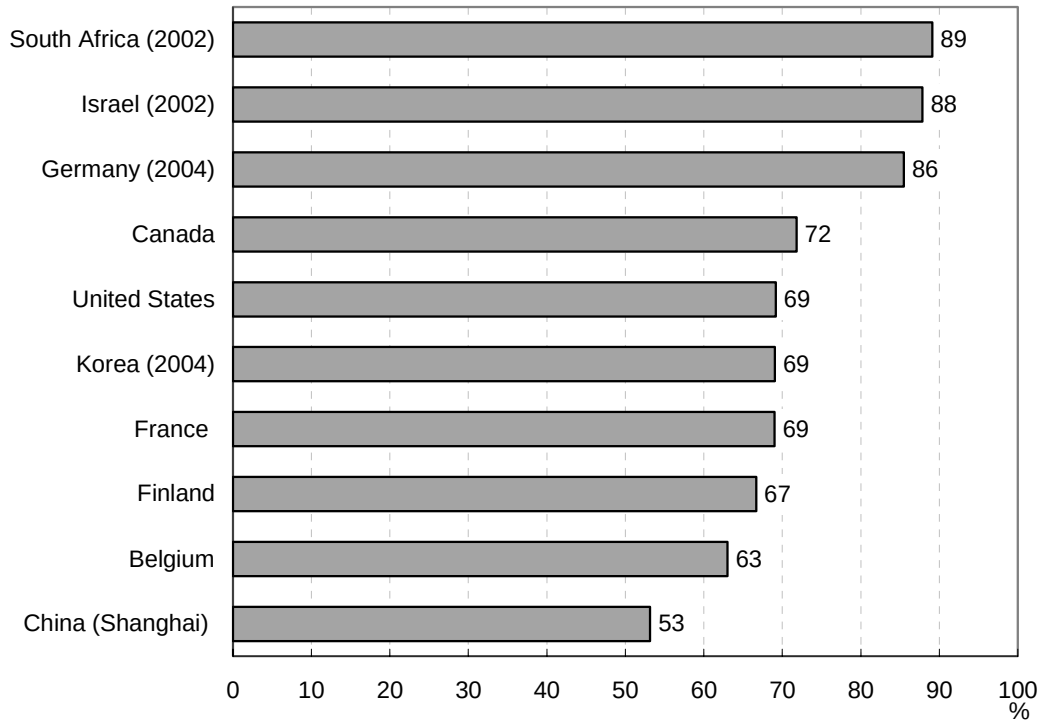
1. Imputed or extrapolated results limited to selected firms or indicators, or to missing survey questions for respondents only.
2. Critical I data are based on annual reports, accounts and a review of company web-sites. The CEOs of firms were invited to review their results, but no information is provided in the published reports on how many CEOs were contacted or how many responded. Extrapolation techniques were used to estimate missing data for specific companies.
3. Large firms in traditional biotechnology (fermented food products) were excluded, but some traditional and second generation biotechnology firms are in the sample.
4. Definition of biotechnology similar but not identical to OECD definition.
5. Wherever possible, the results are limited to 'modern' biotechnology, but this could still include some second-generation or traditional biotechnology activity.
6. May include some second generation biotechnology.
7. GOV = survey or study conducted by a Government agency, NP-GOV = conducted by a non-profit organisation at the request of a Government agency. In all other cases, the name of the consulting firm is given.

CROSS-COUNTRY COMPARATIVE RESULTS

BIOTECHNOLOGY FIRMS

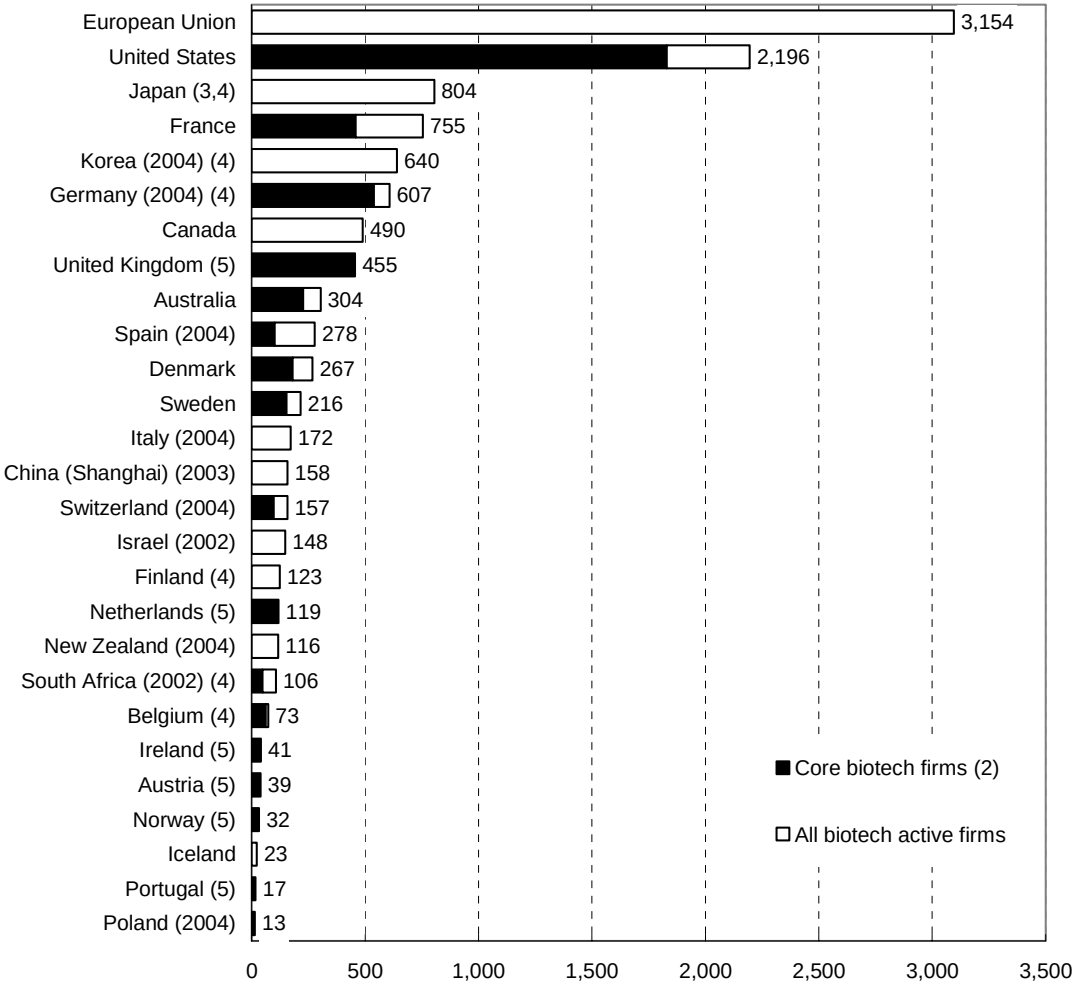
- The number of firms active in modern biotechnology is the most widely available indicator, with data available for 25 countries plus Shanghai in China.
- Results are only available for 'core' biotechnology firms for six countries, defined as firms whose major economic activity is biotechnology. An estimate is available for all other countries of the number of 'biotechnology-active' firms, defined as firms that either perform R&D in biotechnology or produce and sell innovative biotechnology products.
- The share of core firms out of the total for the nine countries with both types of data ranges from a low of 37% (Spain) to a high of 98% (Sweden), with an average of 70%. These results indicate that the number of biotechnology firms will be underestimated in countries, such as the United Kingdom, with data only for core biotechnology firms.
- The United States has the largest number of biotechnology firms (2,196), followed by Japan (804) and France (755). The 15 reporting countries from the European Union have a total of 3,154 biotechnology firms.
- Comparable data on the number of biotechnology firms with less than 50 employees are available for 10 countries. In all 10 countries, the majority of biotechnology firms have less than 50 employees, with the percentage over 85% in South Africa, Israel and Germany.
- Five countries provide data on the number of biotechnology-active large firms with over 500 employees. The share of large firms out of all biotechnology-active firms is 1% in Germany, 6% in the United States, 7% in Belgium and France, and 11% in Korea.

Percent of biotechnology firms with less than 50 employees, 2003



Biotechnology firms

Number of biotechnology firms,[1] 2003



1. Excludes firms that only supply biotechnology equipment. In most countries biotechnology firms are defined as innovative, either performing R&D or having introduced a new biotechnology product or process onto the market in the previous two or three years.
2. The definition of a 'core' biotechnology firm varies across countries, but is usually defined as a firm with less than 500 employees and with biotechnology as is its main activity. When no data are available for core biotechnology firms, the results are limited to all firms with some reported activities in biotechnology.
3. May include some firms that are only active in traditional biotechnology, but as far as possible firms that are only active in traditional biotechnology are excluded.
4. May include a few firms that are active in biotechnology but which do not develop biotechnology innovations.
5. Results from Critical I report for EuropaBio, 13 April, 2005.

BIOTECHNOLOGY R&D

Private sector biotechnology R&D

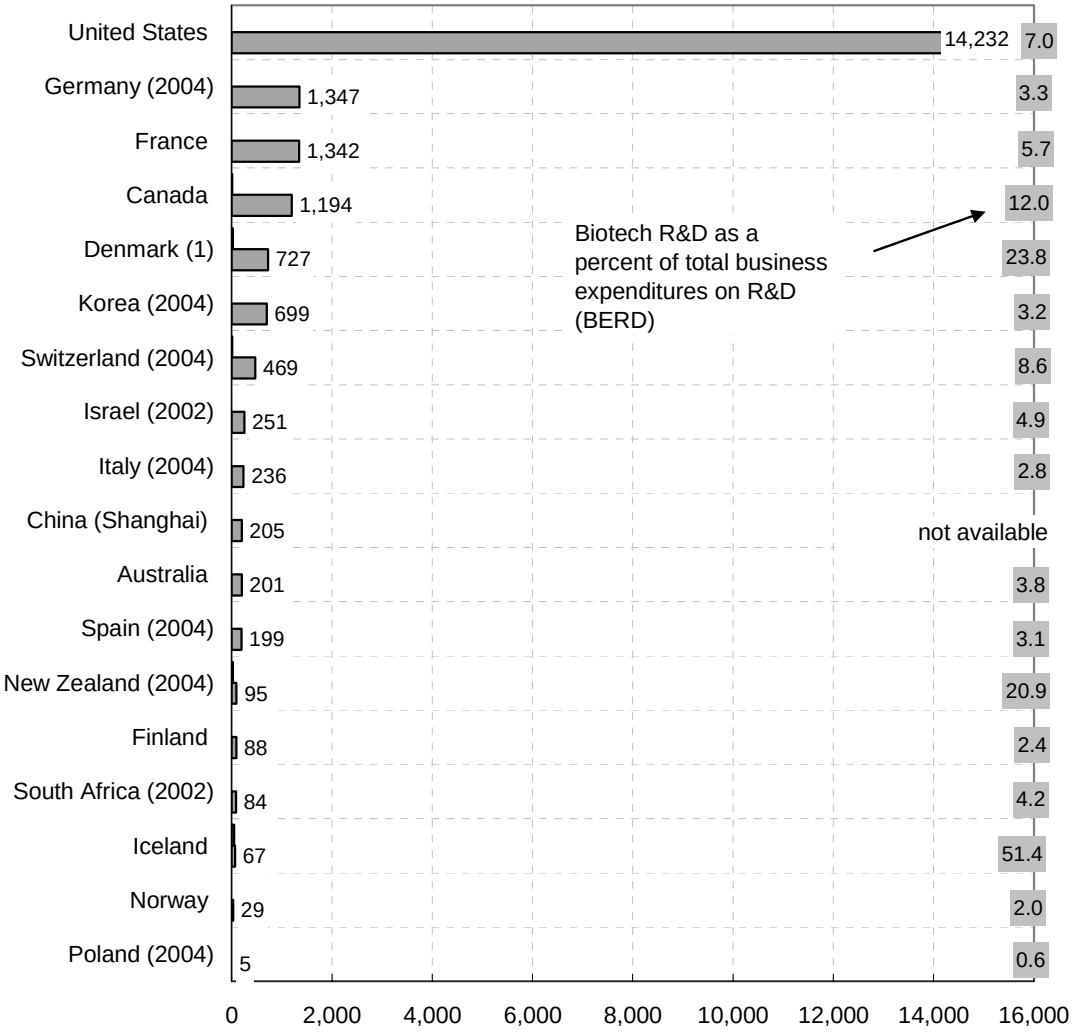
- Business sector expenditures on biotechnology R&D are available for 16 countries plus China (Shanghai).
- Firms active in biotechnology can perform R&D on biotechnology and in other areas. Data on the share of biotechnology R&D out of all R&D performed by biotechnology firms are available for Canada, Finland and Spain. The percentage of total R&D expenditures by these firms that was spent on biotechnology R&D was 65% in Canada, 38% in Finland, and 36% in Spain.
- These results show that biotechnology firms can spend a large share of their total R&D expenditures on non-biotechnology R&D. For this reason, the results given below do not include countries for which only total R&D spending by biotechnology firms is available, as an unknown percentage of this R&D will be on non-biotechnology-related research.
- Business sector expenditures on biotechnology R&D are highest in the United States (PPP$ 14,232 million), accounting for 66.3% of all business sector biotechnology R&D in the 17 countries.
- The share of all business sector R&D due to biotechnology is an indicator of a research focus on biotechnology by firms. In Iceland, biotechnology R&D accounts for 51.4% of all business sector R&D. The share exceeds 10% in Canada (12.0%), New Zealand (20.9%), and Denmark (23.8%). In the United States, 7.0% of business sector R&D expenditures are on biotechnology.
- The share of business sector biotechnology R&D performed in the services sector (mostly in NACE 73) is available for five countries. The share ranges from 24.7% in Switzerland to 70.3% in Australia.
- Complete data on business sector biotechnology R&D by the size of biotechnology firms is available for only two countries. In the United States and France, large firms with over 500 employees account for only 6% and 7% respectively of all biotechnology firms, but these firms perform 61% and 49% of all business sector R&D in biotechnology. Small firms with less than 50 employees account for only 9.3% and 18.0% of business sector biotechnology R&D in the United States and France respectively. In Canada and Germany, small firms account for 33% and 50% of business sector biotechnology R&D, but no data are available for large firms for these two countries.

Public sector biotechnology R&D

- Data on public sector expenditures on biotechnology R&D are available for 10 countries. The results for Canada are for R&D expenditures in the public sector that are financed by the Federal Government. Data for the United Kingdom are limited to government expenditures in public research institutions, and for Sweden the results are limited to government expenditures in higher education institutions. In the other countries the results refer to all expenditures by government research institutes and higher education institutions.
- Out of the ten countries, Korea has the highest level of government expenditures on biotechnology R&D, at PPP$ 727.4 million, followed by Canada and Spain. Biotechnology R&D expenditures in Korea have increased 63.1% in two years, reaching PPP$ 1,186.6 million in 2005.
- The percentage of all public sector R&D expenditures due to biotechnology is a measure of the government's focus on biotechnology research. New Zealand has the highest share, at 24.2%, followed by Korea (15.3%) and Canada (12.4%). The results for the United Kingdom and Sweden are less than 2%, but in both of these countries the data only capture a part of total government R&D spending.
- Although the Norwegian public sector spends comparatively little on biotechnology R&D, public expenditures account for 75.5% of all biotechnology R&D (public and private sectors combined). The majority of biotechnology R&D is performed within the public sector in Spain (69.5%), New Zealand (61.0%), Korea (58.0%), and Finland (54.2%). Conversely, only 7.1% of total biotechnology R&D in Iceland is performed in the public sector, and 15.3% in Denmark.

Biotechnology R&D

Total expenditures on biotechnology R&D by biotechnology-active firms, Million PPP$, 2003

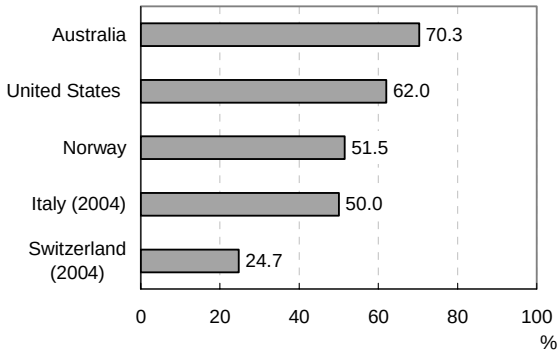


1. Results for Denmark could overestimate biotechnology R&D because a few health biotechnology firms did not give the percentage of their total R&D allocated to biotechnology. For these firms, all R&D was assigned to biotechnology.

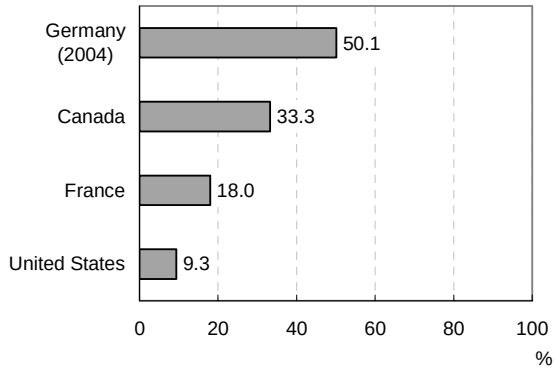
Biotechnology R&D

Biotech R&D intensity[1] in the business sector, 2003

Percent of business sector biotechnology R&D performed in the service sector, 2003



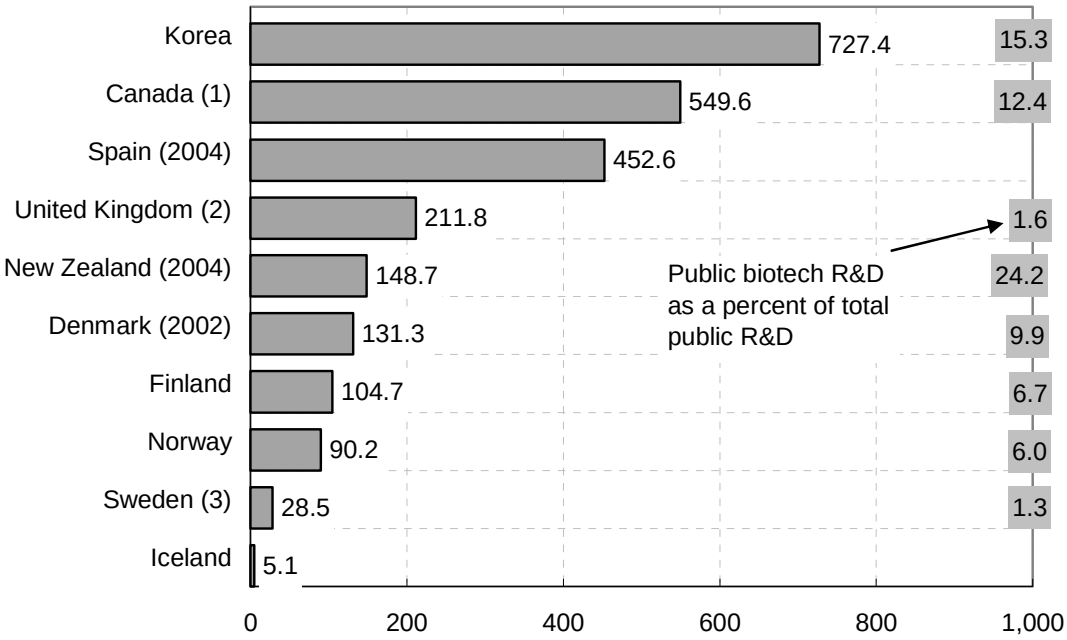
Percent of business sector biotechnology R&D performed by small firms, 2003
Firms with fewer than 50 employees



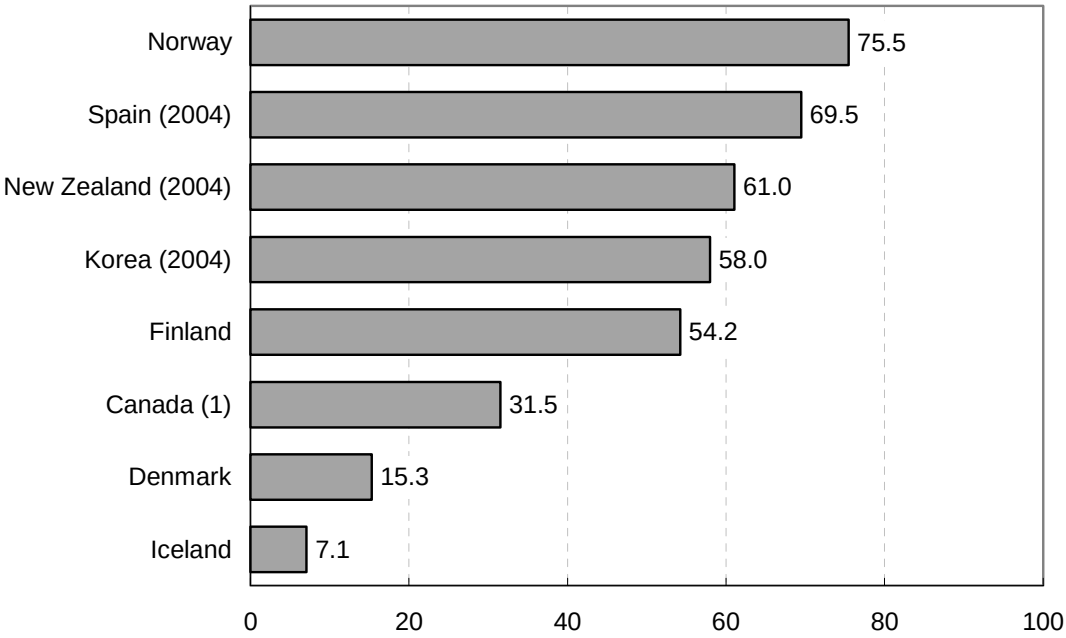
1. Biotechnology R&D expenditures in the business sector as a percent of value added in the business sector.

Biotechnology R&D

Biotechnology R&D expenditures by the public sector, Million PPP$, 2003
Government and higher education biotechnology R&D



Public sector biotech R&D as a percentage of total expenditures on biotechnology R&D, 2003
Private and public sector combined



1. Biotechnology R&D financed by the federal government only (excludes provincial funding) and excludes business funding of public sector research.
2. Central government budget provision for R&D expenditure data.
3. Higher education sector only.

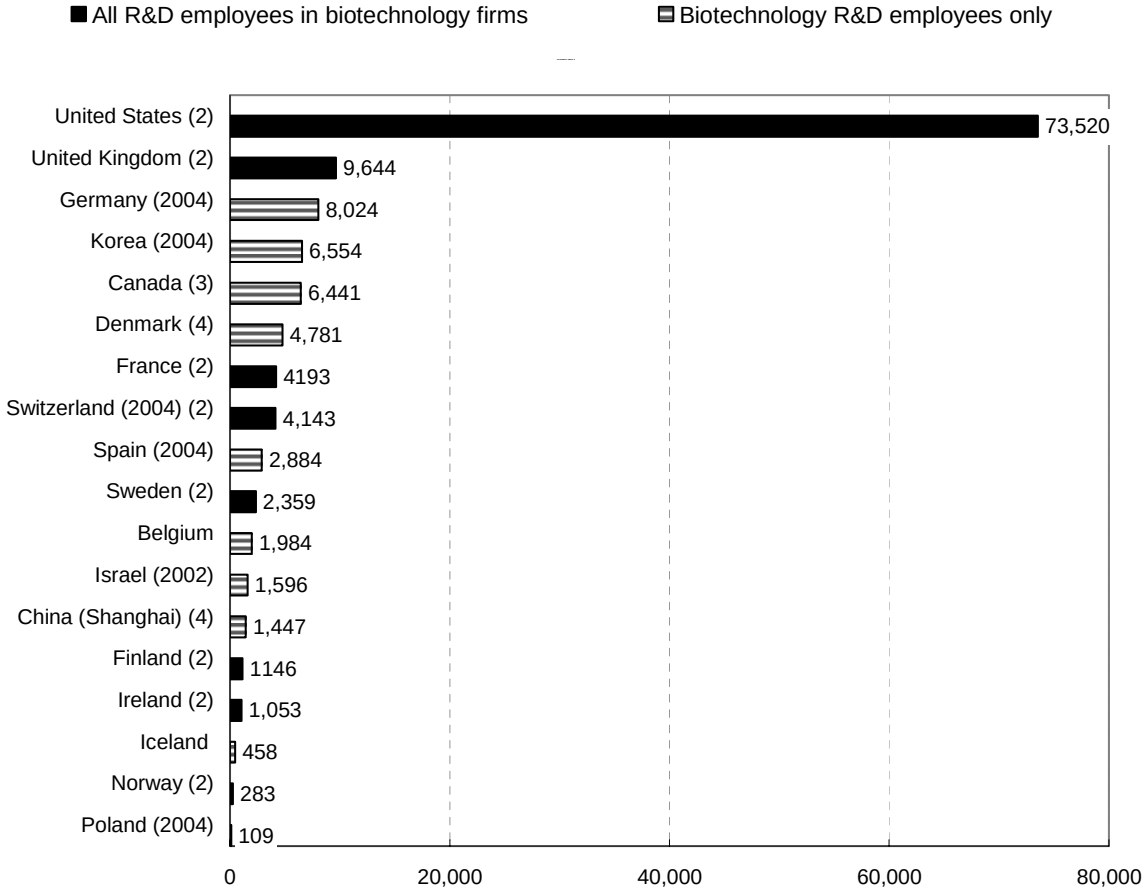
BIOTECHNOLOGY EMPLOYMENT

- There are three measures of biotechnology employment: biotechnology R&D employees (scientists and technical support), all employees with biotechnology-related activities (biotech-active employment), including R&D, management, marketing, and production; and total employment in biotechnology-active firms.
- Data on the number of employees in biotechnology-active firms are available for 23 countries plus China (Shanghai) for 2003 or the closest available year (see Table 1).
- The most commonly available employment statistic is for biotechnology R&D employees. For eight countries the statistic equals all R&D employees in core biotechnology firms. This will overestimate biotechnology R&D employment because an unknown percentage of R&D staff will not be active in biotechnology R&D.
- The United States leads with an estimated 75,320 biotechnology R&D employees in the business sector in 2003, followed by the United Kingdom with 9,644 R&D employees. Both results are based on all R&D employees in core biotechnology firms. Germany had 8,024 biotechnology R&D employees in 2004, obtained from a survey that excluded R&D employees not involved in biotechnology.
- The total number of employees in biotechnology firms is difficult to compare between core biotechnology and all biotech-active firms (see the discussion in the Methodology chapter). A best estimate is given here, comparing data, where available, for all employees with biotechnology responsibilities ('biotech-active') with data on total employment in core biotechnology firms. The United States leads with 172,391 employees in core biotechnology firms, followed by Germany, with 24,131 'bio-active' employees.
- The United States accounts for 59.7% of the estimated total of 288,584 biotechnology employees among the 21 reporting countries and for 56.9% of the estimated 129,172 biotechnology R&D employees among 17 reporting countries.
- Employees active in biotechnology R&D account for an average 42% of the best estimate of total bio-active employment, based on 16 countries where both R&D and total employment data are available. Poland has the lowest percentage of R&D employees (11.5%) and Sweden the highest (63.5%).
- The share of biotechnology R&D employees out of total employment in bio-active firms is available for six countries (see Table 1). The share is 8.5% in Canada, 17.8% in Belgium, 19.1% in Sweden, 41.0% in Israel, and 54.0% in Korea.

See the Methodology chapter for additional information.

Biotechnology employment

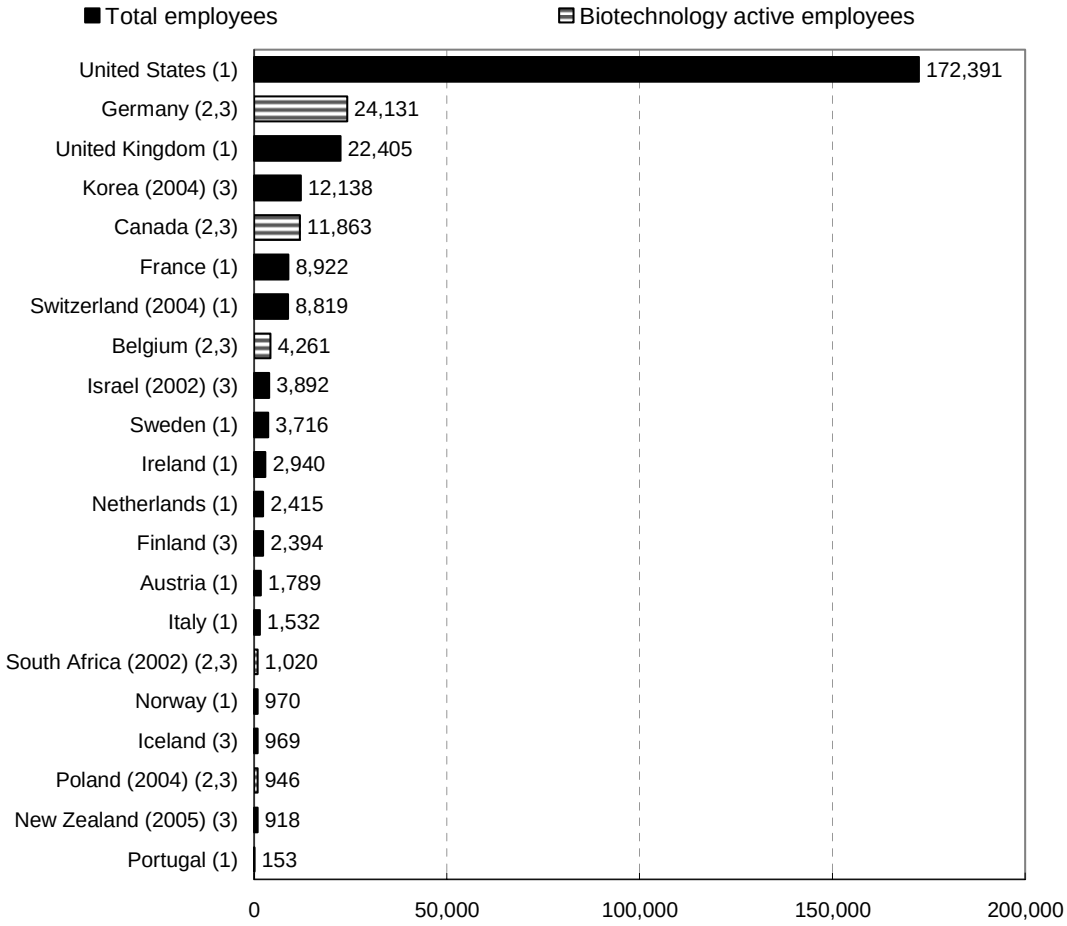
Biotechnology R&D employees, headcounts,[1] 2003



1. R&D employment: includes scientists and support staff such as technicians.
2. Data from Critical I report to the UK DTI, 2005, based on all R&D employees in core biotechnology firms.
3. Excludes firms with less than five employees or less than PPP$ 80,000 in R&D.
4. Full-time equivalents (FTEs).

Biotechnology employment

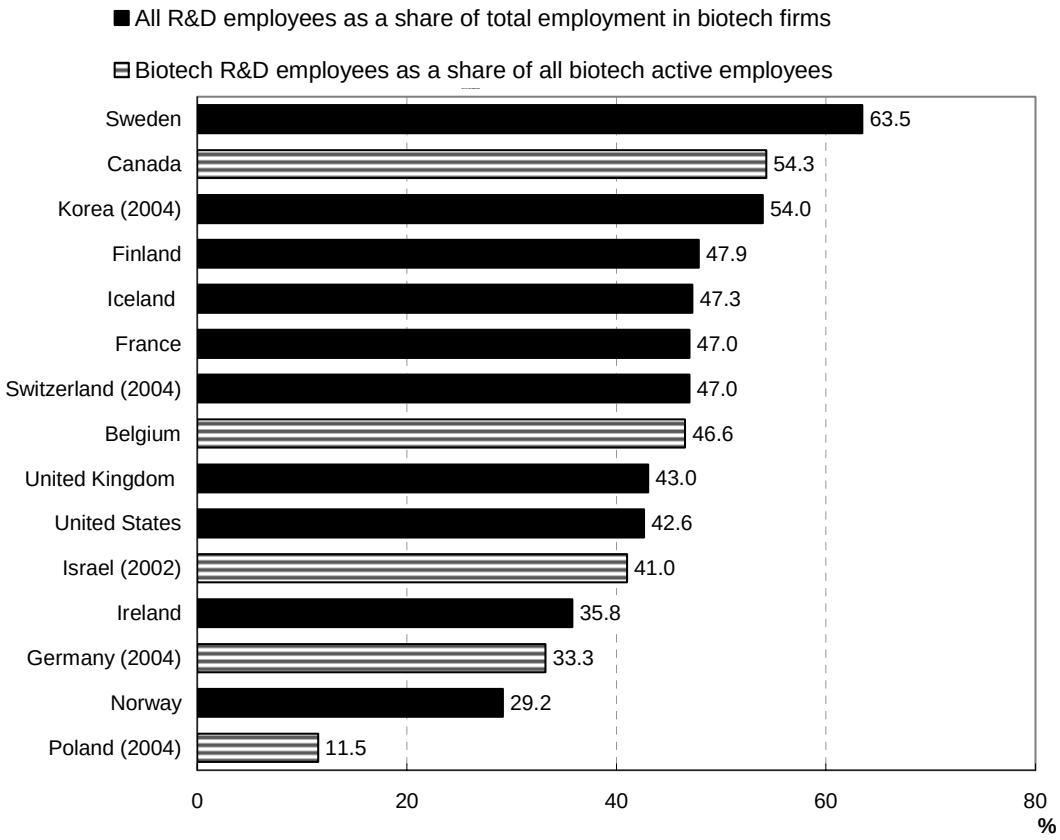
Best comparable estimate of total bio-active employment among biotechnology firms, 2003



1. Data from Critical I report to the UK DTI, 2005, based on total employment in core biotechnology firms.
2. Limited to employees with biotechnology-related responsibilities.
3. Includes employment in both core and non-core firms active in biotechnology.

Biotechnology employment

Biotech R&D employment as a percentage of best estimate of all bio-active employment in biotech firms,[1] 2003



1. The results for Finland, France, Ireland, Switzerland, the United Kingdom, and the United States are from Critical I and are based on employment in core biotechnology firms.

Biotechnology employment

Table 1. **Biotechnology employment**

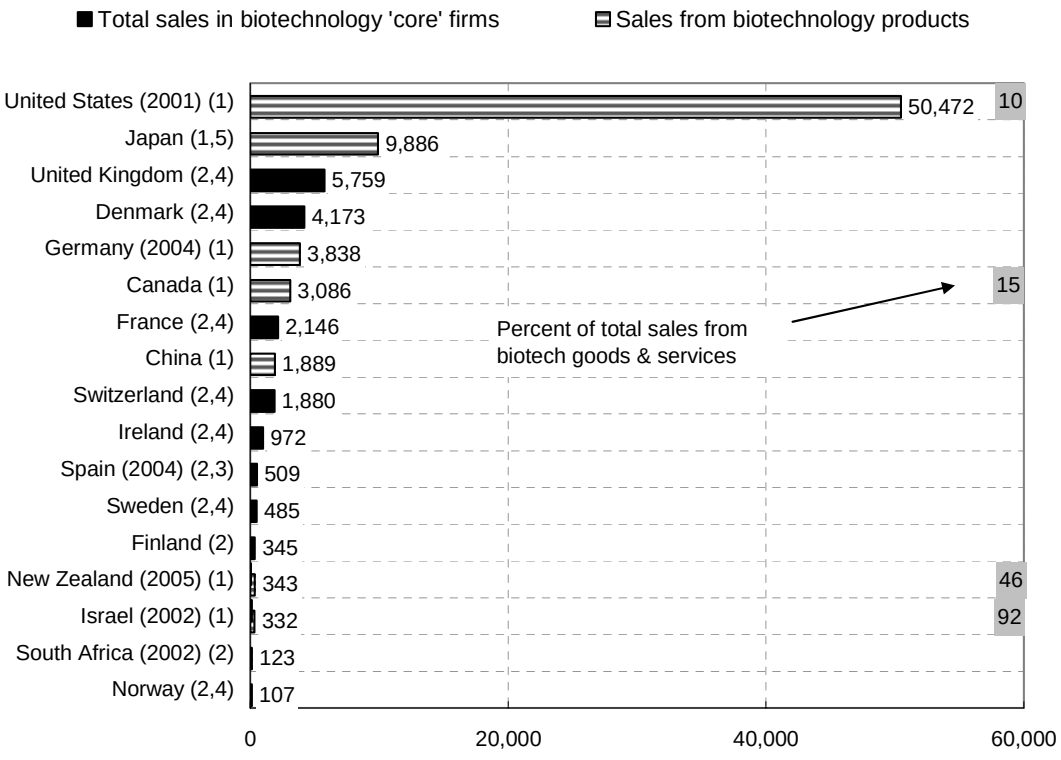
		Core biotech firms[1]		All bio-active firms		
		Total	R&D	Total	Biotech active	Biotech R&D
		Employees		Employees		
Austria	2003	1,789	..	..	..	..
Belgium	2003	2,676	..	11,137	4,261	1,984
Canada	2003	..	..	75,448	11,863	6,441
China (Shanghai)	2003	..	..	..	..	1,447 [2]
Denmark	2003	17,329	3,866	..	..	4,781 [2]
Finland	2003	2,016	1,146	2,394	..	..
France	2003	8,922	4,193	..	..	..
Germany	2004	17,277	8,625	..	24,131	8,024
Iceland	2003	..	..	969	..	458
Ireland	2003	2,940	1,053	..	..	..
Israel	2002	..	..	3,892	3,427	1,596
Italy	2004	1,532	..	..	..	..
Korea	2004	..	..	12,138	..	6,554
Netherlands	2003	2,415	..	..	..	..
New Zealand	2005	..	..	918	..	..
Norway	2003	970	283	..	..	..
Poland	2004	..	..	..	946	109
Portugal	2003	153	..	..	..	..
South Africa	2002/03	..	..	..	1,020	..
Spain	2004	1,484	..	..	..	2,884
Sweden	2003	3,716	2,359	8,632	..	1,648 [2]
Switzerland	2004	8,819	4,143	..	..	..
United Kingdom	2003	22,405	9,644	..	..	..
United States	2003	172,391	73,520	1,134,879 [3]	130,305 [3]	34,257 [3]

1. Data from Critical I report to the UK DTI, 2005, based on core biotechnology firms and full-time equivalents (FTEs).
2. Full-time equivalents (FTEs).
3. 2001 estimates from the US Department of Commerce survey. Biotech R&D employment based on responses from 884 out of the 1,031 reporting firms. Among these 884 firms, total employment was 1,052,327 employees.

BIOTECHNOLOGY SALES

- An estimate of the total sales of biotechnology firms is available for 2003 or the nearest year for 16 countries plus China (Shanghai).
- For seven countries the results are for sales of biotechnology goods and services only among all biotechnology-active firms, while in the remaining nine countries only total sales is available for core biotechnology firms, including sales from other goods and services.
- Four countries provide data for both sales from biotechnology goods and services only and for total sales. The percentage of biotechnology sales out of total sales is 92% in Israel, 46% in New Zealand, 15% in Canada, and 10% in the United States. The difference is lowest when most biotechnology-active firms are small (Israel) and greatest when biotechnology-active firms include large firms (United States).
- Sales in the United States in 2001 for biotechnology goods and services only was PPP$ 50,472 million, or 41% more than the total sales in all other reporting countries combined of PPP$ 35,873 million.
- Data on the percentage of all sales of biotechnology goods and services by firm size are available for Canada and Germany. Large firms account for 68.4% of biotechnology sales in Germany (over 500 employees) and for 64.2% of biotechnology sales in Canada (over 150 employees).

Sales of biotechnology firms, Million PPP$, 2003



1. Total sales from biotechnology goods and services only.
2. Total sales in core biotechnology firms.
3. Data from *Genoma España*, 2005.
4. Data from Critical I report to the UK DTI, 2005.
5. Sales of 'modern' biotechnology goods and services only.

BIOTECHNOLOGY APPLICATIONS

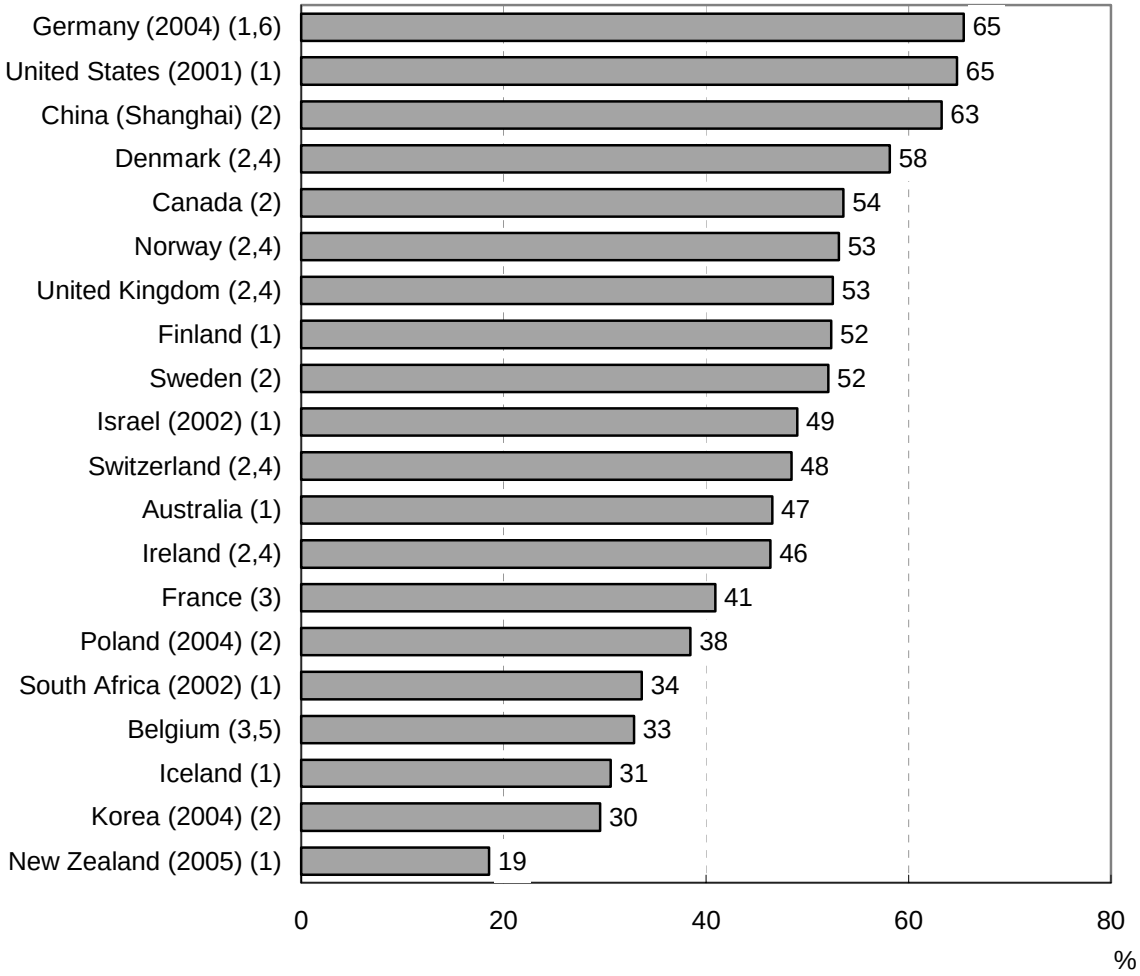
- Biotechnology has applications in many fields, including human and animal health, agriculture, fishing and forestry, food processing, industrial processing, and natural resource extraction, including energy.
- Although the definition of the application fields differs across countries, it is possible to create three main application fields that are generally comparable across all countries: health, agro-food, and industry-environmental applications. Health includes both human and animal health, agro-food includes all agricultural applications plus fishing, silviculture and food processing; and industry-environmental includes industrial processing, natural resources, and environmental applications. In addition, an 'other' category covers services and platform technologies such as bioinformatics plus other application fields that are not included in the three main categories in some countries.
- Data are available by application field for the number of firms, R&D investments, sales, and employment. The figures provide results for health, agro-food and industrial-environmental applications. The tables on pages 40 to 43 provide all results, including data for the 'other' application field.

Number of firms by application

- Data on the number of firms active in each application are available for 19 countries plus China (Shanghai).
- Firms can be active in more than one application field. For 11 countries each firm was assigned to a primary application, for 7 countries firms could report activity in more than one field, and for 2 countries the application field was based on the firm's sector. For the seven countries where firms report activity in more than one application, the results are the percentage of the total number of 'reports' in each application field.
- The majority of firms, 51%, are active in health, followed by 19% of firms active in agro-food, 16% active in the other category, and 15% active in industry-environmental applications.
- Germany and the United States have the highest activity rate for health applications (65%), followed by China (63%) and Denmark (58%). Only 19% of activity is in health in New Zealand.
- Conversely, New Zealand leads all other countries in the activity rate for firms in agro-food applications, at 53%. The activity rate for agro-food applications is less than 10% in Sweden, the United States, the United Kingdom, Switzerland, and Denmark.
- Industry-environmental activity is highest in Korea (41%). The activity rate for firms is under 10% in the United States, Canada, Switzerland, Norway, and Denmark.

Biotechnology applications: firm counts

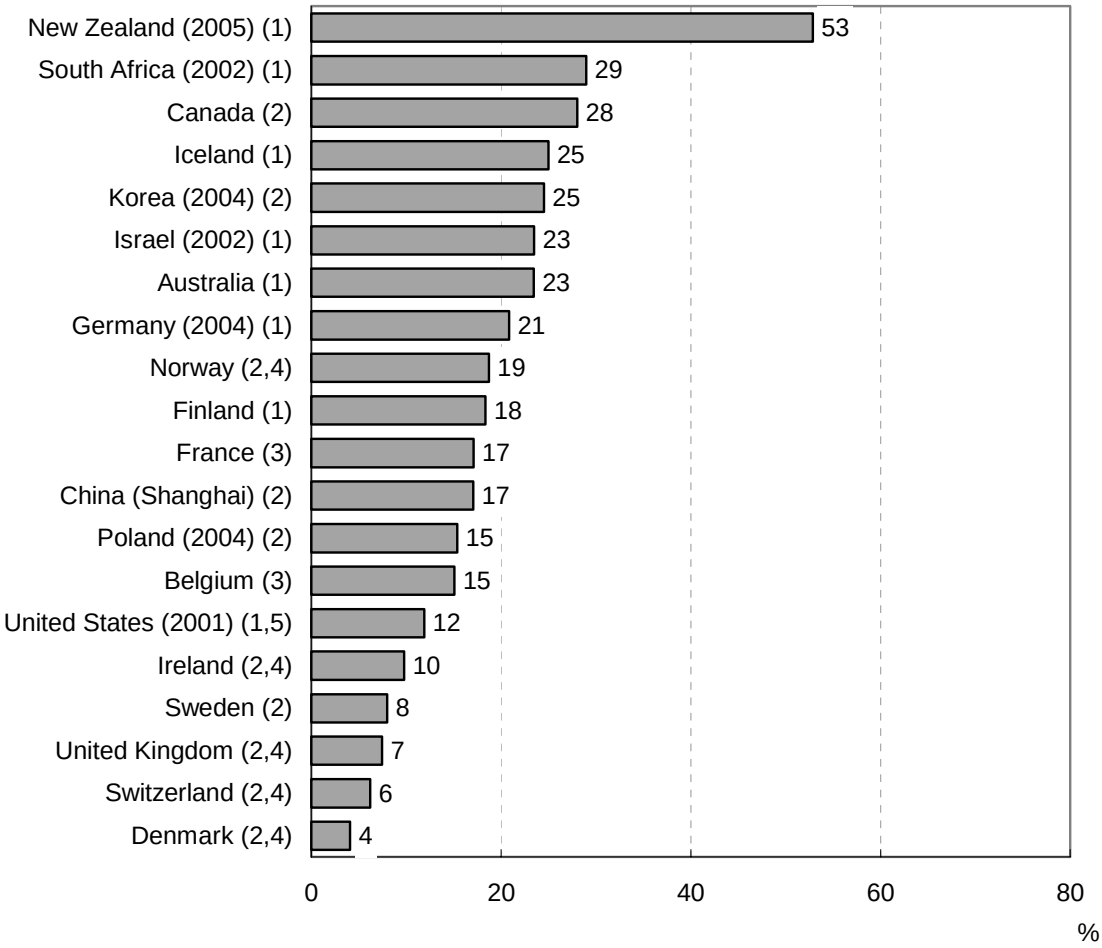
Percent of biotechnology firms active in health applications, 2003



1. Firms can be active in more than one application field.
2. Main application field of the firm.
3. Application field based on NACE sector of activity, underestimating firms active in health as many of these are in R&D services, assigned to 'other'.
4. Data from Critical I report to the UK DTI, 2005, based on core biotechnology firms.
5. Health services included under 'other'.
6. Health may include platform technologies and services.

Biotechnology applications: firm counts

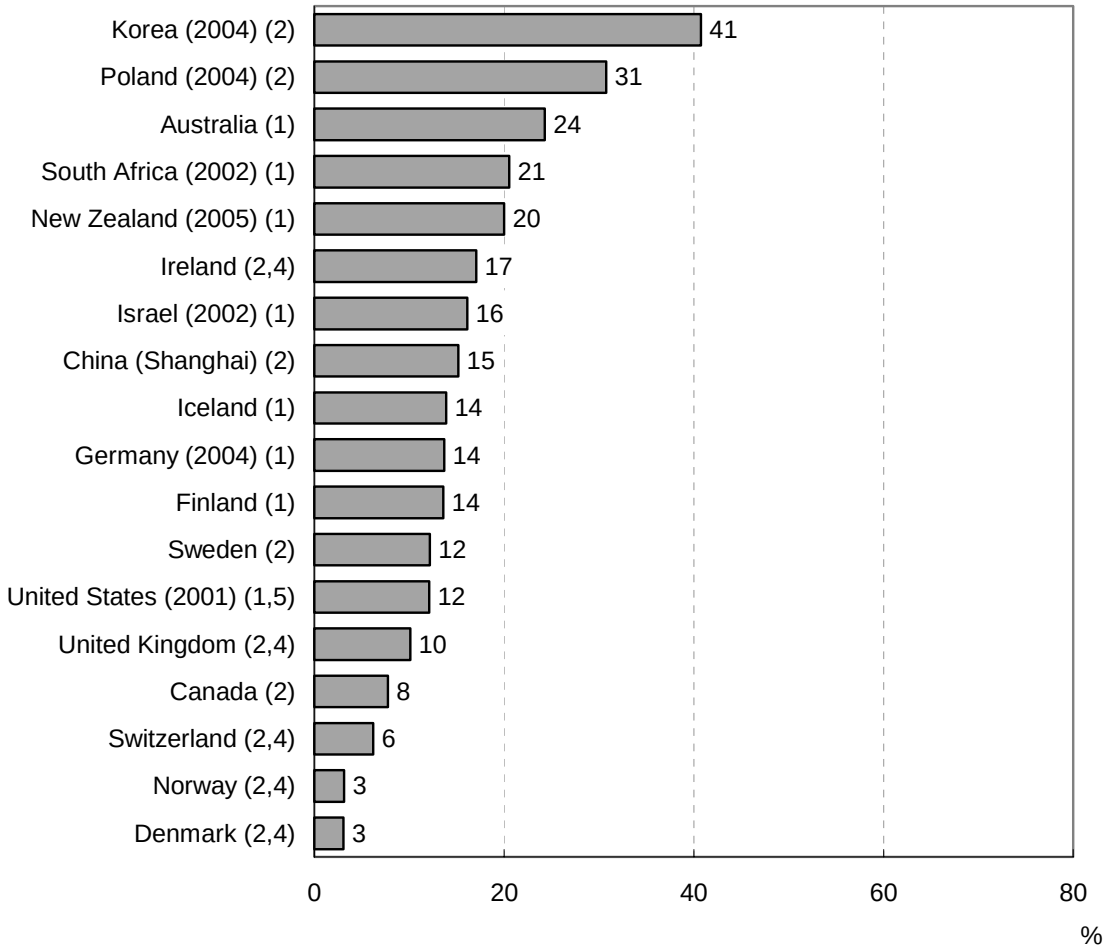
Percent of biotechnology firms active in agro-food applications, 2003



1. Firms can be active in more than one application field.
2. Main application field of the firm.
3. Application field based on NACE sector of activity.
4. Data from Critical I report to the UK DTI, 2005, based on core biotechnology firms.
5. Agriculture-derived processing assigned to industrial-environmental applications.

Biotechnology applications: firm counts

Percent of biotechnology firms active in industrial-environmental applications, 2003



1. Firms can be active in more than one application field.
2. Main application field of the firm.
3. Application field based on NACE sector of activity.
4. Data from Critical I report to the UK DTI, 2005, based on core biotechnology firms.
5. Agriculture-derived processing assigned to industrial-environmental applications.

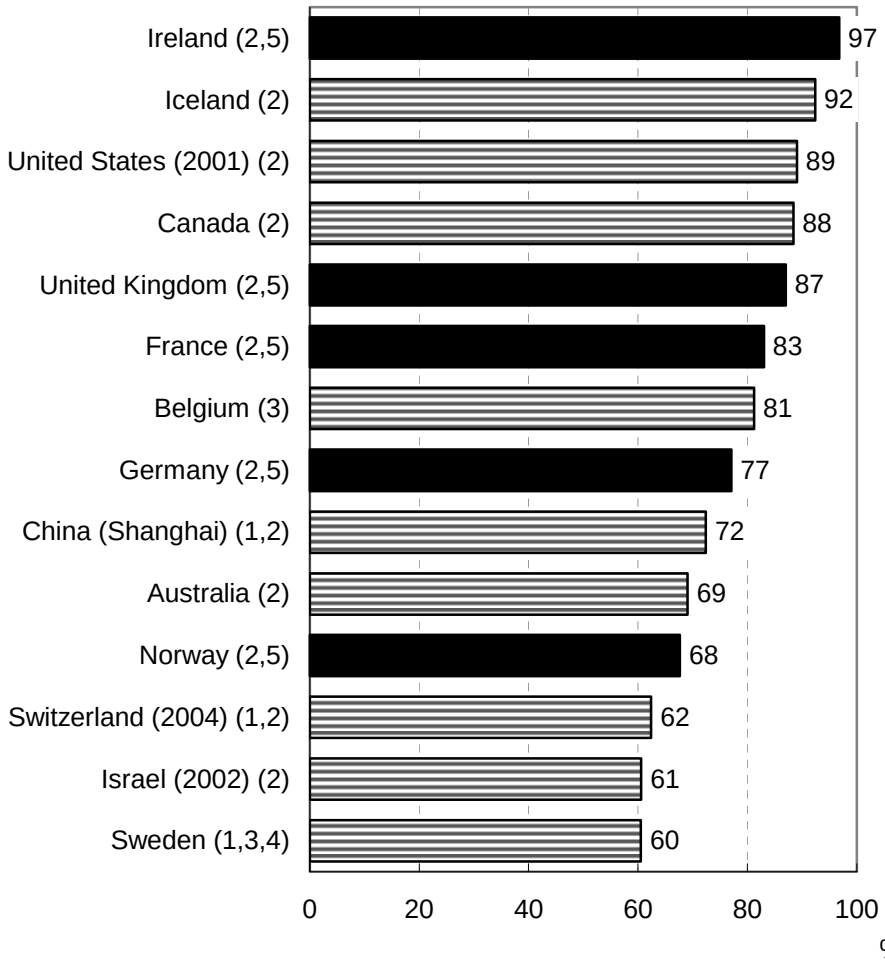
BIOTECHNOLOGY APPLICATIONS

R&D investments by application

- Data on R&D investments by application field are available for 13 countries plus China (Shanghai). The data are for R&D expenditures in 12 countries, but Sweden and Belgium provide data in terms of R&D employees. Given the close relationship between R&D employees and R&D expenditures, the two methods of measuring R&D investment are presented in the same Figures for health, agro-food, and industrial-environmental applications.
- The results for five countries (France, Germany, Ireland, Norway and the United Kingdom) are limited to total R&D expenditures by core biotechnology firms, which will include R&D on non-biotechnology-related research and excludes biotechnology R&D performed by large firms. All other results are for biotechnology R&D and include large firms if active in biotechnology.
- Health applications dominate biotechnology R&D. Excluding Sweden and Belgium where the shares are based on R&D employees, 87% of all estimated biotechnology R&D expenditures in the remaining 12 countries are for health applications, 4% for agro-food applications, 2% for industrial-environmental applications, and 7% for 'other' applications.
- In all countries, the majority of biotechnology R&D investments are focused on health applications. Almost 90% or more of biotechnology R&D is for health applications in the United States (89%), Iceland (92%), and Ireland (97%). The lowest share is in Sweden, but this is partly because health-related biotechnology employment in the service sector is assigned to the 'other' category.
- Israel and China have the highest share of biotechnology R&D investment on agro-food applications (14%), followed by Australia (12%). There are no detectable expenditures on agro-food biotechnology in Ireland.
- Australia has the highest share of biotechnology R&D investment for industrial-environmental applications, at 15%, followed by Switzerland (10%) and Israel (7%). The share is below 2% for four countries: Germany, France, the United Kingdom and Iceland. With the exception of Iceland, the very low shares could be due to the limitation on core biotechnology firms. For instance, 14% of all German firms with biotechnology R&D report activity in industrial-environmental applications. The discrepancy between firm count data and R&D expenditure data could be partly explained if many industrial-environmental applications are researched by large firms.

Biotechnology applications: R&D

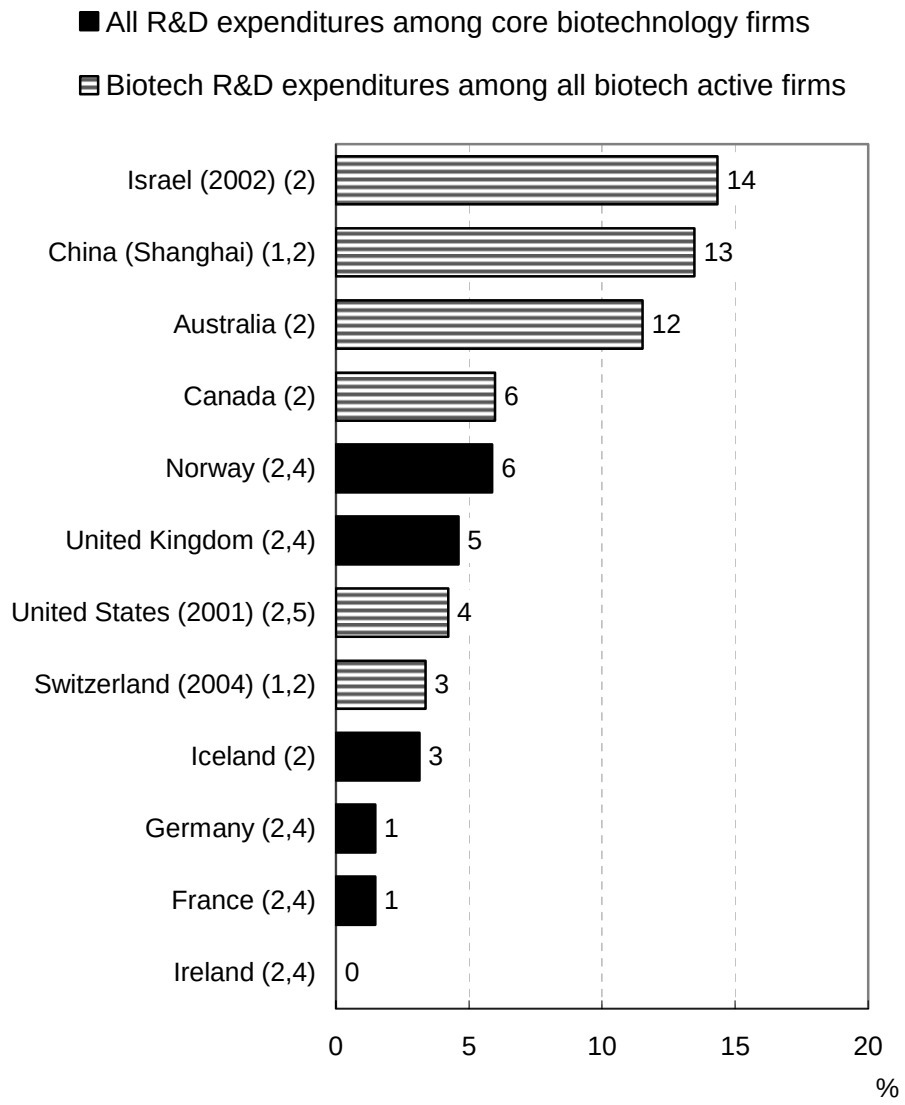
Percent of biotechnology firm R&D investments on health applications, 2003



1. Application field based on sector of activity, underestimating firms active in health as many of these are in R&D services, assigned to 'other'.
2. Application focus based on distribution of R&D expenditures.
3. Application focus based on distribution of R&D employees.
4. Limited to firms with more than 50 employees.
5. Data from Critical I report to the UK DTI, 2005, based on total R&D expenditures in core biotechnology firms.

Biotechnology applications: R&D

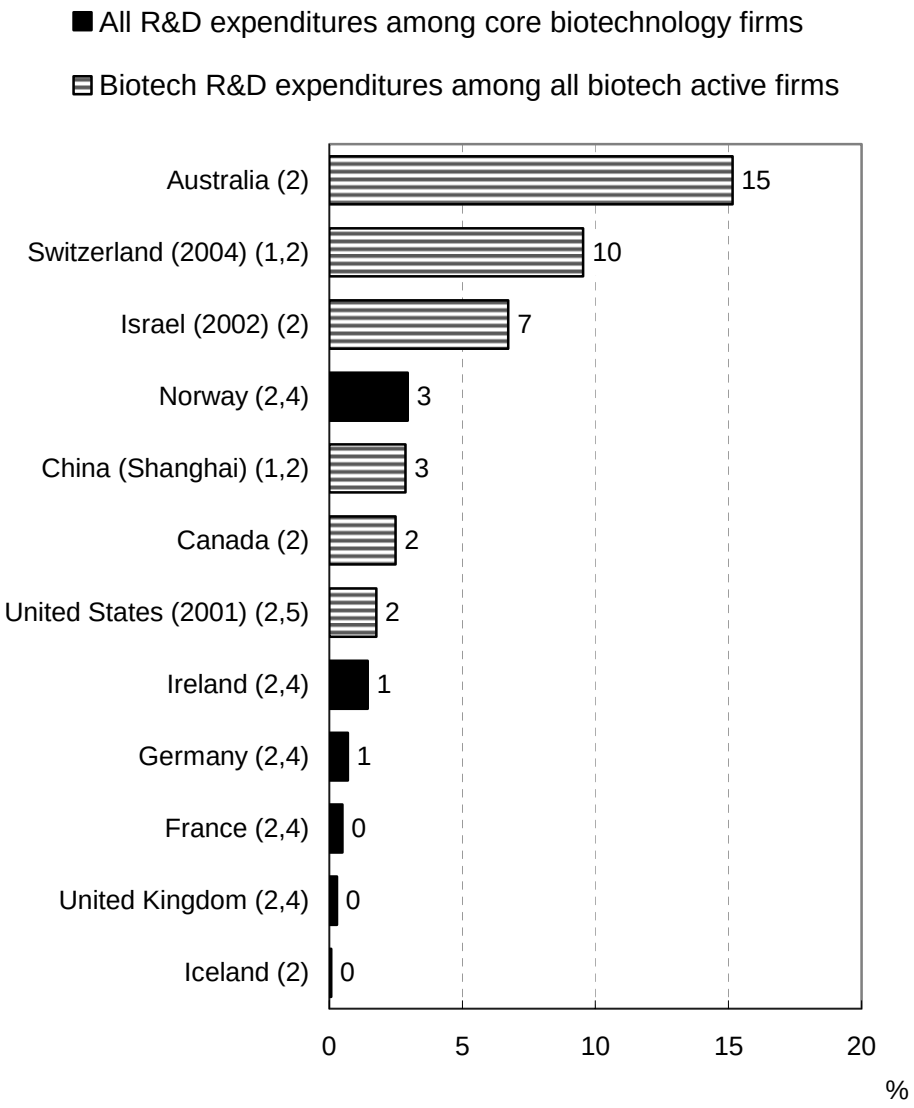
Percent of biotechnology firm R&D investments on agro-food applications,[3] 2003



1. Application field based on sector of activity.
2. Application focus based on distribution of R&D expenditures.
3. No results for Sweden and Belgium where the sector definition of the application area is not detailed enough to identify agro-food or industrial-environmental applications.
4. Data from Critical I report to the UK DTI, 2005, based on total R&D expenditures in core biotechnology firms.
5. Agriculture-derived processing assigned to industrial-environmental applications.

Biotechnology applications: R&D

Percent of biotechnology firm R&D investments on industrial-environmental applications,[3] 2003



1. Application field based on sector of activity.
2. Application focus based on distribution of R&D expenditures.
3. No results for Sweden and Belgium where the sector definition of the application area is not detailed enough to identify agro-food or industrial-environmental applications.
4. Data from Critical I report to the UK DTI, 2005, based on total R&D expenditures in core biotechnology firms.
5. Agriculture-derived processing assigned to industrial-environmental applications.

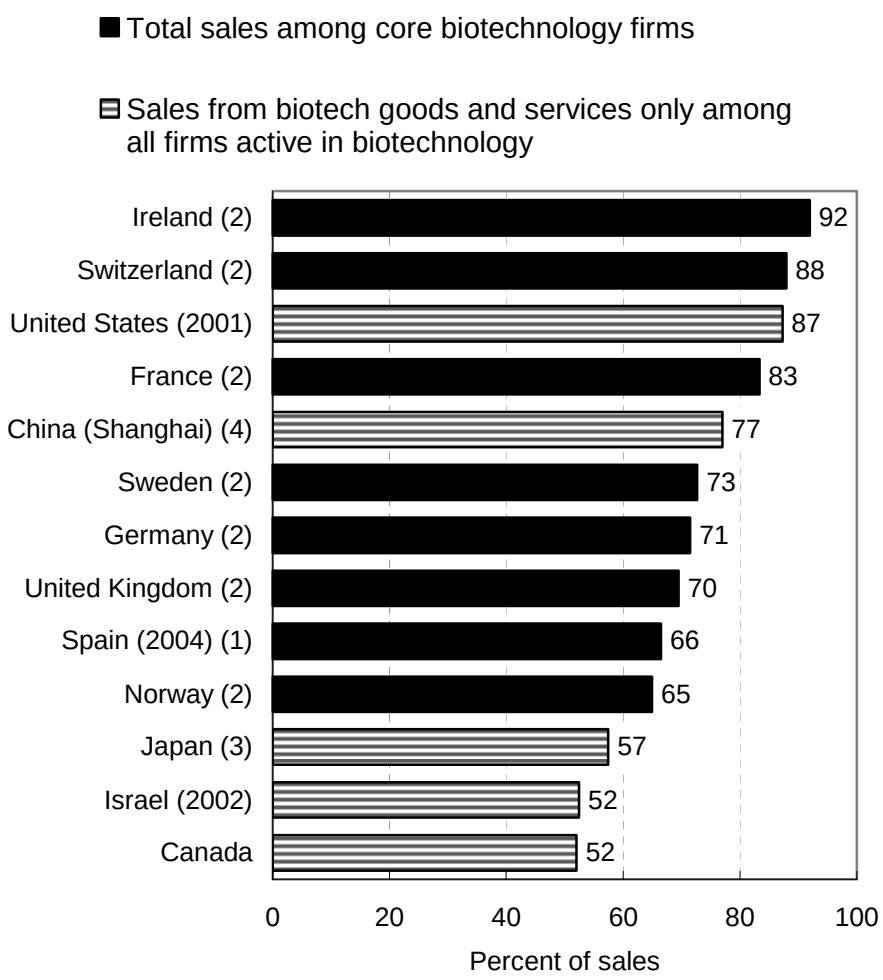
BIOTECHNOLOGY APPLICATIONS

Biotechnology sales by application

- Data on sales from biotechnology goods and services are available for 12 countries plus China (Shanghai). However, for eight countries the results are for total sales among core biotechnology firms. Sales results for biotechnology goods and services only, among all firms active in biotechnology, are only available for five countries: Canada, China (Shanghai), Israel, Japan and the United States. The results for Japan are limited to 'modern' biotechnology, but this could include sales from biotechnologies that do not fit the list-based OECD definition.
- The total sales in the 13 countries is PPP$ 82,852 million. As with R&D investments, health applications account for the large majority of the total at 80%, followed by the 'other' (mostly services) at 9%, agro-food applications at 6%, and industry-environmental applications at 5%.
- The share of sales from health applications of biotechnology is above 80% in four countries: France (83%), the United States (87%), Switzerland (88%), and Ireland (92%). Conversely, the health applications share is below 60% in Japan (57%), Israel (52%), and Canada (53%).
- The agro-food sales share of 45% in Canada is almost as high as the share from health applications. Other countries with a relatively high proportion of sales from agro-food applications are Israel (30%) and Norway (27%).
- The share of sales from industrial-environmental applications only exceeds 10% in China (12%) and Japan (22%). Germany performs better in sales from industrial-environmental applications (5%) than it does for R&D investments in this application field (0.7%).

Biotechnology applications: sales

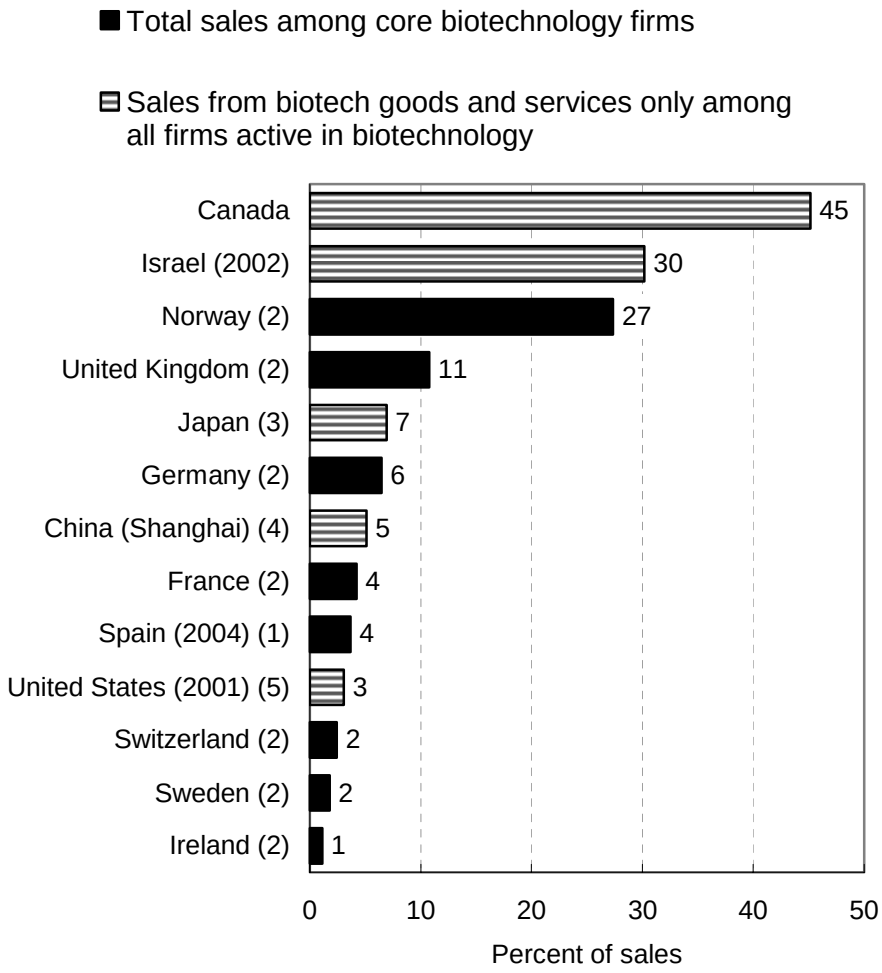
Share of sales from health applications among biotechnology firms, 2003



1. *Genoma España* results for total sales of core biotechnology firms.
2. Data from Critical I report to the UK DTI, 2005, based on total sales of core biotechnology firms.
3. Limited to 'modern' biotechnology goods and services.
4. Application field based on sector of activity.

Biotechnology applications: sales

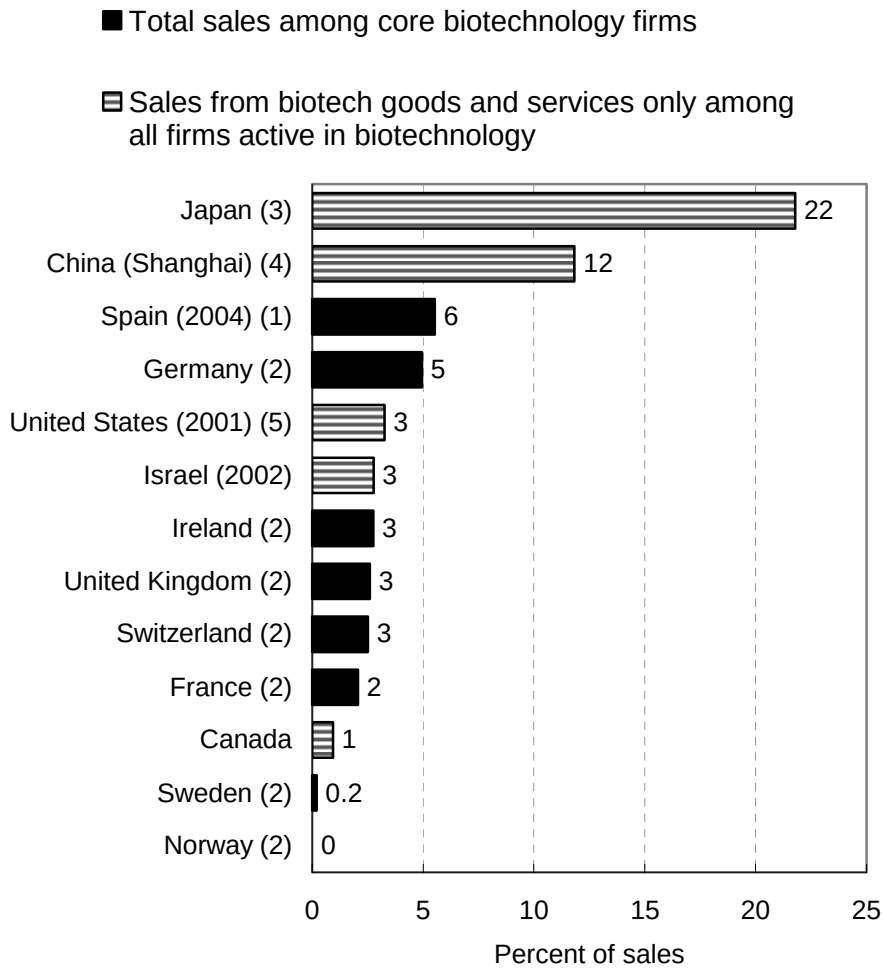
Share of sales from agro-food applications among biotechnology firms, 2003



1. *Genoma España* results for total sales of core biotechnology firms.
2. Data from Critical I report to the UK DTI, 2005, based on total sales of core biotechnology firms.
3. Limited to 'modern' biotechnology goods and services.
4. Application field based on sector of activity.
5. Agriculture-derived processing assigned to industrial-environmental applications.

Biotechnology applications: sales

Share of sales from industrial-environmental applications among biotechnology firms, 2003



1. *Genoma España* results for total sales of core biotechnology firms.
2. Data from Critical I report to the UK DTI, 2005, based on total sales of core biotechnology firms.
3. Limited to 'modern' biotechnology goods and services.
4. Application field based on sector of activity.
5. Agriculture-derived processing assigned to industrial-environmental applications.

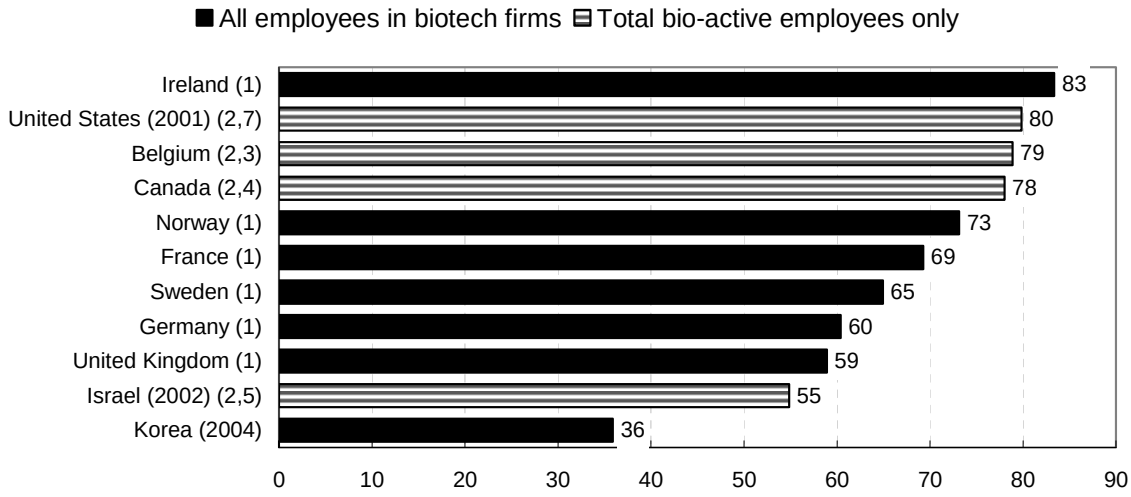
BIOTECHNOLOGY APPLICATIONS

Total employment by application

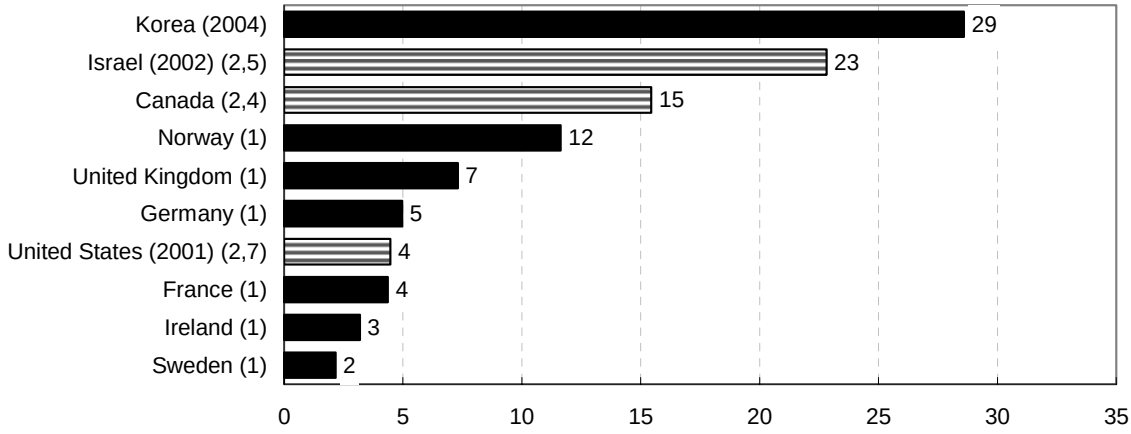
- Data on total employment by application field are available for up to 11 countries. For eight countries data are only available for total employment among firms active in biotechnology. For four countries (Belgium, Canada, Israel and the United States), the data are for bio-active employees, or employees with biotechnology-related responsibilities.
- Data for Belgium, Canada, Israel, Korea and the United States are for all firms active in biotechnology, whereas the results for the other six countries are for core biotechnology firms only.
- The figures for the distribution of total employment by application do not include Denmark, due to problems with the estimate for employment in health applications, but the results for Denmark for the other three application areas are included in Table 4.
- The employment data by application for the United States is from the US Department of Commerce survey for 2001 and estimates 24.4% fewer biotechnology employees than the Critical I estimate for 2003, which is used on page 21. The difference is unlikely to be due to rapid growth in employment during these two years, but to the 2001 survey underestimating total employment due to a response rate of 61% with no extrapolation (see the Methodology chapter for additional information). However, the 2001 results for the United States should provide a reasonable estimate of the distribution of employment by application field.
- For all eleven countries combined, 72.8% of employment is in health applications, 6.9% in agro-food, 6.7% in industrial-environmental, and 13.9% in other applications.
- Korea is the only country where the majority of employees are not active in health applications. The share of total biotechnology employment in health applications is 80% or higher in the United States and Ireland.
- Agro-food applications account for over 10% of total employment in four countries: Norway (12%), Canada (15%), Israel (23%), and Korea (29%).
- The share of total biotechnology employment in industry-environmental applications only exceeds 10% in Korea, at 31%.

Biotechnology applications: employment

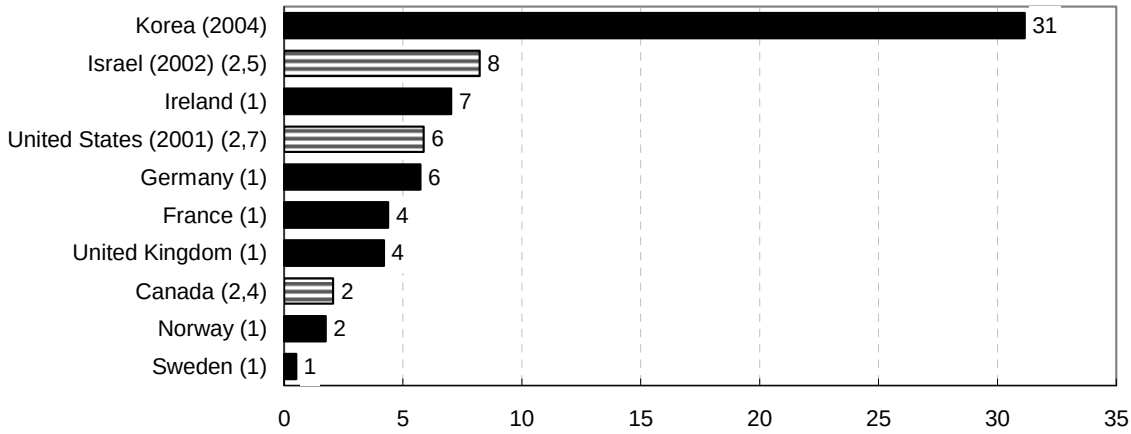
Percent of biotechnology employment by application: health, 2003



Percent of biotechnology employment by application: agro-food, 2003



Percent of biotechnology employment by application: industrial-environmental, 2003



See Table 4 for footnotes.

Biotechnology applications: firm counts

Table 1. **Percent of biotechnology firms active in each main application field**

		Health	Agro-food	Industrial-environmental	Other	Total
		Percent				
Australia[1]	2003	47	23	24	6	100
Belgium[3,5]	2003	33	15	..	52	100
Canada[2]	2003	54	28	8	11	100
China (Shanghai)[2]	2003	63	17	15	4	100
Denmark[2,4,9]	2003	58	4	3	35	100
Finland[1]	2003	52	18	25	5	100
France[3,6,10]	2003	41	17	..	41	100
Germany[1,11]	2004	66	21	14	..	100
Iceland[1]	2003	31	25	14	31	100
Ireland[2,4,9]	2003	46	10	17	27	100
Israel[1,7]	2002	49	24	16	11	100
Korea[2]	2004	30	25	41	5	100
New Zealand[1]	2005	19	53	20	9	100
Norway[2,4,9]	2003	53	19	3	25	100
Poland[2]	2004	39	15	31	15	100
South Africa[2]	2002	34	29	21	17	100
Sweden[2,8]	2003	52	8	12	28	100
Switzerland[2,4,9]	2003	49	6	6	39	100
United Kingdom[2,4,9]	2003	53	8	10	30	100
United States[1,12]	2001	65	12	12	11	100

Application definitions

Health: includes human and animal health applications.
Industrial-environmental: includes industrial processing, environmental, energy and natural resource extraction applications.
Agro-Food: includes agricultural and food processing, marine, and silviculture applications.
Other: includes bioinformatics, support services not included above, and other applications not included above.

1. Each firm can be active in more than one application field. The results are the percentage of the total number of firm-application combinations in each application.
2. Main application field of the firm.
3. Application field based on NACE sector of activity. This will underestimate the number of firms active in health as many of these firms are in R&D services and assigned to the 'other' category.
4. Data from Critical I report to the UK DTI, 2005, based on core biotechnology firms.
5. Health services included under 'other'.
6. Other includes firms in industry sectors where it is not possible to determine their applications.
7. Other includes cosmetics; silviculture is assigned to environmental (industrial) applications.
8. Limited to firms with more than 50 employees. Other includes manufacturers of biotech tools and supplies.
9. Other includes bioprocessing and chemicals.
10. Estimate of industry-environmental applications is inaccurate for France, as most manufacturing sector firms outside of pharmaceuticals are assigned to the 'other' category.
11. None of the firms in Germany are assigned to the 'other' application field. The 'health' category probably includes platform technology firms.
12. Agriculture-derived processing assigned to industrial-environmental applications.

Biotechnology applications: R&D

Table 2. **R&D investments by application field, 2003**

	Health	Agro-food	Industrial-environmental	Other	Total
	R&D expenditures (Million PPP$)				
Australia	138.5	23.1	30.4	8.5	200.5
Canada	1,316.0	89.0	37.0	46.0	1,488.0
China (Shanghai)[1]	144.0	26.8	5.7	22.4	198.9
Denmark [2,3]	..	4.4	0.0	121.7	..
France [2]	557.4	9.9	3.3	100.4	671.1
Germany [2]	1,043.2	20.0	9.5	280.6	1,353.4
Iceland	62.1	2.1	0.1	3.0	67.3
Ireland [2]	269.0	0.0	4.0	5.0	278.0
Israel (2002)	152.1	36.0	16.9	46.1	251.1
Norway [2]	21.0	1.8	0.9	7.3	31.0
Switzerland (2004) [1]	292.9	15.8	44.8	115.7	469.2
United Kingdom [2]	1,746.8	92.5	5.7	162.3	2,007.3
United States (2001)[7]	14,997.0	710.0	298.0	829.0	16,834.0
Total	**20,740.1**	**1,027.1**	**456.3**	**1,626.3**	**23,849.7**
Percent all R&D expenditures[6]	87%	4%	2%	7%	100%
R&D employees					
Belgium [5]	1,612	..	..	372	1,984
Sweden [1,4,5]	997	..	..	651	1,648

1. Application field based on sector of activity.
2. Data from Critical I report to the UK DTI, 2005, based on total R&D expenditures in core biotechnology firms. The 'other' category includes bioprocessing and chemicals, which are assigned to industry-environmental in other countries.
3. The Critical I estimates of the Danish biotechnology health sector account for almost all output of the pharmaceutical sector in Denmark. This substantially overestimates biotechnology activity in the health sector and prevents comparability with other countries.
4. Limited to firms with more than 50 employees.
5. 'Other' includes agro-food and industry-environment applications.
6. Results for Denmark are excluded.
7. Agriculture-derived processing assigned to industrial-environmental applications.

Biotechnology applications: sales

Table 3. **Biotechnology sales by application field, 2003**

	Health	Agro-food	Industrial-environmental	Other	Total
	Sales (Million PPP$)				
Canada	1,999.0	1,735.0	36.0	72.0	3,842.0
China (Shanghai)[1]	1,454.2	96.4	223.5	114.8	1,888.9
France[2]	1,788.1	90.5	44.2	223.0	2,145.7
Germany[2]	2,302.7	207.8	159.3	551.7	3,221.5
Ireland[2]	903.0	11.0	27.0	41.0	982.0
Israel (2002)	174.0	100.1	9.2	48.5	331.8
Japan[3]	5,677.4	685.2	2,153.5	1,370.3	9,886.3
Norway[2]	69.3	29.2	0.0	8.2	106.6
Spain (2004)[4]	259.9	14.3	21.6	95.1	390.9
Sweden[2]	352.4	8.7	1.0	123.0	485.0
Switzerland[2]	1,897.0	52.0	54.0	154.0	2,157.0
United Kingdom[2]	4,004.2	620.3	149.7	985.9	5,760.1
United States[5]	45,104.0	1,580.0	1,687.0	3,284.0	51,655.0

1. Estimated sales value.
2. Data from Critical I report to the UK DTI, 2005, based on total sales of core biotechnology firms including non-biotechnology products.
3. Domestic production. Modern biotechnology only.
4. *Genoma España* results for total sales of core biotechnology firms, including non-biotechnology products.
5. Limited to sales in the firms that identified the application as their primary field of application. Agriculture-derived processing assigned to industrial-environmental applications.

Biotechnology applications: employment

Table 4. **Biotechnology employment by application field**

	Health	Agro-food	Industrial-environmental	Other	Total
	Employees				
Belgium[2,3]	3,360	..	..	901	**4,261**
Canada[2,4]	9,255	1,832	246	531	**11,864**
Denmark[1,6]	..	359	74	2,985	**..**
France[1]	6,182	390	391	1,960	**8,923**
Germany[1]	10,434	857	990	4,996	**17,277**
Ireland[1]	2,452	94	207	188	**2,941**
Israel (2002)[2,5]	1,879	782	282	484	**3,427**
Korea (2004)	4,356	3,471	3,780	531	**12,138**
Norway[1]	710	113	17	131	**971**
Sweden[1]	2,413	81	19	1,204	**3,717**
United Kingdom[1]	13,199	1,638	941	6,628	**22,406**
United States (2001)[2,7]	104,024	5,832	7,646	12,803	**130,305**
Total[8]	**158,264**	**15,090**	**14,519**	**30,357**	**218,230**

1. Data from Critical I report to the UK DTI, 2005, based on total employment in core biotechnology firms
2. Bio-active employment (employees with biotechnology-related responsibilities) only.
3. Agro-food and industry-environmental applications assigned to 'Other'.
4. Industry-environmental limited to environmental applications, with industrial applications in 'Other'.
5. Cosmetics assigned to 'Other'.
6. Critical I estimates for health employment may substantially overestimate actual employment and are therefore not given (see footnote 3, Table 2).
7. Industrial-environmental includes agriculture-derived processing. Original data for the United States overestimates the true number of employees (130,305) by 6.9% due to double counting. The results given here have been proportionately reweighted to total actual number of employees. Results in FTEs.
8. Totals exclude Denmark.

BIOTECHNOLOGY PATENTS

The following was extracted from the OECD (2005), *Compendium of Patent Statistics*. The report is available on line at: www.oecd.org/sti/ipr-statistics

- Biotechnology patents have grown more rapidly than overall patent applications at the European Patent Office (EPO). Between 1991 and 2002, they grew by 8.3% a year, while total EPO patent applications grew by 5.7%. The rate of increase in biotechnology patents accelerated from 1994 onwards. The latest available data show a slight decline in biotechnology patent filings at the EPO. This could be related to the adoption by the EPO of more restrictive policies for examining biotechnology patents in recent years. This trend is also observed for countries with a large biotechnology patent portfolio.
- The latest available data show that around 5.3% of all EPO patent applications are in the biotechnology field (see methodological box for definition). However, the ratio of biotechnology patents to all EPO patents varies substantially across countries. New Zealand, Denmark and Australia have a very high ratio of biotechnology patents to all EPO patents (more than 10%). In contrast, only around 2% of all EPO patents originating from Finland and Italy are biotechnology patents.
- For the majority of countries, the ratio of biotechnology patents to all EPO patents increased between 1991 and 2002. However, notable exceptions are Denmark and Belgium as well as countries with a low ratio of biotechnology patents to all EPO patents.
- In 2002, more than 5,800 biotechnology patents were filed at the European Patent Office (EPO), most of which originated from the United States (39.9%) and the European Union (34.5%). Around 14% of the EPO biotechnology patents originate from Japan. Since 1997, the shares of the European Union and Japan in biotechnology patents have increased, while those of the United States have continuously decreased.
- To measure a country's level of specialisation in biotechnology patents, country shares can be expressed in terms of a specialisation index (see methodological box). By this measure, the United States is highly specialised in biotechnology patents, while the European Union and Japan are not.
- Denmark, Canada, New Zealand and Australia are the most specialised countries in biotechnology patents. Italy, Turkey and Luxembourg are the least specialised. Three non-OECD countries (Israel, China and India) are also relatively specialised in biotechnology patents.

Definition of biotechnology patents

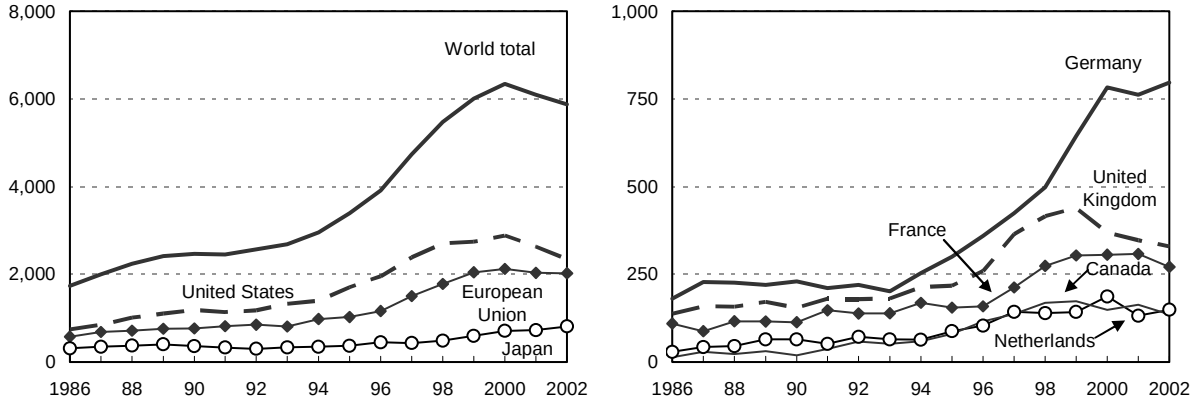
The definition of biotechnology patents covers the following IPC classes: A01H1/00, A01H4/00, A61K38/00, A61K39/00, A61K48/00, C02F3/34, C07G(11/00, 13/00, 15/00), C07K(4/00, 14/00, 16/00, 17/00, 19/00), C12M, C12N, C12P, C12Q, C12S, G01N27/327, G01N33/(53*, 54*, 55*, 57*, 68, 74, 76, 78, 88, 92).

For further details on the IPC classes, see www.wipo.int/classifications/fulltext/new_ipc/index.htm.

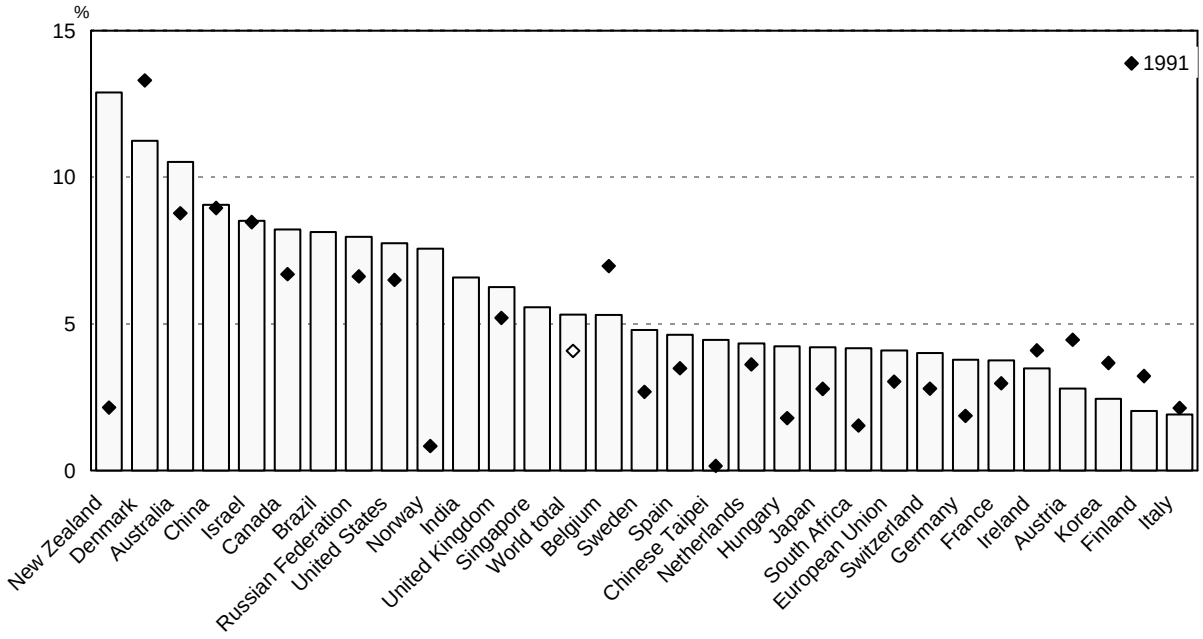
The specialisation index (SI) is calculated as the share of country A in a specific technology area (*i.e.* biotechnology patents) divided by the share of country A in all technology areas (total EPO patents of country A). When the SI of biotechnology patents is greater than 1, the country has a higher share in biotechnology patents relative to its share in all technology areas. Conversely, when the SI of biotechnology patents is below 1, the country has a lower share in biotechnology patents than in all technology areas combined.

Biotechnology patents

Trends in biotechnology patents[1] filed at the EPO
Total number, major regions and leading countries



Biotech patents[1] as a percentage of the national total (EPO): selected countries/economies,[2] 2002



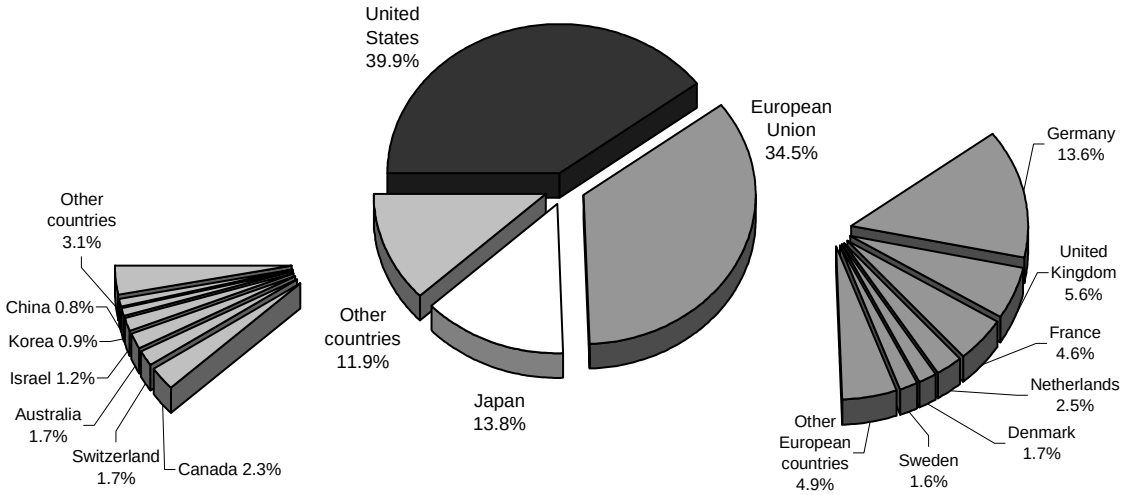
Patent counts are based on the inventor's country of residence, the priority date and fractional counts.

1. The provisional definition of biotechnology patents is presented in the methodological box.
2. The graph only covers countries with more than 100 EPO applications in 2002.

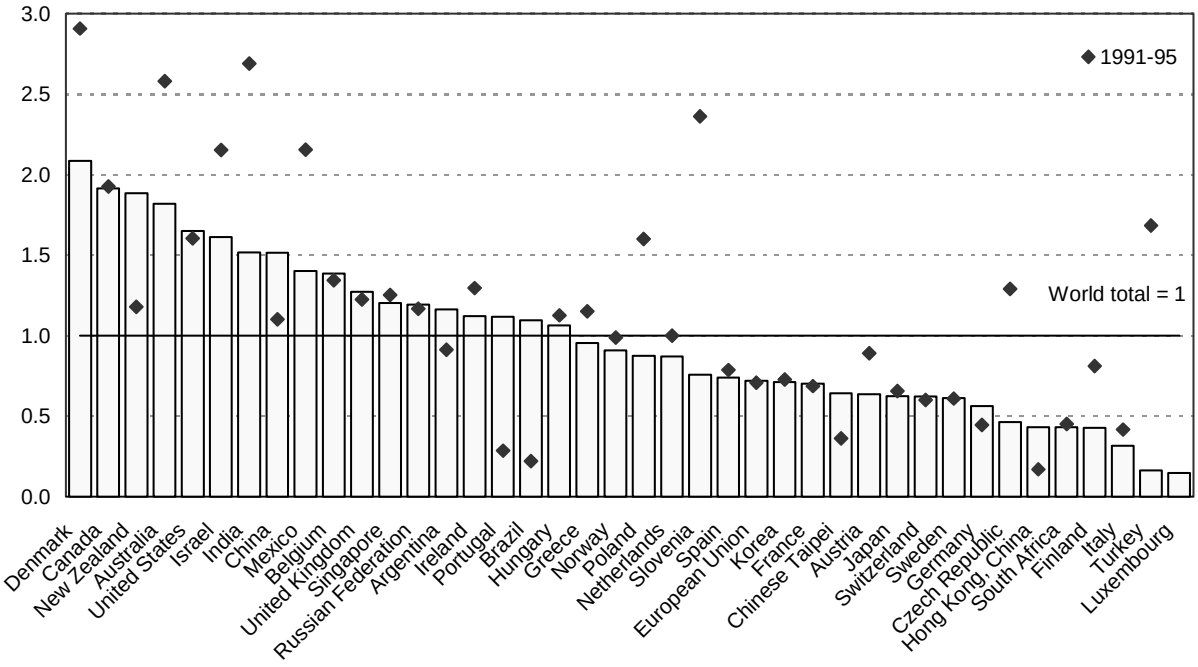
Source: OECD (2005), *Compendium of Patent Statistics*, January 2006.

Biotechnology patents

Share of countries in biotechnology patents[1] filed at the EPO, 2002



Specialisation index of biotechnology patents[1] filed at the EPO,[2] 1996-2002



Patent counts are based on the inventor's country of residence, the priority date and fractional counts.

1. The provisional definition of biotechnology patents is presented in the methodological box.
2. The graph only covers countries/economies with more than 200 EPO applications for the period 1996-2002.

Source: OECD (2005), *Compendium of Patent Statistics*, January 2006.

BIOTECHNOLOGY IN AGRICULTURE

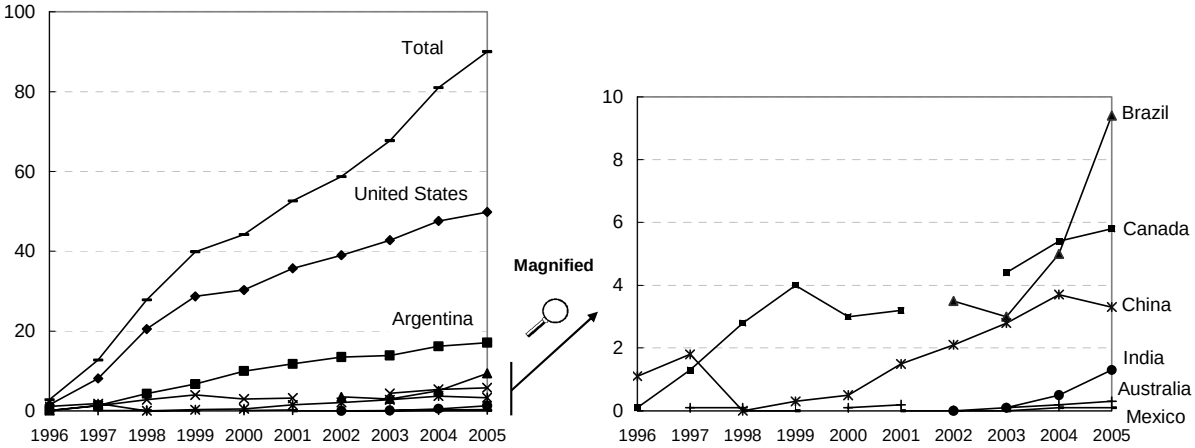
- Biotechnology has many applications in agriculture, including diagnostics, vaccines and therapeutics for animal health; DNA fingerprinting for managing animal stocks and identifying specific plant varieties, animal and plant propagation, marker-assisted selection for plant and animal breeding programmes, and genetic modification (GM) of plant and animal varieties using rDNA technology. Animal health applications are combined in this report with human health applications, due to the similarity in the underlying biotechnologies.
- Internationally comparable data for biotechnology applications in agriculture are limited to GM plant varieties. Two types of data are available: hectares planted with GM crops and field tests of new GM varieties.

Hectares planted with GM crops

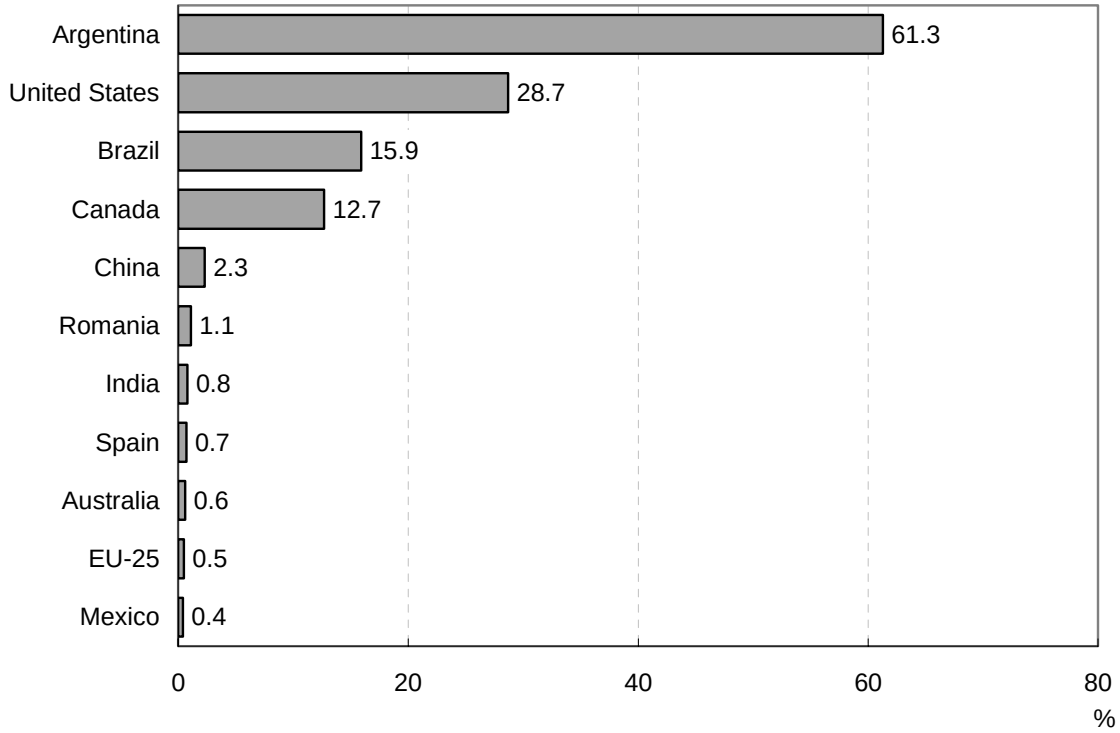
- GM crops were first extensively commercialised in 1996. Data on GM crop hectares are available for four OECD countries outside the European Union members, plus for India, China, Argentina and Brazil. The number of hectares planted with GM crops is negligible in most European Union countries, although some commercial GM crops are reported in 2005 for Spain, Germany, Portugal, France and the Czech Republic.
- In 2005, the United States accounted for 89% of GM crop hectares within the OECD. The United States' share of global GM crop hectares declined from 68% in 2000 to 55% in 2005, as the number of hectares planted with GM crops increased rapidly in other countries.
- In the three years between 2002 and 2005, the number of hectares planted with GM crops increased 27% in Argentina, 28% in the United States, 53% in Canada, 57% in China, and 169% in Brazil.
- The maximum area that can be planted with GM crops partly depends on the total arable land under cultivation. Argentina has the highest percentage of arable land planted with GM crops in 2005, at 61%, followed by the United States (29%), Brazil (16%) and Canada (13%). The estimate of 0.5% of arable land in the EU-25 under GM crops is likely to substantially overestimate the actual value.
- Two other main factors that determine the area planted with GM crops are regulations and the types of crops grown in each country. GM use is highest for countries with suitable growing conditions for the main GM crops to date: soybeans, maize, cotton, and canola.

Biotechnology in agriculture

Million hectares planted with GM crops, 1996 to 2005



Percent of all arable land[1,2] planted with GM crops, 2005



1. Data for arable land is for 2003. The amount of error in the estimated percentage of land planted with GM crops is likely to be low because the total area of arable land is relatively stable. For example, between 2001 and 2003 total arable land decreased by 0.5% in the United States and increased by 0.4% in Canada. A larger change was observed in Australia, with a decrease of 1%.
2. Arable land is defined as land under annual crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for "Arable land" does not measure the amount of land that is potentially cultivable.

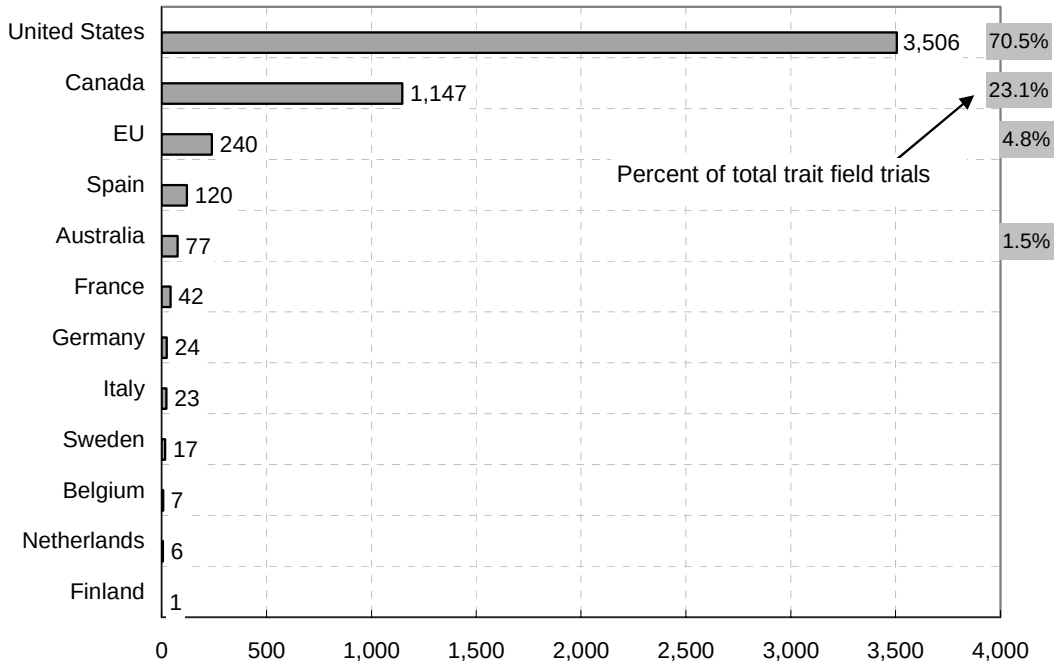
Sources: Clive James, 1997, 1999 'Global Review of Transgenic Crops', ISAAA Briefs, The International Service for the Acquisition of Agri-biotech applications (ISAAA), Ithaca New York; Clive James (2004, 2005), 'Global Status of Commercialized Biotech/GM Crops', ISAAA, Ithaca, New York; Data on arable land from FAOSTAT, 2006. http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=agriculture

BIOTECHNOLOGY IN AGRICULTURE

Field trials of GM varieties

- For regulatory reasons, Australia, Canada, the European Union, Japan and the United States maintain publicly available databases of field trials of GM plant varieties. The field test data provide information on both the amount of development work to produce new GM plant varieties and the types of GM traits under development (see the methodological note).
- Field trials can be undertaken for one genetic trait or for two or more traits simultaneously (stacked traits). The results presented here count each trait, rather than each field trial.
- Field trial data are not available for Japan after 2001, and are therefore not included here. The most comparable recent time period for the remaining countries is between 2002 and 2004. The field trials are aggregated over these three years because of the low number of trials in the European Union and Australia.
- Between 2002 and 2004 inclusive, 4,970 traits were field tested in the United States, Canada, the European Union, and Australia combined. The United States accounted for 70.5% of the total, Canada for 23.1%, Europe for 4.8% and Australia for 1.5%.
- Canada has the highest intensity for field trials of specific traits, with 35.1 traits field tested per billion PPP$ of agricultural output at producer prices and 36.2 traits field tested per million population. The United States is second, with 18.2 traits field tested per billion PPP$ of output and 12.0 traits field tested per million population.
- The field trials cover five major categories of genetic traits: tolerance to commercial herbicides, pest resistance to viruses, bacteria, insects, nematodes and fungi; improvements to product quality such as the type of oils, starches, sugars or cellulose in the plant, and improvements to agronomic characteristics such as yield or salt and cold tolerance. A fifth type of field trial covers technical traits, such as marker genes, genetic containment or other triats that are unclassifiable.
- A large percentage of the field trials in the 1990s concerned herbicide tolerance. Other types of GM technology offer potential environmental advantages by reducing pesticide use and improving agronomic characteristics (which could reduce fertilizer use). In addition, 'second generation' traits for improved product quality, such as low phytase animal feeds or improved oil seeds, could increase the value added of crop production, replace non renewable industrial feed stocks with renewable agricultural feed stocks, and provide a range of environmental benefits.
- An increase over time in the share of product quality traits out of all traits is a marker for increasing interest in the commercial possibilities of second generation traits, which could reach the market within two to six years after the field trials. Trend data are available for the United States, Canada, and the EU-15.
- Over time, the share of domestic field tests for product quality fell in the United States from 24% in 1995 to 12% in 2000, but increased after 2004, reaching 24% of American trials in 2005. The percentage of trials for product quality traits in the European Union reached 28% in 2003, but this is based on a total of only 111 traits that were field tested, compared to 814 traits tested in field trials in the United States in 2003. There is no consistent trend for Canada in the share of product quality traits.
- The share of all domestic field trials for agronomic traits has increased the most in Canada, from 4% of all Canadian field trials of traits in 1998 to 24% of Canadian trials in 2004, followed by a slight decline to 22% in 2005. There is also a moderate upward trend in the United States since 2000, increasing from 7% to 17% of American field trials for agronomic traits in 2005.
- The United States accounted for over 50% of all field trials for each trait category between 2002 and 2004 inclusive. The United States conducted 81.4% of the 795 tests for product quality traits between 2002 and 2004 in the United States, Canada, the European Union, and Australia combined. The United States also conducted 86.3% of all trials during these three years for pest resistance traits and 54.9% of all trials for agronomic traits.

Total number of trait field trials, 2002 to 2004 inclusive



Source: UNU-MERIT field trials database, March 2006.

Methodology

In the United States, the European Union, Canada and Australia field trials of new GM plant varieties are registered and the data are publicly available. Field trials cover a comparatively late stage of the development of GM varieties, as they do not include greenhouse and laboratory trials. Consequently, field trials provide evidence on relatively late stage research that could be ready for commercialisation within two to six years.

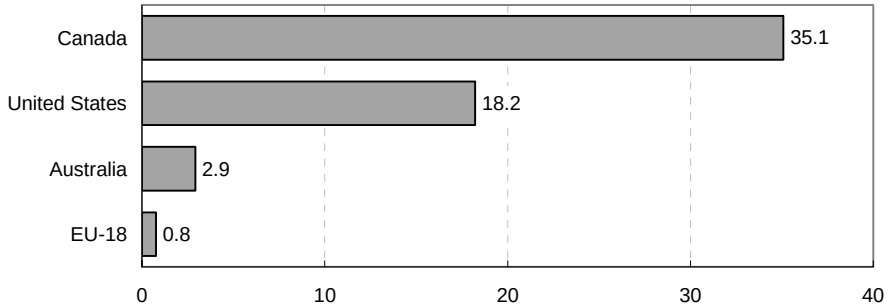
Field trial data have many of the advantages and limitations of patents. Both provide a measure of investment in particular lines of research by firms and public sector institutions to develop new plant varieties (field trials) or inventions (patents), but in both cases there is no direct relationship between the number of trials or patents and the outcome in terms of commercialised GM varieties or inventions. A series of trials can be abandoned, with no commercialisation of the GM variety, and there is a large range in the number of field trials required to develop a GM variety. For example, several hundred field trials were conducted in the United States to alter the ripening characteristics of a tomato variety whereas only 15 trials were required to develop a virus resistant papaya variety.

In the United States, field tests of GM varieties that have already received approval do not need to be registered, which decreases the comparability between Europe and the United States. The UNU-MERIT field trial database used here includes American data for both releases and notifications (an expedited type of release permit). For all countries, the UNU-MERIT database excludes non-plant field tests. The original field test data for Europe are available from http://biotech.jrc.it/deliberate/gmo.asp, for the United States from http://www.aphis.usda.gov, for Canada from http://www.inspection.gc.ca, and for Australia from http://www.ogtr.gov.au.

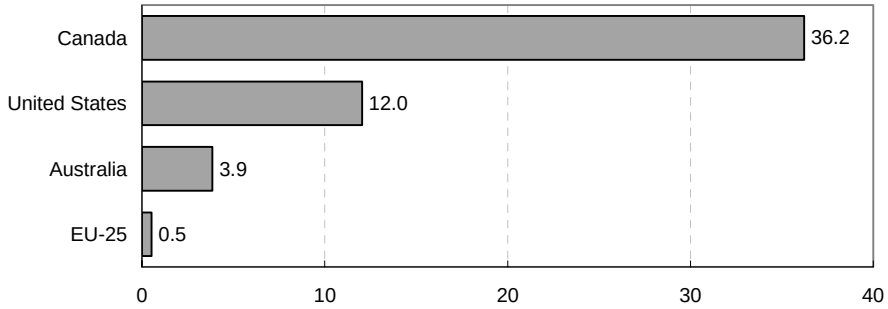
The United States provides ten identifiers for the purpose of each trait. These identifiers were used by UNU-MERIT to identify field trials of specific traits for herbicide tolerance, pest resistance, product quality, agronomic characteristics, and other types of traits. The European Union, Canada, and Australia provide information on the trait but do not include an identifier. UNU-MERIT used the data from the United States and other sources to assign each trait in these countries to one of the five main categories. This classification system contains an unknown but small amount of error because some genetic traits can be used for different purposes. In a small number of trials insufficient detail is provided to accurately determine the purpose of a trial. These are assigned to the 'other' category. All results are based on field tests of specific traits. Approximately 20% of the field tests are for two or more 'stacked' traits. In these cases, each trait is counted separately.

Biotechnology in agriculture

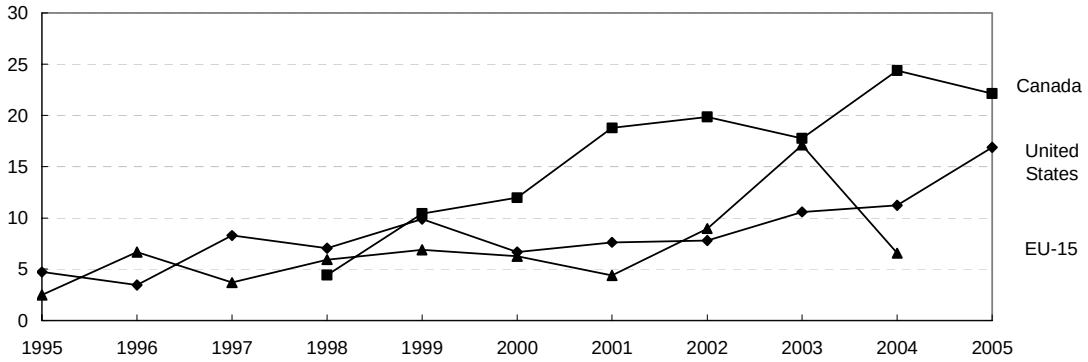
Trait field trials (2002 - 2004 inclusive) per billion PPP$ producer prices of agricultural output (2003)



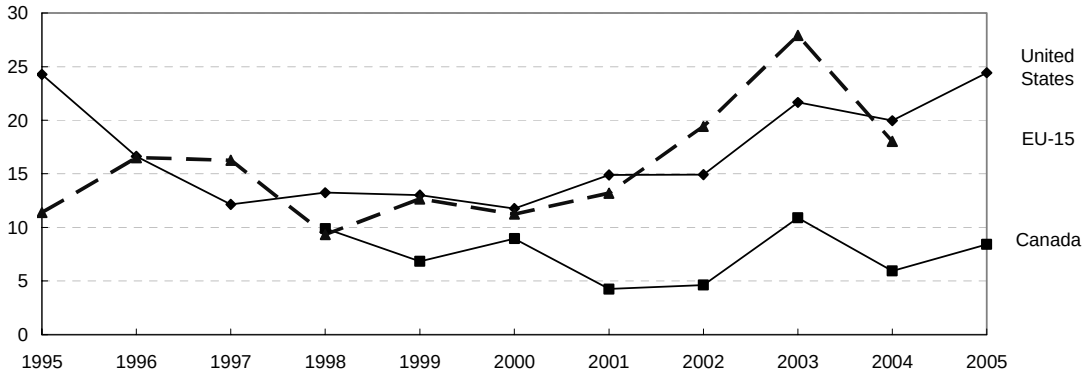
Trait field trials (2002 - 2004 inclusive) per million population (2002)



Percent of all domestic trait field trials for agronomic traits, 1995 to 2005



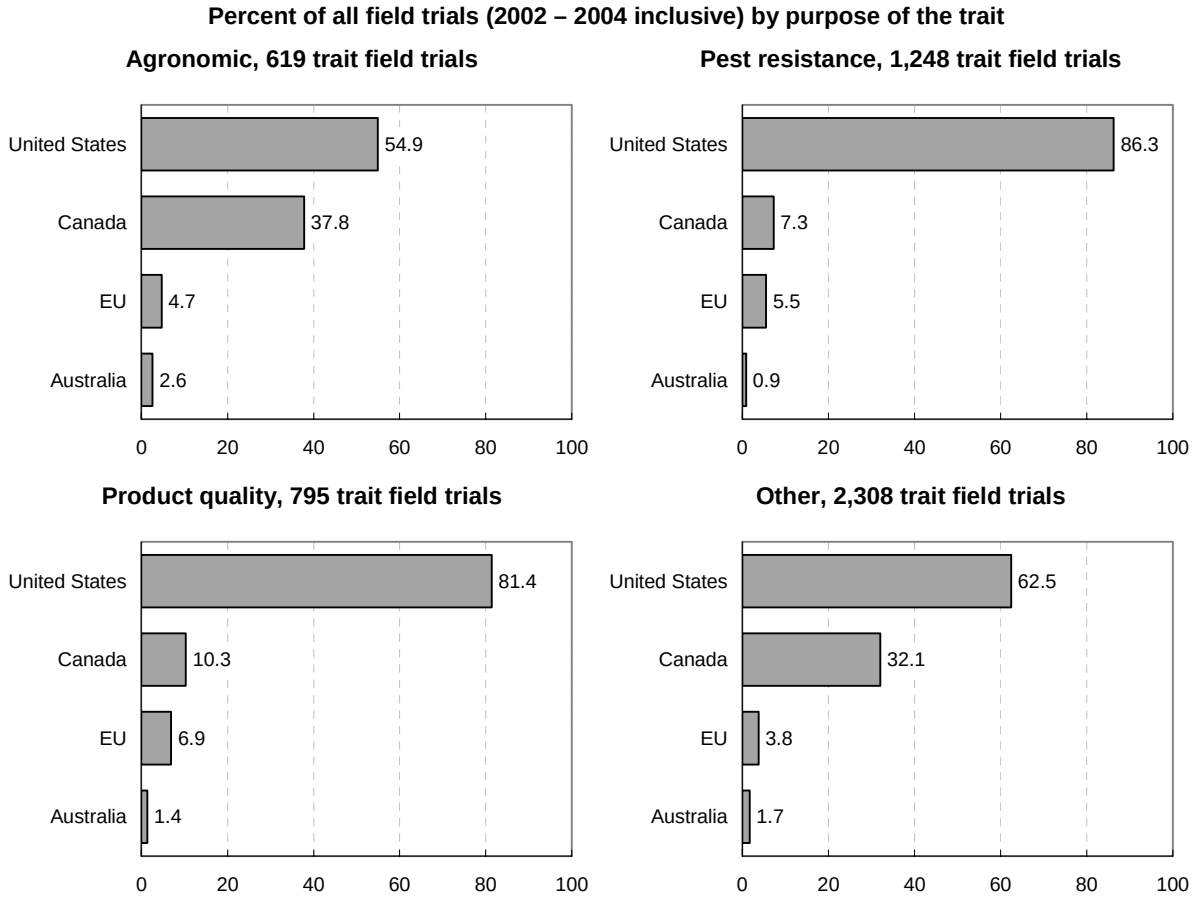
Percent of all domestic trait field trials for product quality traits, 1995 to 2005



Sources: Value at producer prices from OECD, *Economic Accounts for Agriculture 2005*; UNU-MERIT field trials database, March 2006.

Biotechnology in agriculture

Percent of all field trials (2002 – 2004 inclusive) by purpose of the trait



Source: UNU-MERIT field trials database, March 2006.

Biotechnology in agriculture

Table 1. **Million hectares planted with GM crops, 1996 to 2005**

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
United States	1.5	8.1	20.5	28.7	30.3	35.7	39	42.8	47.6	49.8
Argentina	0.1	1.4	4.3	6.7	10	11.8	13.5	13.9	16.2	17.1
Brazil	..	..	..	..	..	..	3.5	3	5	9.4
Canada	0.1	1.3	2.8	4	3	3.2	..	4.4	5.4	5.8
China	1.1	1.8	n.a.	0.3	0.5	1.5	2.1	2.8	3.7	3.3
India	..	..	..	..	..	..	<0.1	0.1	0.5	1.3
Australia	..	0.1	0.1	..	0.1	0.2	..	0.1	0.2	0.3
Mexico	..	..	<0.1	<0.1	..	<0.1	<0.1	<0.1	0.1	0.1
Spain	..	..	<0.1	<0.1	..	<0.1	<0.1	<0.1	0.1	0.1
Germany	..	..	..	..	..	<0.1	<0.1	<0.1	<0.1	<0.1
Portugal	..	..	..	<0.1	..	..	..	..	..	<0.1
France	..	..	<0.1	<0.1	..	..	..	..	..	<0.1
Czech Republic	..	..	..	..	..	..	..	..	..	<0.1
Other countries	..	..	..	..	..	..	..	..	..	2.8
Total	**2.8**	**12.7**	**27.8**	**39.9**	**44.2**	**52.6**	**58.7**	**67.7**	**81**	**90**

Sources: Clive James, 1997, 1999 ' Global Review of Transgenic Crops', ISAAA Briefs, The International Service for the Acquisition of Agri-biotech applications (ISAAA), Ithaca New York; Clive James (2004, 2005), 'Global Status of Commercialized Biotech/GM Crops', ISAAA, Ithaca, New York.

Table 2. **Number of field tests for specific traits, 1995 to 2005**

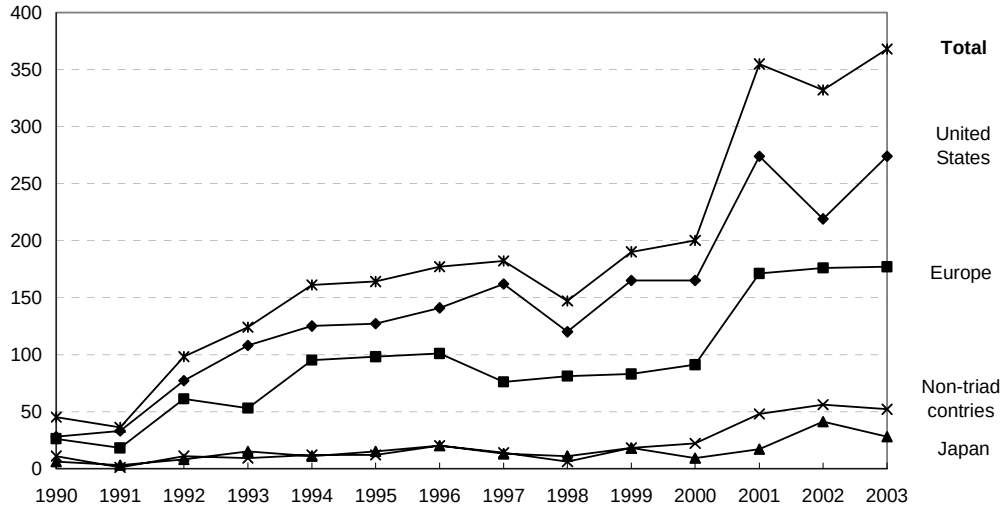
	Trait	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	**Total**
United States	Agronomic	40	30	103	151	157	88	113	107	103	130	172	**1,194**
	Product quality	206	145	151	284	207	155	221	205	211	231	249	**2,265**
	Herbicide tolerance	209	248	419	657	366	390	352	438	304	360	269	**4,012**
	Pest resistance	346	387	496	954	732	521	609	529	251	297	194	**5,316**
	Other	48	61	75	99	126	163	189	95	105	140	135	**1,236**
	Total traits	**849**	**871**	**1,244**	**2,145**	**1,588**	**1,317**	**1,484**	**1,374**	**974**	**1,158**	**1,019**	**14,023**
Canada	Agronomic	..	..	..	48	67	87	93	86	70	78	87	**616**
	Product quality	..	..	..	109	44	65	25	20	43	19	33	**358**
	Herbicide tolerance	..	..	..	229	240	211	119	119	108	82	86	**1,194**
	Pest resistance	..	..	..	283	72	70	47	47	21	23	27	**590**
	Other	..	..	..	412	221	294	211	161	152	118	160	**1,729**
	Total traits	**..**	**..**	**..**	**1,081**	**644**	**727**	**495**	**433**	**394**	**320**	**393**	**4,487**
EU-15	Agronomic	7	21	12	14	18	10	4	6	19	4	..	**115**
	Product quality	32	52	53	22	33	18	12	13	31	11	..	**277**
	Herbicide tolerance	140	140	162	105	137	73	40	25	31	22	..	**458**
	Pest resistance	62	77	63	78	52	33	24	21	27	21	..	**875**
	Other	40	25	36	17	21	26	11	3	3	3	..	**185**
Total	**Total traits**	**281**	**315**	**326**	**236**	**261**	**160**	**91**	**67**	**111**	**61**	**..**	**1,909**

Sources: UNU-MERIT field trial database, March 2006.

BIOTECHNOLOGY ALLIANCES

- The CATI-MERIT database collects information on strategic alliances by domestic and multinational firms for technology transfer or joint research in biotechnology from announcements or articles in newspapers and professional journals, many of which are in English. The most recent data are from the National Science Foundation's 2006 Science and Engineering Indicators.
- Whether or not an alliance is made public and subject to a newspaper report will depend on the interests of the partners and the importance of the alliance to readers. Therefore, the CATI-MERIT database is likely to exclude small alliances and those that the partners do not wish to publicly disclose. In addition, the database favours publications in English and consequently alliances from English-speaking countries such as the United States are likely to be over represented.
- Results are only available for major countries or regions: the United States, Europe, Japan, and non-triad countries (involving a country outside the previous three).
- The share of all CATI-MERIT alliances that involve biotechnology has been increasing over time, from 11% of the total in 1990 to 53% in 2003.
- Between 2001 and 2003 inclusive, 1,055 reported biotechnology alliances were included in the CATI-MERIT database. An alliance can include firms from two or more of the four countries or regions, or it can only include domestic firms. A partner from the United States was involved in 72.7% of the 1,055 biotechnology alliances over these three years, a European partner in 49.7%, a Japanese partner in 8.2%, and a partner from a non-triad country in 14.8%.
- The total number of biotechnology alliances increased from 45 in 1990 to 368 in 2003. The growth in alliances was greatest for those involving partners from the United States, where the number of alliances increased 9.8 times from 28 in 1990 to 274 in 2003. The increase was 6.8 times for alliances involving European partners (26 alliances in 1990 and 177 in 2003), 4.7 times for Japanese partners (6 alliances in 1990 and 28 in 2003), and 4.7 times for partners from non-triad countries (11 alliances in 1990 and 52 in 2003).

Number of biotechnology alliances, 1990 to 2003

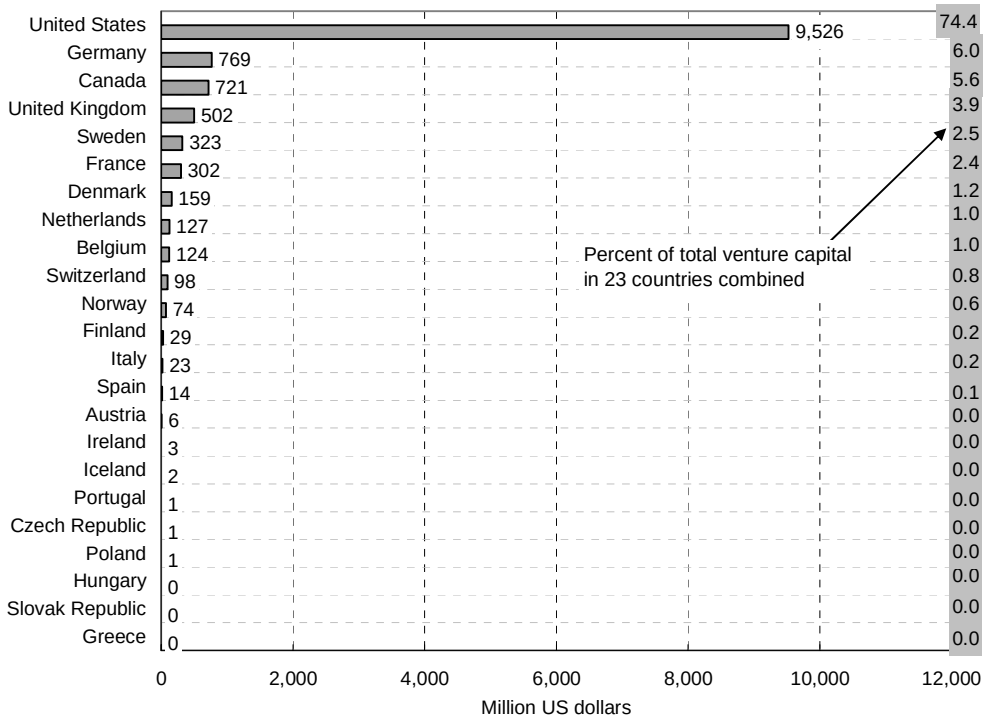


Source: National Science Foundation (2006), Science and Engineering Indicators 2006, Volume 2, Table 4-37.

BIOTECHNOLOGY VENTURE CAPITAL

- Venture capital investments in biotechnology firms are available for 23 OECD countries, from several venture capital associations. The latest available year for venture capital disaggregated by sector is 2003.
- Absolute investments in venture capital are aggregated over three years, 2001 to 2003 inclusive, due to volatility in these investments after 2001. The total for all 23 reporting OECD countries is USD 12,807 million of venture capital investment in biotechnology. The United States accounted for 74.4% of the total, Germany for 6.0%, and Canada for 5.6%.
- There were no detectable venture capital investments over 2001 to 2003 inclusive in Greece and the Slovak Republic.
- Data on venture capital as a percentage of GDP in 2003 are available for 22 countries (no results for Iceland).
- The United States had the highest share of GDP from venture capital investments in biotechnology at 0.031%, followed by Canada (0.026%), Denmark (0.024%), and Norway (0.022%).
- No detectable venture capital investments were recorded in 2003 for five countries: Slovak Republic, Poland, Hungary, Greece and Austria.
- Firms have access to many other sources of funds than venture capital, including government investment, the stock market, banks, and private investors. Survey data on the venture capital share of the total amount of capital raised by biotechnology firms in a specific year are available for Israel, Denmark and Canada and for Belgium for the number of firms. The venture capital share was 6% in Israel in 2002, 13% in Denmark in 2002, and 22% in Canada in 2003. In Belgium, 16% of 49 biotechnology firms reported raising venture capital funds in 2003.

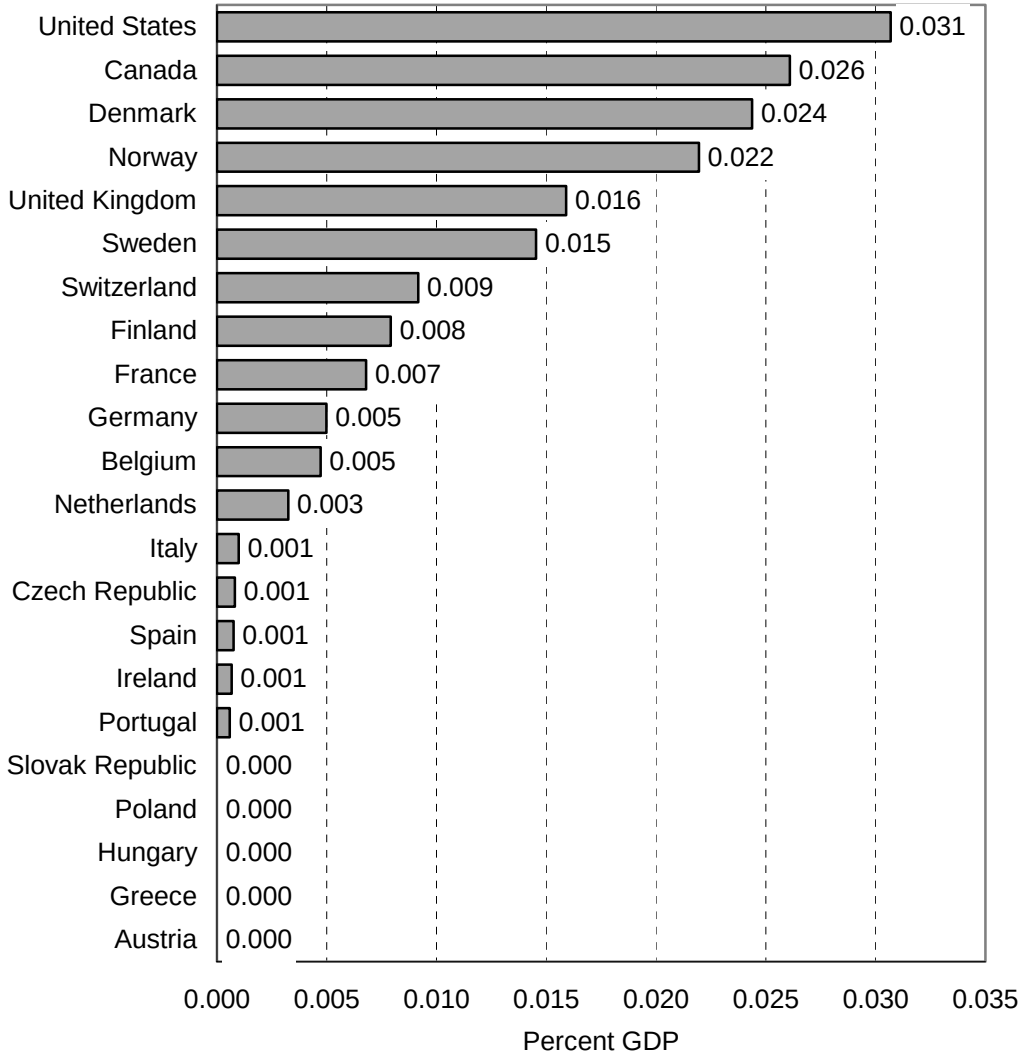
Total venture capital investments in biotechnology, 2001 to 2003 combined



Sources: OECD, based on data from EVCA (Europe); NVCA (United States); CVCA (Canada); several years.

Biotechnology venture capital

Biotechnology venture capital investments as a percentage of GDP, 2003



Sources: OECD, based on data from EVCA (Europe); NVCA (United States); CVCA (Canada); several years.

COUNTRY PROFILES

BIOTECHNOLOGY IN AUSTRALIA

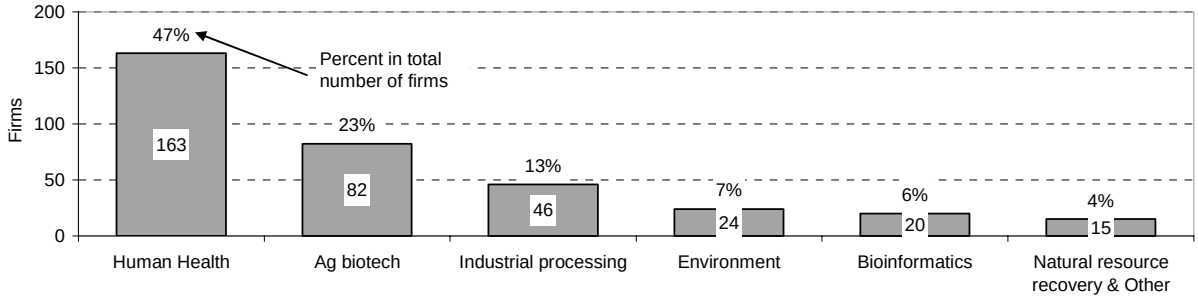
- The Australian Bureau of Statistics (ABS) added 10 questions on biotechnology to its Businesses Survey of Research and Experimental Development for reference year 2003-04. The survey excludes firms mainly engaged in Agriculture, forestry and fishing. The survey included the OECD definition of biotechnology.
- The Businesses Survey of Research and Experimental Development is an annual mandatory survey. Non-responding firms which reported R&D activity in the previous cycle have data imputed based on the previous response. The response rate for the 2003-04 survey was 86%.
- In 2003-04, 304 firms were directly or indirectly involved in biotechnology R&D. Two hundred and twenty-seven firms performed intramural biotechnology R&D, while 78 of these firms also paid another organisation to conduct biotechnology R&D on their behalf. Another 77 firms only contracted out biotechnology R&D to another organisation (firm, university, etc).
- The intramural biotechnology R&D by the 227 firms amounted to PPP$ 200.5 million or 3.8% of total BERD.
- For greater comparability with the other country profiles, the results for R&D applications and sectors focus on the intramural biotechnology R&D.
- When firms were asked to classify their intramural R&D to the appropriate biotechnology application, 47% classified themselves as active in the Human Health bio-industry sector, 23% in the Ag-biotech sector, and 13% in Industrial processing.
- In terms of biotechnology R&D expenditure, 69% was allocated to the Human Health bio-industry sector, followed by 12% in Ag-biotech.
- The sector Property and Business Services (ANZSIC Division L) reported the largest share of biotechnology-active firms (61%) and the highest share of biotechnology R&D expenditures (69%).
- One hundred and forty-five firms paid one or more Australian organisations to perform biotechnology-related R&D. Another 36 contracted out biotechnology R&D abroad.
- Seventy-three percent of the 145 firms that contracted biotechnology R&D to Australian organisations had fewer than 19 employees.
- Smaller firms, with 99 or fewer employees, favoured contracting biotechnology R&D to Universities or other higher education institutions.
- Firms with over 100 employees favoured contracting biotechnology R&D to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Contract Research Organisations (CROs).

Australia

Based on responses to the 2003-04 Business R&D survey

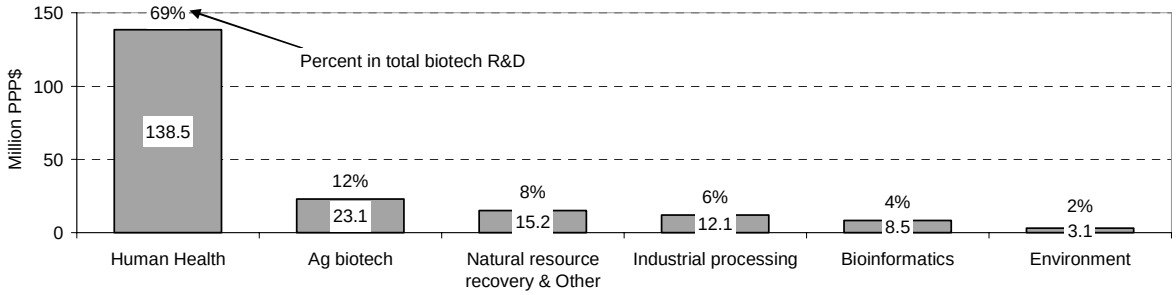
Distribution of 227 firms performing intramural R&D by application field, 2003-04

A firm can be active in more than one application; hence the sum of firms active in each application adds up to 350.

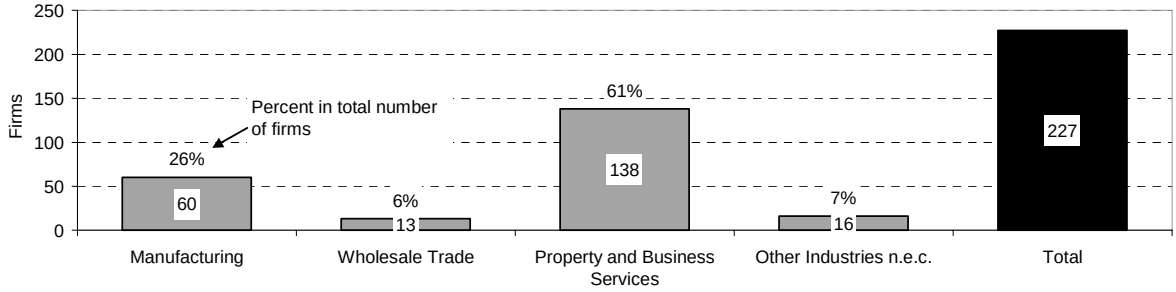


Distribution of intramural biotech R&D by application field, Million PPP$, 2003-04

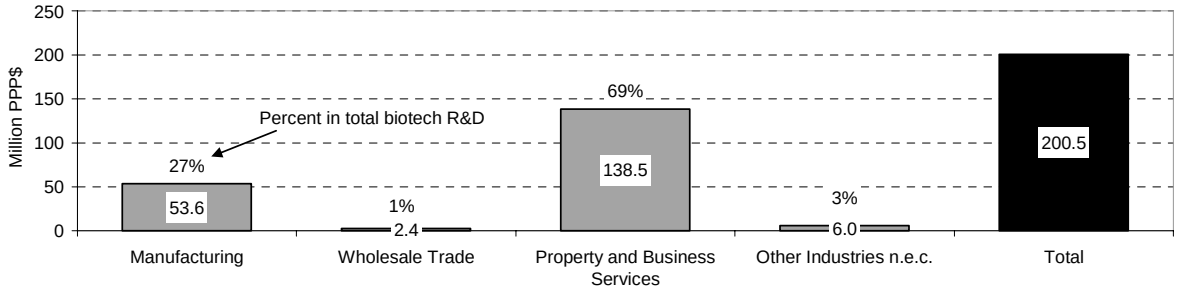
Total intramural biotech R&D of PPP$ 200.5 million



Firms performing intramural biotechnology R&D by industry,[1] 2003-04



Biotechnology R&D expenditure by industry,[1] Million PPP$, 2003-04



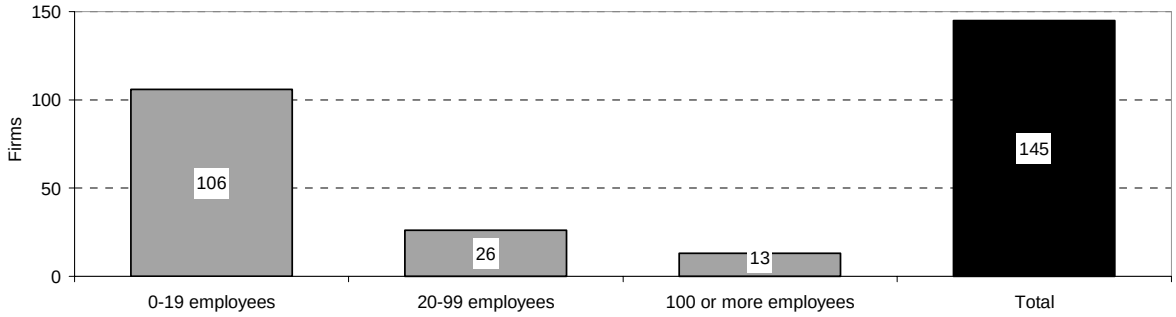
1. Based on the Australian and New Zealand Standard Industrial Classification (ANZSIC). The survey scope excludes firms mainly engaged in Agriculture, forestry and fishing (*i.e.* Division A).

Source: ABS (2005), Research and Experimental Development, Businesses 2003-04, cat. No 8104.0, September.

Australia

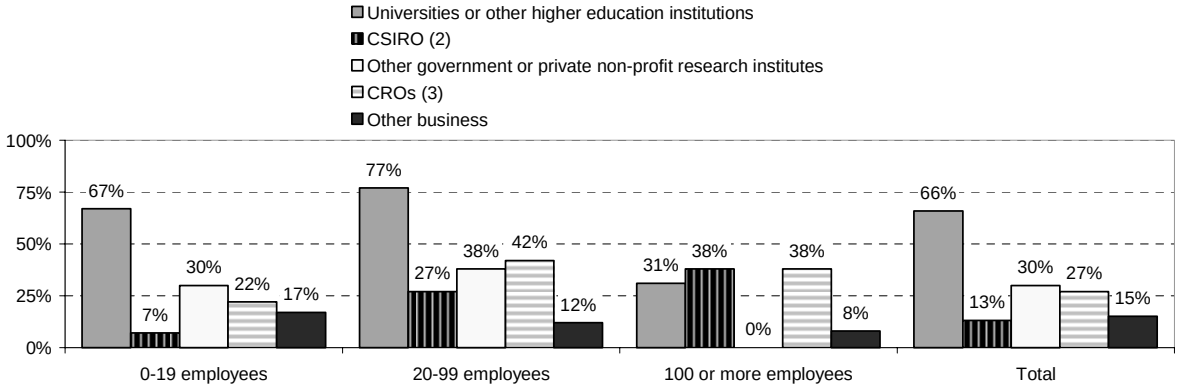
Based on responses to the 2003-04 Business R&D survey

Distribution of 145 firms that paid Australian organisations to perform biotech R&D by size, 2003-04



Distribution of 145 firms that paid Australian organisations to perform biotech R&D by size and by type of organisation,[1] 2003-04

A firm can respond to more than one category, hence the proportions sum to more than 100%



1. Percent of total reported firm-organisation combinations.
2. Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia's national science agency.
3. Contract Research Organisation.

Source: ABS (2005), Research and Experimental Development, Businesses 2003-04, cat. No 8104.0, September.

BIOTECHNOLOGY IN BELGIUM

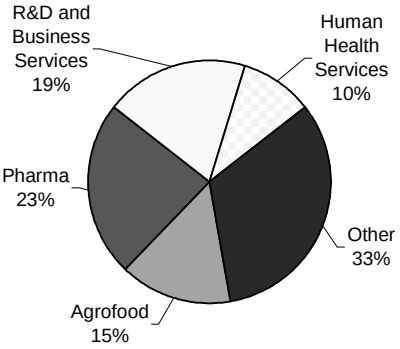
- A Belgian Biotechnology Use and Development survey was run for the reference year 2003 at the initiative of the Office for Scientific, Technical and Cultural Affairs. The practical organisation of the survey – data collection and analyses – was undertaken with several partners: the *Limburgs Universitair Centrum* (Center for Statistics, ITEO), the University of Liege (CRGB) and the Vlerick Management school.
- This survey was the first of its kind in Belgium. The survey was modeled on the recommendations of the OECD *Ad hoc* Biotechnology Statistics group and included the OECD definition of biotechnology.
- The survey was voluntary. The survey response rate was 31% and there was no weighting for non-respondents.
- The survey identified 73 biotechnology firms in Belgium in 2003.
- The European Classification of Economic activities (NACE) was used to categorise firms into different sectors.
- In 2003, firms were classified into four industrial sectors: Agrofood (a combination of Agriculture, and Food and Beverages), Pharmaceuticals, R&D and Business Services and Human Health Services. There was also an "Other" category.
- Twenty-four firms (33%) fell in the "Other" category; 17 firms (23%) were classified in the Pharmaceuticals sector; 14 firms (19%) were classified in R&D and Business Services and 7 firms (10%) were in Human Health Services.
- In 2003, 41% of biotechnology firms had less than 10 employees. Only 7% had over 500 employees.
- Seventy of the 73 biotechnology firms responded to the detailed employment questions in the survey.
- In 2003, the 70 biotechnology firms employed 11,137 persons. Of these, 4,261 (38%) had biotechnology-related responsibilities, including 1,984 with biotechnology R&D responsibilities (18% of the total employment).
- A much higher percentage of the total employment in biopharma versus non-biopharma firms had biotechnology responsibilities: 51.5% compared to 19.5%.
- The 2003 survey also collected information on the nine types of biotechnology techniques used by firms, and whether firms were using, or planning to use, an existing technique or were developing a new technique.
- The top biotechnology techniques developed by firms were Proteins and molecules and Process technologies, with 36.1% of all firms reporting developing each of these techniques. Cell tissue culture techniques ranked second with 34.7% of all firms reporting developing that technique.
- The top three biotechnology techniques used by firms were: Proteins and molecules (used by 54.2% of all firms), DNA coding (used by 47.2% of all firms) and Process technologies (used by 44.4% of all firms).
- Nanotechnologies and the 'other' group were the least used and developed biotechnology techniques by firms.

See annex tables for additional information.

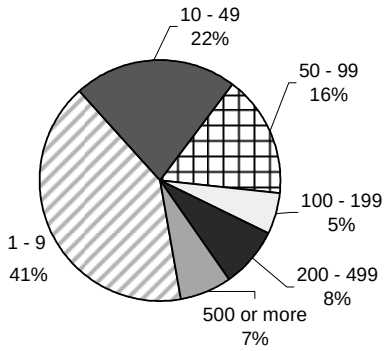
Belgium

Based on responses to Biotechnology Use and Development survey, 2003

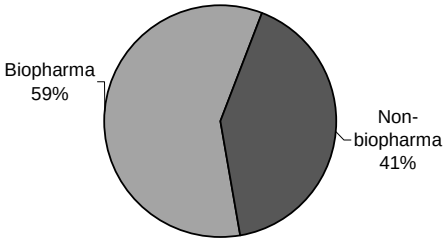
Biotech firms in the business enterprise sector, 2003
Percentage breakdown – 73 firms



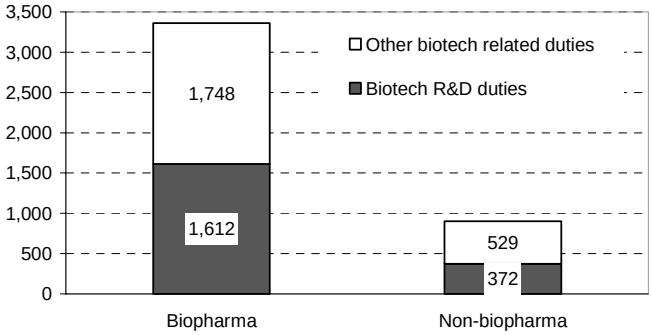
Biotechnology firms by size class, 2003
Employees



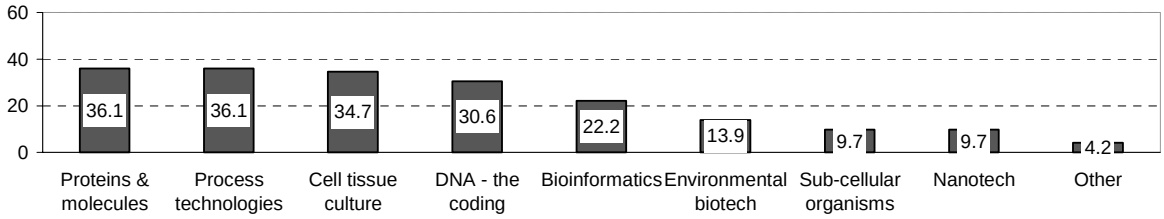
Biotechnology employment, 2003
Breakdown of total employment – 11,137 employees



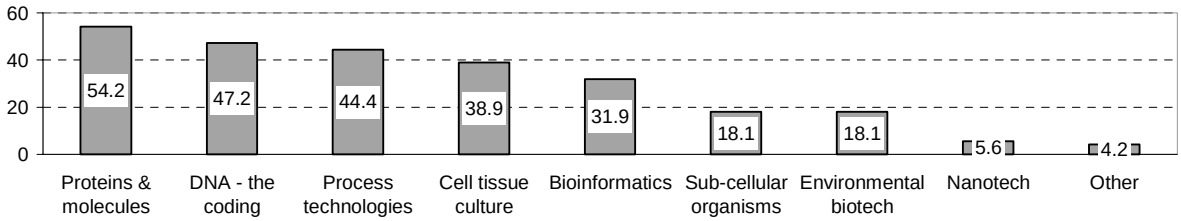
Biotech employment, 2003
Responsibilities



Biotechnology techniques developed, 2003
Percentage of firms that reported developing biotechnology techniques



Biotechnology techniques used, 2003
Percentage of firms that reported using biotechnology techniques



Source: Belgian Federal Office for Scientific, Technical and Cultural Affairs (Forthcoming), The Biotechnology Industry in Belgium, National Report to the OECD, TIP Case Study on Biotechnology, First phase report.

BIOTECHNOLOGY IN CANADA (1)

- Statistics Canada has been collecting data on biotechnology since 1989. For a detailed account of the past surveys, refer to the "OECD Biotechnology Statistics Inventory", available on line, at

http://www.oecd.org/sti/biotechnology/inventory

- Canadian biotechnology data is derived from two sources: the Federal Science Expenditures and Personnel Survey and the Biotechnology Firm Survey (1997), which was replaced by the Biotechnology Use and Development Survey (1999, 2001, 2003).

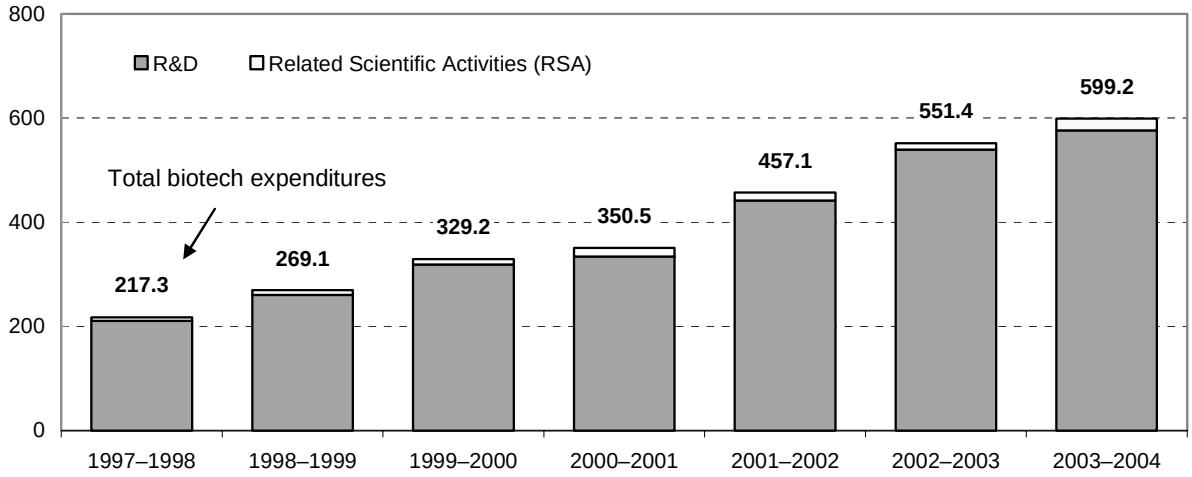
Federal Science Expenditures and Personnel Survey

- The Federal Science Expenditures and Personnel Survey has been collecting data on federal biotechnology-related activities annually since fiscal year 1996-97. These data relate to science and technology (S&T) expenditures, which include R&D and related scientific activities (RSA), and to full-time equivalent (FTE) personnel associated with biotechnology activities.
- In 2003-04, the federal government spent PPP$ 575.9 million on biotechnology R&D, which represented 13% of total federal R&D expenditures. Related scientific activities accounted for an additional PPP$ 23.3 million in federal government expenditures in 2003-04.
- The higher education sector was the largest recipient of biotechnology funds with PPP$ 304.5 million (52%) of all funds. Thirty-two percent of biotechnology funds were intramural, *i.e.* spent by federal government research institutes and laboratories in Canada.
- From 1997 to 2003-04, federal government biotechnology expenditures grew by an average of 18% per year.

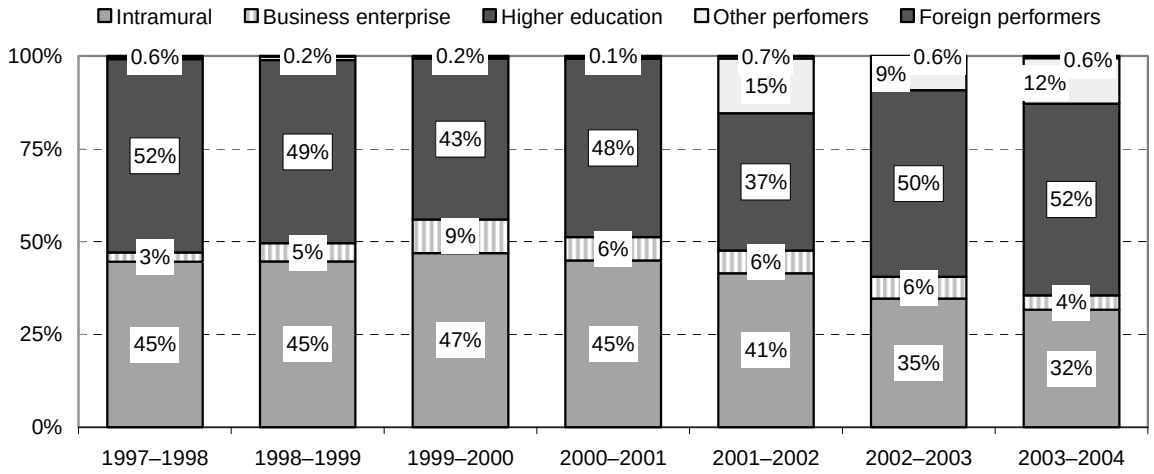
Canada

1. Based on responses to Federal Science Expenditures and Personnel Surveys

Canadian federal government science and technology expenditures on biotech, 1997-98 to 2003-04
Million PPP$



Distribution of Canadian federal government biotech R&D expenditures, 1997-98 to 2003-04



Source: Government of Canada (2005), Canadian Trends in Biotechnology, 2nd edition, September.
http://bioportal.gc.ca/trends

BIOTECHNOLOGY IN CANADA (2)

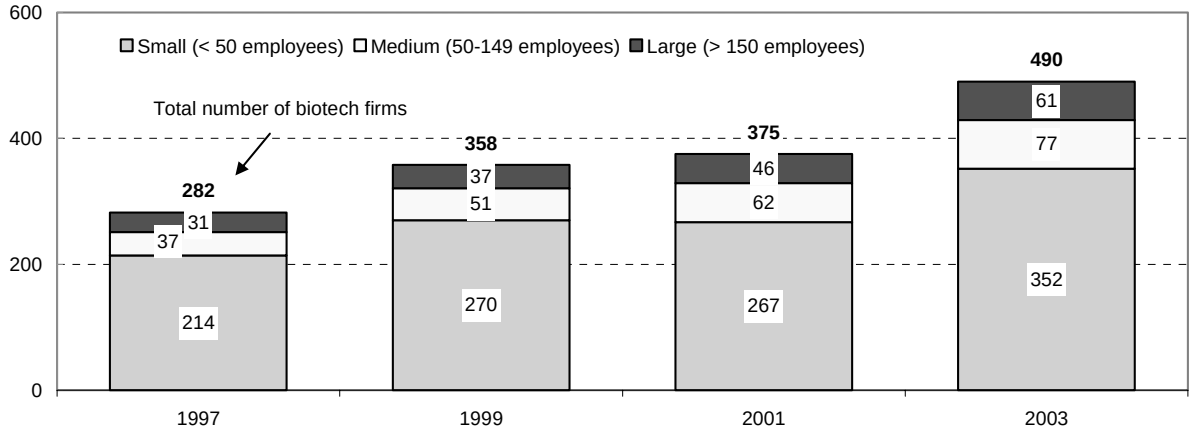
Biotechnology Firm Survey and Biotechnology Use and Development Survey

- Statistics Canada has run four surveys of biotechnology firms: for 1997, 1999, 2001 and 2003. All surveys provided a definition of biotechnology. As of 2001, the OECD definition of biotechnology was provided.
- All firm surveys were conducted on a voluntary basis and weighting was used to reflect the entire firm population. In 2003, the survey response rate was 80%.
- The surveys' target population was "innovative biotechnology firms," defined as firms that meet at least one of three criteria: "it has one or more biotechnology products or processes on the market, it is currently developing products or processes that require the use of biotechnology, or it considers biotechnology central to its activities or strategies." The 2003 survey excluded firms with less than 5 employees, less than PPP$ 80,321 in R&D expenditures, and with less than PPP$ 200,803 in sales. The survey also excluded not-for-profit organisations, universities, government laboratories, hospitals, companies that use only traditional biotechnologies, and service sector firms.
- http://bioportal.gc.ca/trends.
- In 2003, there were 490 innovative biotechnology firms in Canada, compared to 282 in 1997. The number of biotechnology firms grew by 74% from 1997 to 2003.
- In all the years surveyed, the majority of biotechnology firms were Small and Medium-Sized Enterprises (SMEs), which are defined as firms with between 5 and 149 employees by Statistics Canada. In 2003, 88% or 429 of all biotechnology firms were SMEs.
- In 2003, 262 biotechnology firms (54%) were classified in the Human health sector. In 1997, 48% of biotechnology firms were classified in Human health.
- In 2003, biotechnology firms spent PPP$ 1,194.4 million on biotechnology R&D, or 65% of their total R&D spending. Spending on biotechnology R&D grew by 192% from 1997 to 2003. Total R&D spending by the biotechnology firms grew at a slower rate of 139% over the same period.
- Biotechnology revenues were PPP$ 3,085.9 million or 13% of the firms' total revenues in 2003. In 1997, biotechnology revenues constituted only 6% of the total revenues of biotech firms.
- In 2003, biotechnology firms employed 75,448 employees, of which 11,863 (16%) had biotechnology-related responsibilities. A little over half, or 6,441, of the employees with biotechnology-related responsibilities were in scientific research: "Scientific research and direction" and "Technicians".
- In 2003, biotechnology firms reported that they had 17,065 biotechnology products/processes at various stages of development including: R&D, Pre-clinical trials/confined field trials, Regulatory phase/unconfined release and Approved/On market/In production.
- In 2003, biotechnology firms reported that 65% of biotechnology products/processes were on the market, 11,046 of 17,065. In 1999, only 38% of biotechnology products/processes were on the market, while 49% were in the R&D stage.
- In 2003, the Human health sector had the largest number of biotechnology products/processes, with 10,692 or 63%. The Agriculture biotechnology sector had the second largest number of biotechnology products/processes in 2003, with 4,813 or 28%, and Food processing was third, with 622 or 4%.
- The 2003 results show several changes from 1999, where the Bioinformatics sector had the largest number of biotechnology products/processes, with 7,249 or 41%. The Agriculture biotechnology sector had the second largest number of biotechnology products/processes in 1999, with 5,557 or 32%, and Health was third, with 3,435 or 20%.

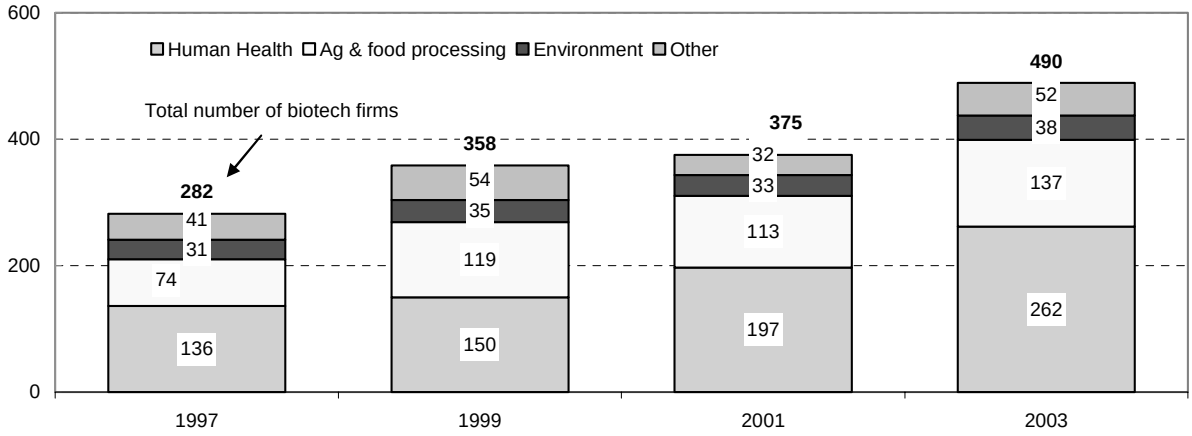
Canada

2. Based on responses to Biotechnology Firm Survey / Biotechnology Use and Development Survey

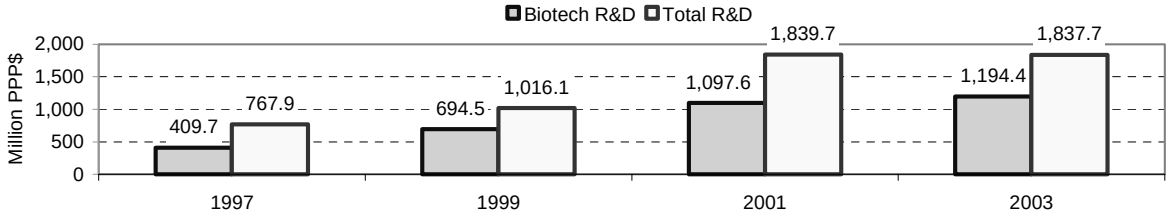
Number of innovative biotechnology firms by size class, 1997 to 2003



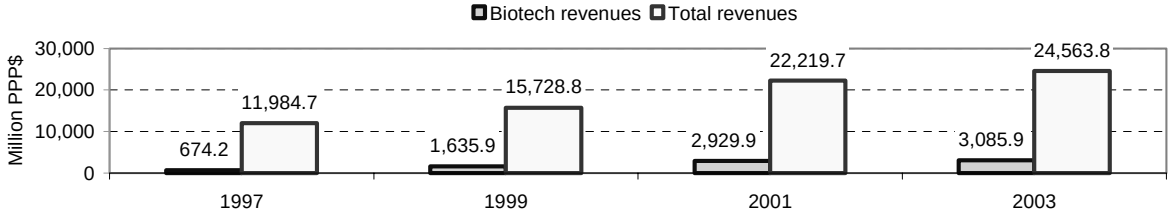
Number of innovative biotechnology firms by application field, 1997 to 2003



Total R&D and biotech R&D of biotechnology firms, Million PPP$, 1997 to 2003



Total revenues and biotech revenues of biotechnology firms, Million PPP$, 1997 to 2003

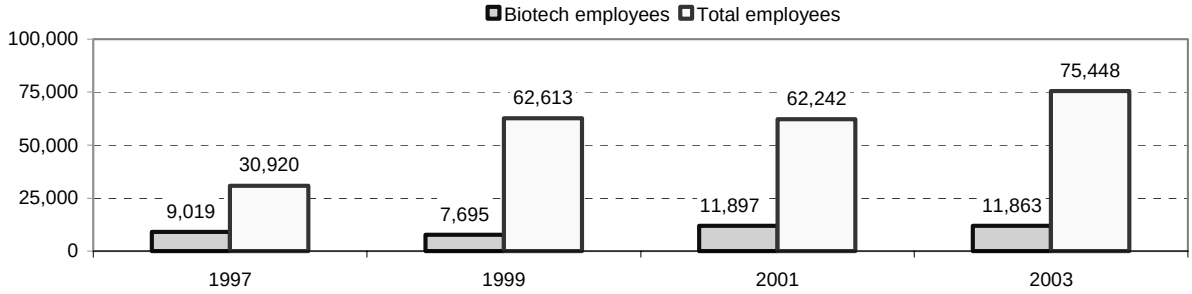


Source: Government of Canada (2005), Canadian Trends in Biotechnology, 2nd edition, September.
http://bioportal.gc.ca/trends

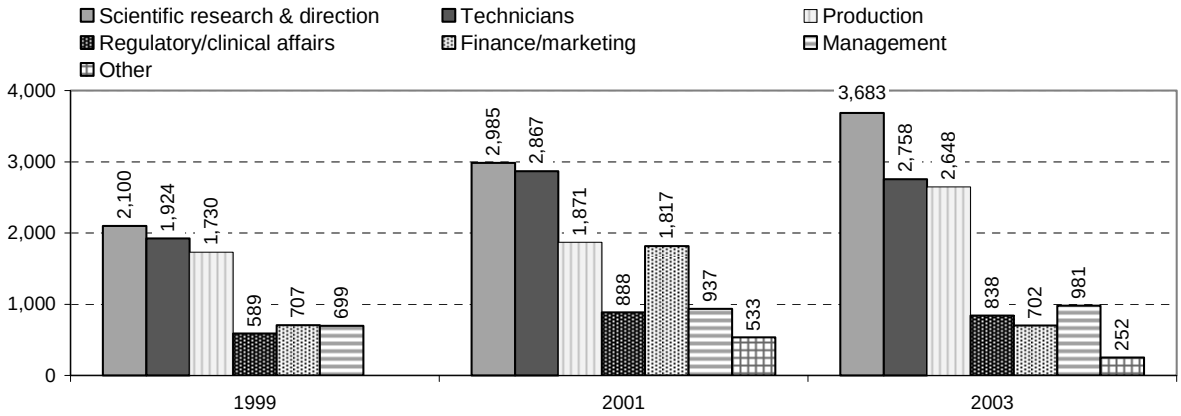
Canada

2. Based on responses to Biotechnology Firm Survey / Biotechnology Use and Development Survey

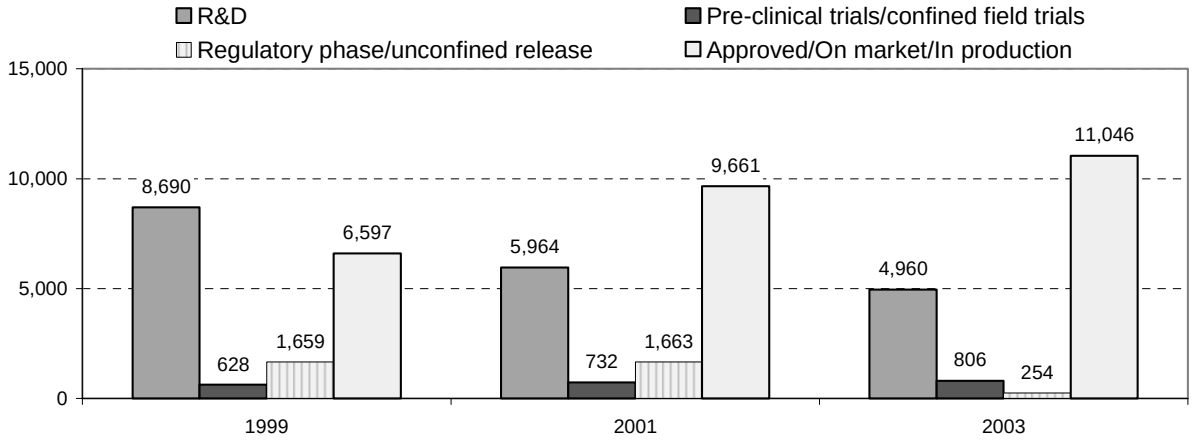
Total employees and biotech employees of biotechnology firms, 1997 to 2003



Biotech employees, 1999 to 2003



Number of biotech products/processes by development stage, 1999 to 2003



Source: Government of Canada (2005), Canadian Trends in Biotechnology, 2nd edition, September.
http://bioportal.gc.ca/trends

BIOTECHNOLOGY IN SHANGHAI, CHINA

- In 2004, the Shanghai Science and Technology Commission undertook a biotechnology survey of Shanghai, for the Ministry of Science and Technology of the People's Republic of China.
- Shanghai had an estimated population of 17.1 million[5] inhabitants in 2003. For comparison, Belgium had an estimated 10.5 million[6] inhabitants in 2005.
- This mandatory survey, covering reference year 2003, was the first of its kind.
- The survey provided both a single definition and a list-based definition of biotechnology.
- The survey scope covered firms, R&D institutions, and higher education and subsidiary institutions.
- The survey focused on 'modern' biotechnology and did not include traditional biology-related companies.
- In 2003, 158 firms, 31 R&D institutions and 22 higher education and subsidiary institutions were active in biotechnology in Shanghai.
- Thirty-three percent of biotechnology firms were in the R&D stage of activity and 20% were involved in product & process development.
- Over three-quarters of all biotechnology firms were in the manufacturing sector (123 firms).
- Three-quarters of all biotechnology firms had less than 150 employees (119 firms).
- The dominant sector of application was biomedicine (66 firms), followed by human health (34 firms).
- In 2003, intramural biotechnology R&D by firms was estimated to be PPP$ 204.5 million. Over three-quarters of this R&D was spent in the manufacturing sector.
- In 2003, firms reported having 1,447FTE employees with biotechnology R&D-related duties.
- Biotechnology firms reported having 388 products in the pipeline or on the market. Over half of these products were pharmaceuticals (206 of 388).

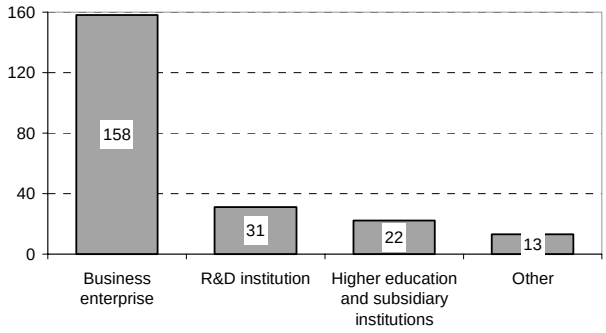
[5] National Bureau of Statistics of China (2004), China Statistical Yearbook 2004.

[6] http://statbel.fgov.be/figures/home_fr.asp Consulted 11 April, 2006.

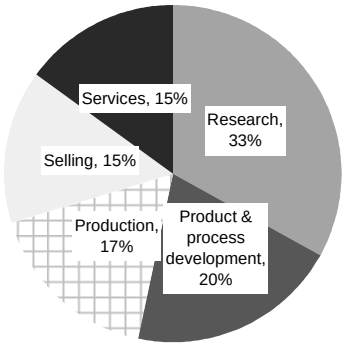
Shanghai, China

Based on the Shanghai Biotechnology Survey

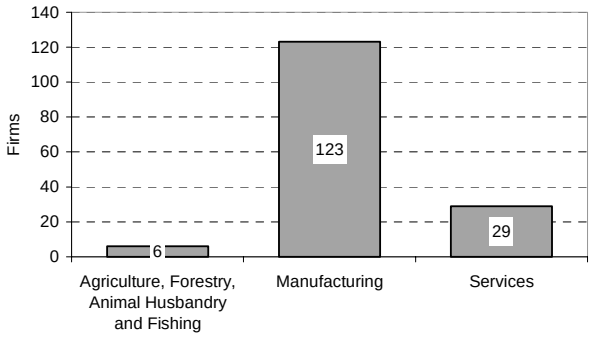
Biotechnology performers, 2003
Breakdown of 224 units



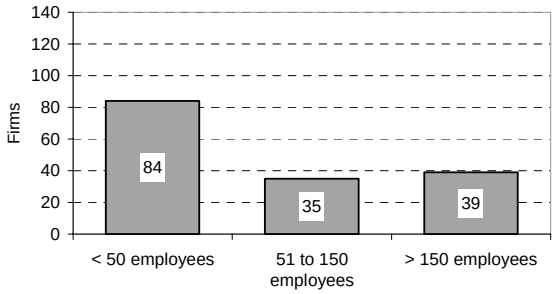
Biotech firms by stage of activity, 2003
Breakdown of 158 firms



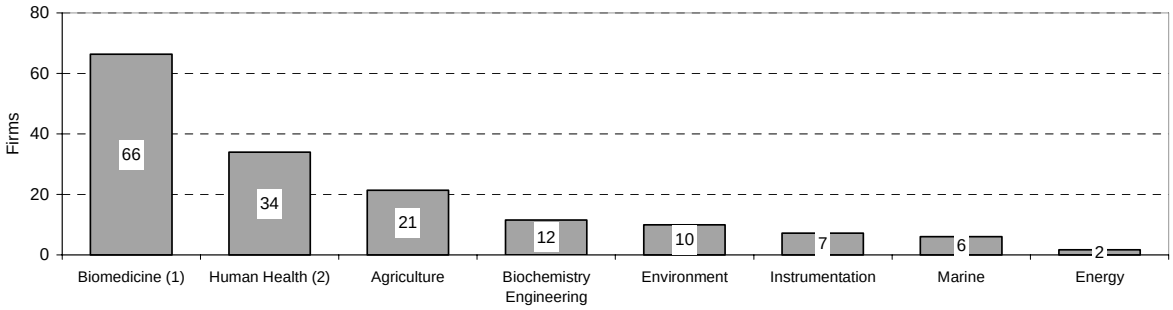
Biotech firms in the business enterprise sector, 2003
Breakdown of 158 firms



Biotech firms by size class, 2003
Breakdown of 158 firms



Main application field for each enterprise, 2003
Breakdown of 158 firms



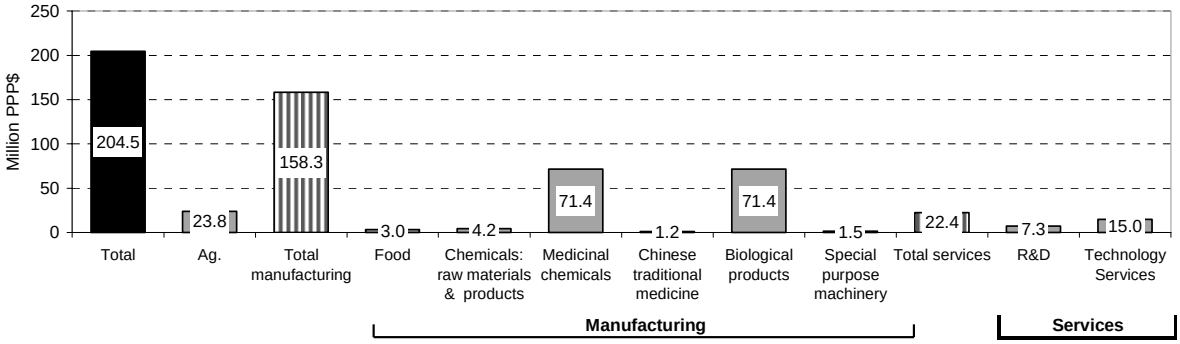
1. Biomedicine includes: medication relevant to biotechnology, diagnostic substances for medicine, health care products with biotechnology, etc.
2. Human Health includes: diagnostics, therapeutics, gene therapy, etc.

Source: Ministry of Science and Technology of the People's Republic of China (2005), Shanghai Biotechnology Survey Report 2003, December.

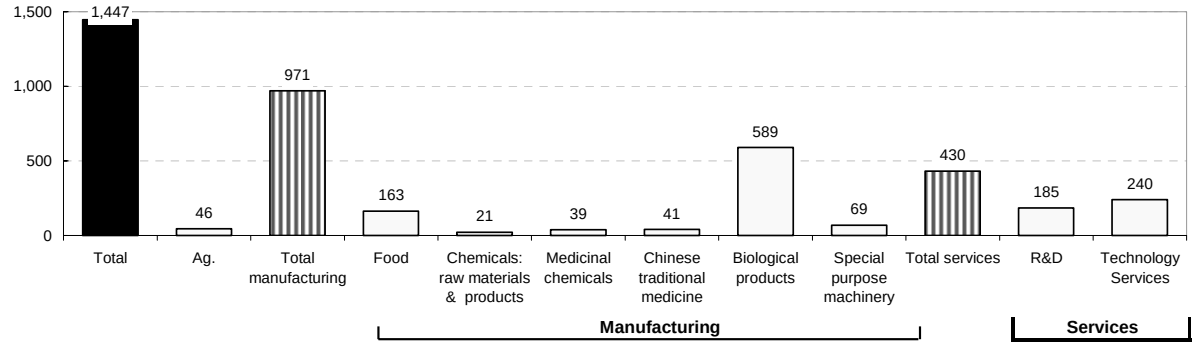
Shanghai, China

Based on the Shanghai Biotechnology Survey

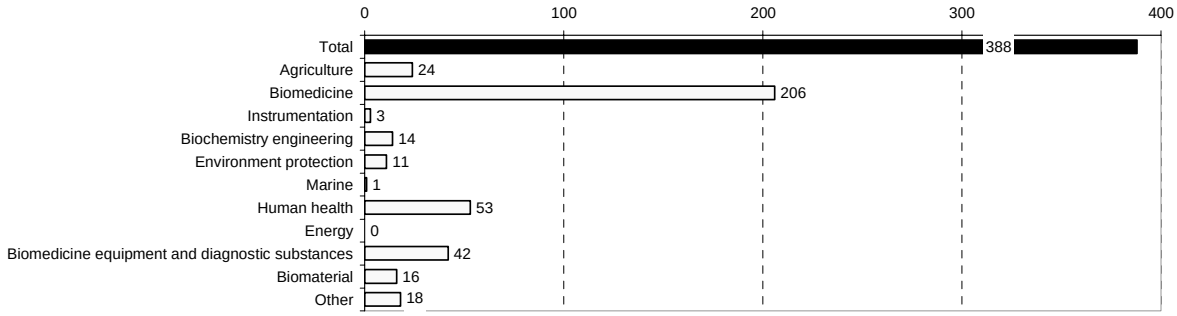
Biotechnology R&D in firms by sector, Million PPP$, 2003



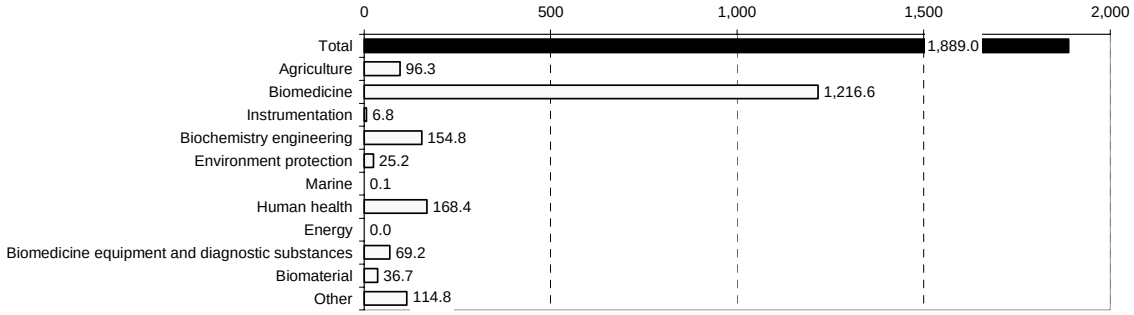
Full-time equivalent biotechnology R&D employees in firms by sector, 2003



Number of biotechnology products by application field, 2003



Estimated sales value of biotechnology products by application field, Million PPP$, 2003



Source: Ministry of Science and Technology of the People's Republic of China (2005), Shanghai Biotechnology Survey Report 2003, December.

BIOTECHNOLOGY IN DENMARK

- The Danish Centre for Studies in Research and Research Policy added a biotechnology question to its private sector and public sector R&D surveys in 1991. In both surveys, respondents were asked to estimate the percent of total R&D expenditures devoted to biotechnology. Neither survey included a definition of biotechnology.
- The private sector R&D survey covers the private business enterprise sector and the public R&D survey covers institutes, universities, hospitals and non-profit organisations.
- The private sector R&D survey is voluntary and is conducted every other year. The public sector R&D survey is annual and mandatory. The response rate for the 2003 private survey was 63% and weighting was conducted for non-respondents. The response rate for the public survey was 95% and no weighting was conducted for non-respondents.
- The Danish Centre for Studies in Research and Research Policy took the biotechnology R&D survey results and created a database of biotechnology firms in Denmark. The database was supplemented with firms identified using other sources, including biotechnology organisations, science parks etc.
- Firms with biotechnology activities were then categorised into two main groups: core biotechnology firms and firms with significant biotechnology activities. Both groups are active in biotechnology R&D.
- Core biotechnology firms are those whose primary activity is biotechnology. Firms with significant biotechnology activities are those where biotechnology is not their primary activity.
- The creation of the database was only possible using data beginning in 1997; earlier data are not comparable.
- For more information on the methodology undertaken by the Danish Centre for Studies in Research and Research Policy a study was released in April 2004 and is available on line, at:

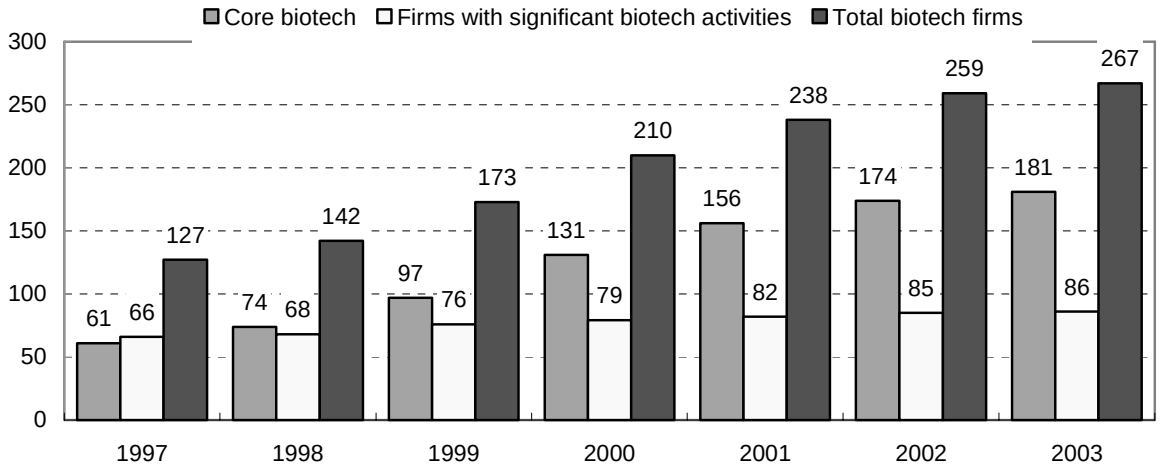
  http://www.cfa.au.dk/Publikationer/Working_papers/WP2004_1.pdf.
- In 2003, there were 181 core biotechnology firms and 86 firms with significant biotechnology activities in Denmark.
- From 1997 to 2003, the number of core biotechnology firms grew at an average annual rate of approximately 20%. Over the same period, the number of firms with significant biotechnology activities grew at a slower rate (4.5%).
- Most core biotechnology firms were started in, or after 2000.
- In 2003, the private sector spent PPP$ 726.8 million on biotechnology R&D, or 23.8% of total private R&D spending. The public sector spent PPP$ 131.3 million on biotechnology R&D, which constituted 9.9% of total public R&D spending.
- From 1997 to 2003, extramural biotechnology R&D spending (22.6% average annual growth rate) grew faster than intramural spending (12.4% average annual growth rate).
- In 2003, private sector biotechnology firms employed 4,781 full-time equivalent (FTE) R&D personnel (16.5% of total private sector R&D FTEs). In the same year, the public sector employed 1,406 FTE biotechnology R&D personnel (9.5% of total public sector R&D FTEs).
- From 1997 to 2003, the average annual growth rate of private biotechnology R&D employment was 5.2%; it was 0.4% for the public sector.

See annex tables for additional information.

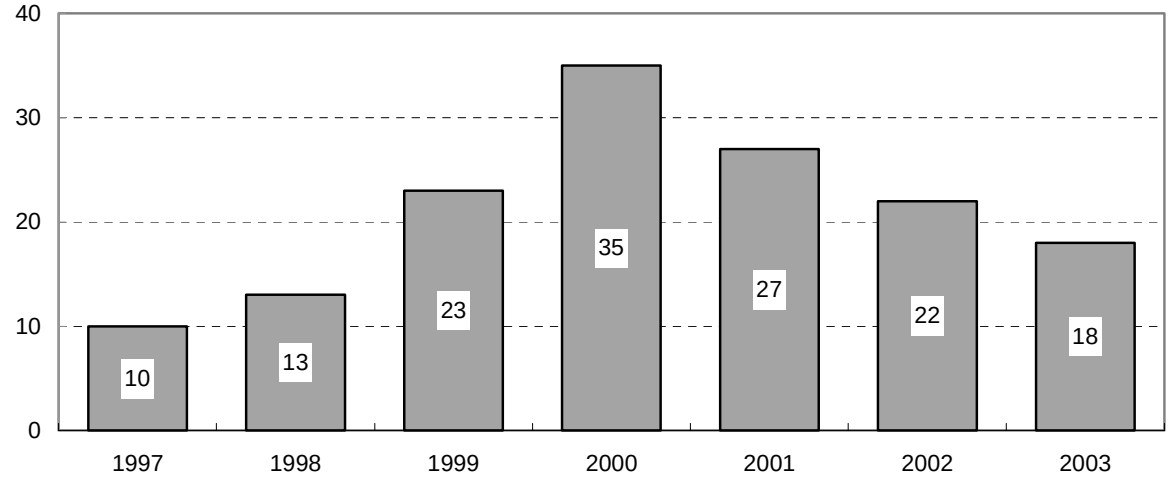
Denmark

Based on responses to R&D surveys and biotech firm database

Number of biotechnology firms,[1] 1997 to 2003



Number of core biotechnology firm start-ups, 1997 to 2003



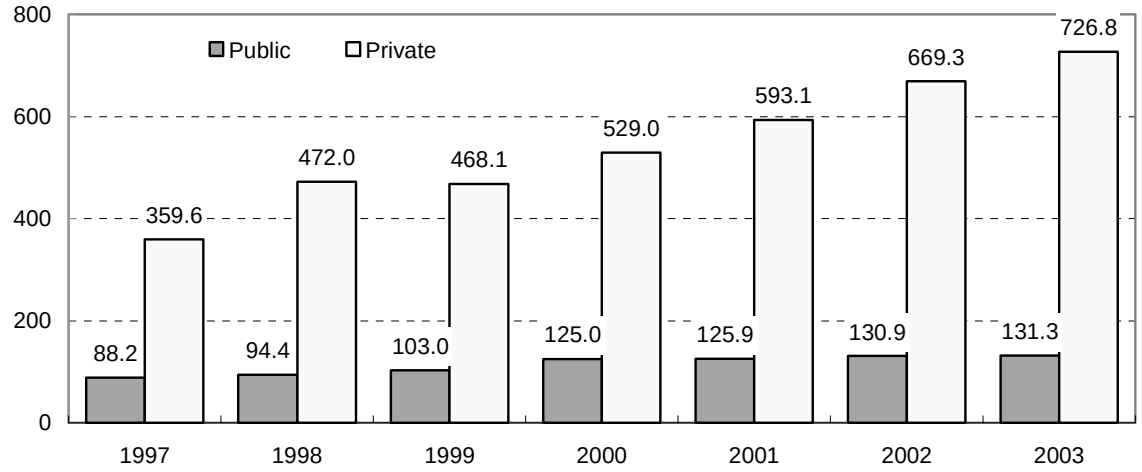
1. Core biotechnology firms are firms that are active in biotechnology R&D and for which biotechnology is their primary activity. Whereas firms with significant biotech activities perform biotechnology R&D, but biotechnology is not their primary activity.

Source: Danish Centre for Studies in Research and Research Policy, October 2005.

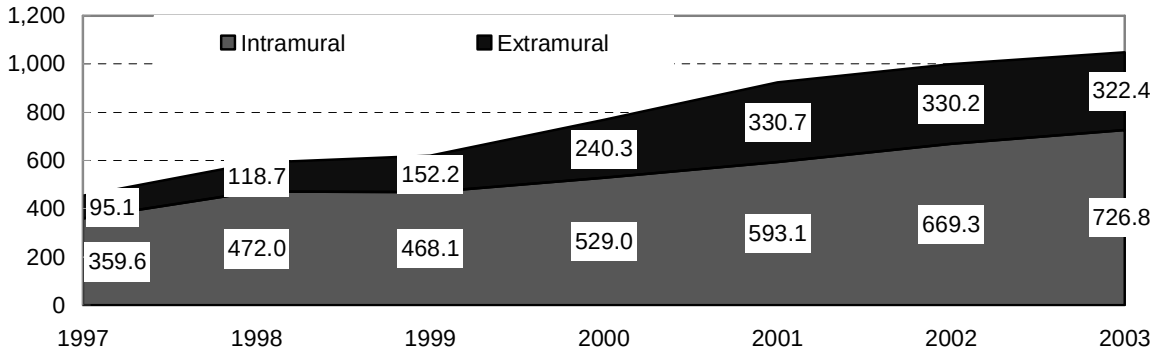
Denmark

Based on responses to R&D surveys and biotech firm database

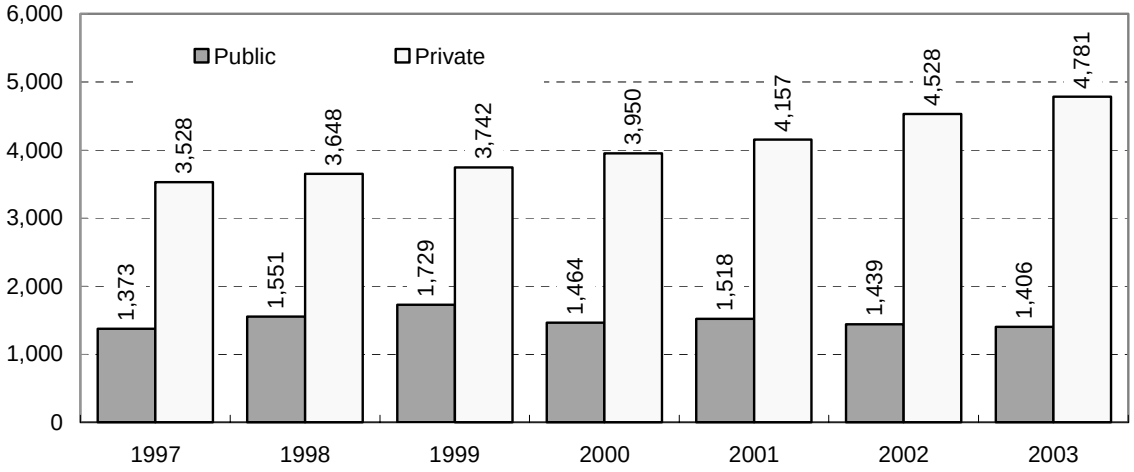
Biotechnology R&D in Denmark,[1] Million PPP$, 1997 to 2003



Intramural and extramural biotechnology R&D in the private sector, Million PPP$, 1997 to 2003



Total biotechnology R&D personnel (FTE), 1997 to 2003



1. For the private sector, data for 2000 was estimated based on an average of 1999 and 2001. Private sector data is unweighted. R&D data was not estimated for biotechnology firms where R&D data was not available for any year. For the public sector, data for 1998 was estimated based on an average of 1997 and 1999.

Source: Danish Centre for Studies in Research and Research Policy, October 2005.

BIOTECHNOLOGY IN FINLAND

- In Finland, two agencies have collected data on biotechnology: Statistics Finland and ETLA, the Research Institute of the Finnish Economy.

Statistics Finland

- Statistics Finland added a question on biotechnology R&D to their 2003 R&D survey. The survey included the OECD definition of biotechnology.
- The survey response rate was 83% and the results are weighted for non-respondents.
- In 2003, total R&D expenditure on biotechnology by both the public and business sectors was PPP$ 192.9 million, or 3.7% of all R&D expenditure (PPP$ 5,220.3 million). The business sector spent the most on biotechnology R&D (PPP$ 88.3 million). However, this represented only 2.4% of total business enterprise R&D expenditures. The higher education sector spent 8.6% or PPP$ 87.4 million on biotechnology R&D, out of a total higher education sector R&D expenditure of PPP$ 1,015.4 million. The government sector spent PPP$ 17.3 million on biotechnology R&D, or 3.2% of total government R&D.
- In 2003, the 102 firms engaging in biotechnology R&D employed 2,394 persons, 13% of whom had PhDs. The proportion of personnel with PhDs is higher for biotechnology firms than for other R&D active firms, where only 5% had PhDs.
- In 2003, 44 of the biotechnology R&D active firms were in the Manufacturing sector and 34 in the Research & Development sector (Services sector ISIC 73).
- Sixty-six percent of all biotechnology R&D active firms had 49 or fewer employees.

Research Institute of the Finnish Economy

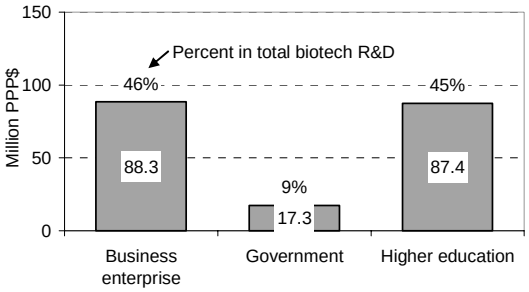
- ETLA conducted two surveys on the Finnish biotechnology industry, one in 2002, covering 2001, and another in 2004, covering 2003. At the end of 2001, there were an estimated 119 biotechnology firms in Finland, including 73 Small and Medium-sized Enterprises (SMEs). At the end of 2003, there were approximately 120 biotechnology firms in Finland, of which 93% were SMEs (112 firms). The survey included the OECD definition of biotechnology. The survey response rate was 71% and there was no weighting for non-respondents.
- The 2004 survey focused only on SMEs, as it was felt that the larger firms would skew results.
- In 2003, the Diagnostics and devices sector had the largest number of firms (43 SMEs), followed by the Drug discovery/development sector (34 SMEs), and then the Food and feed sector (22 SMEs). Some SMEs were active in more than one sector and are therefore double-counted.
- Total sales by Finnish biotechnology SMEs were approximately PPP$ 345.3 million in 2003. However, the sector as a whole was not making a profit, with total operating profits and total net profits at PPP$ -62.4 million and PPP$ -72.8 million, respectively.
- Sales in Enzymes were highest, representing 34% of total sales by Finnish biotechnology SMEs in 2003. The Drug development sector followed with 24% in sales. The Food and feed sector ranked third, with 20% of sales. The Bioinformatics sector had the lowest sales figures, with 0.2% of sales.
- The 2004 survey also collected information on the cross between the biotechnology technique (using the OECD list-based definition) and sector of application.
- DNA biotechnology techniques were most prevalent. These techniques were used in every sector of application.
- Only three techniques – all process biotechnology techniques – were not used at all by Finnish biotechnology SMEs: biopulping, biodesulphurisation and bioremediation.
- The bioinformatics sector reported using the widest array of techniques, followed closely by the drug development sector and the diagnostics sector.
- See the ETLA study released in April 2005 for more information. It is available on line at: http://www.etla.fi/files/1302_Dp978.pdf.

See annex tables for additional information.

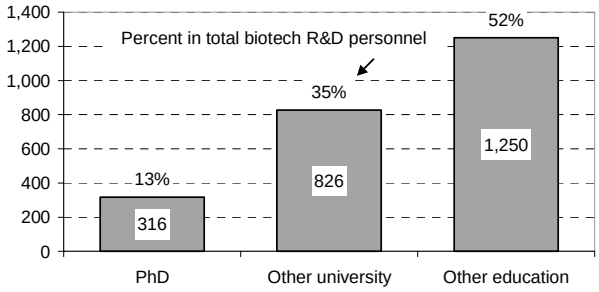
Finland

1. Data based on the R&D survey

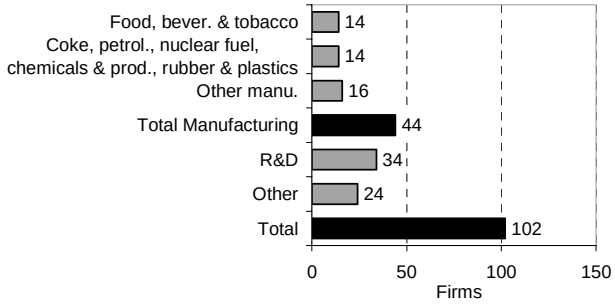
Biotechnology R&D, 2003
Million PPP$



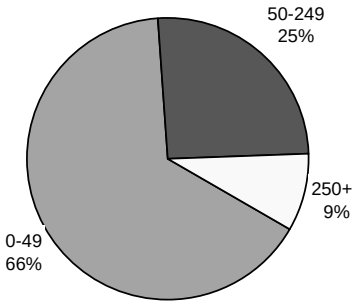
Firms engaging in biotech R&D: employees by level of education, 2003



Biotechnology R&D performing firms in the business enterprise sector, 2003
102 firms



Biotechnology R&D performing firms by size class, 2003
Determined by the number of employees -102 firms

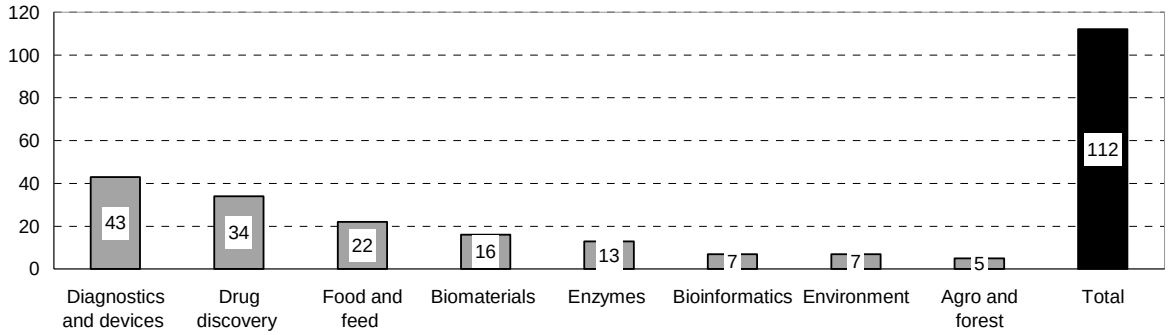


Source: Statistics Finland, March 2006.

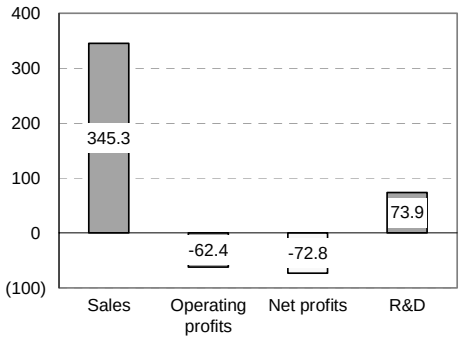
Finland

2. SMEs data based on the ETLA Small and Medium-sized Enterprises (SME) survey

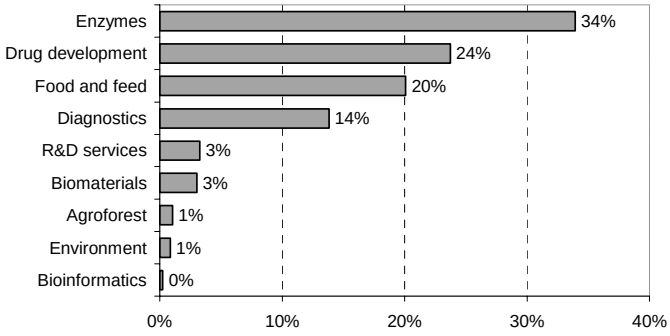
Sectoral breakdown of biotechnology SMEs by field of activity,[1] 2003



Biotech sales, profits and R&D,[2,3] 2003
Results for 109 SMEs in Million PPP$



Biotech sales by application field, 2003
Percentage sale distributions of 109 SMEs



1. Based on data from 112 SMEs. Some SMEs are active in more than one sector.
2. Sales and profits data includes 7 SMEs that were subsidiaries of large firms. These accounted for PPP$ 230 million of sales, had an operating profit of PPP$ 11 million, and a net profit of PPP$ 1 million.
3. R&D expenditure based on data from 81 SMEs.

Sources: Statistics Finland (2005), Science and Technology in Finland 2004, March; Hermans, R., M. Kulvik and A-J. Tahvanainen, (2005), ETLA 2004 Survey on the Finnish Biotechnology Industry, April.

BIOTECHNOLOGY IN FRANCE

- The MENRT, the Ministry of Education, Research and Technology (*Ministère de l'éducation nationale, de la recherche et de la technologie*), first added a biotechnology question to its annual business enterprise R&D survey in 2000. Respondents were asked to estimate the percent of total R&D expenditures devoted to biotechnology. The survey included the OECD definition of biotechnology.
- The French R&D survey is mandatory and is corrected for non-response. The response rate to the 2003 R&D survey was 71.5%.
- In 2003, 755 firms undertook biotechnology R&D in France, which represented 11% of all firms undertaking R&D.
- Fifty-seven percent of all R&D active pharmaceutical firms were undertaking biotechnology R&D. Forty-three percent of all R&D active agriculture firms were undertaking biotechnology R&D.
- In 2003, the 755 firms spent PPP$ 1,342.0 million on biotechnology R&D, which represented 5.6% of total business enterprise R&D spending.
- Biotechnology R&D was concentrated in 458 firms that dedicated over 75% of their total R&D expenditure to biotechnology. These firms are defined here as 'core' biotechnology firms.
- The core biotechnology firms spent PPP$ 1,196.6 million on biotechnology R&D, which represented 89% of total biotechnology R&D.
- In 2003, 95% (433) of the core biotechnology firms were SMEs with less than 250 employees.
- There were 170 core biotechnology firms (37% of all core biotechnology firms) where over 75% of the employees were working on R&D. These firms spent PPP$ 704.7 million (59% of total R&D spending) on biotechnology R&D in 2003.
- In 2003, most core biotechnology firms were in the Pharmaceuticals sector (255 of 458). These firms were responsible for 80% (PPP$ 958.5 million) of all biotechnology R&D.
- Over half of all R&D-active pharmaceutical firms (57%) in France undertook biotechnology R&D in 2003. These firms spent PPP$ 1,010.3 million on biotechnology R&D, which represented 75% of total biotechnology R&D spending.

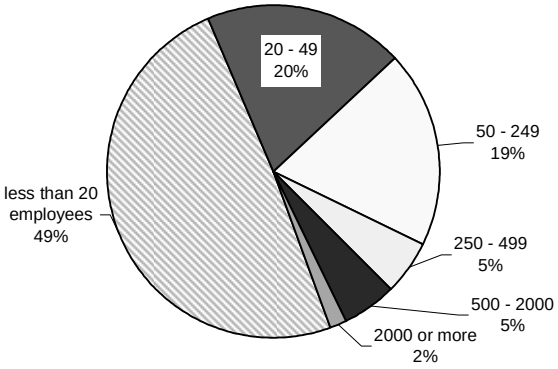
See annex tables for additional information

France

Based on responses to the R&D survey

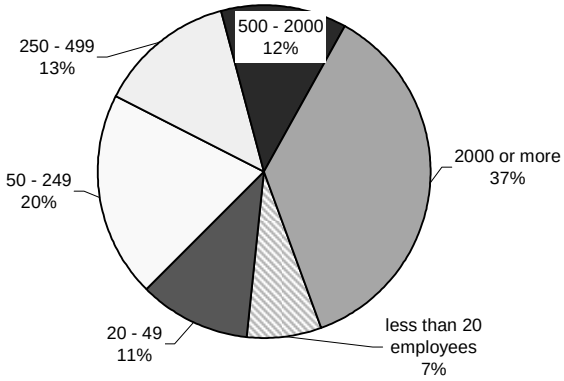
Firms undertaking biotech R&D by size class, 2003

Percentage breakdown - 755 firms



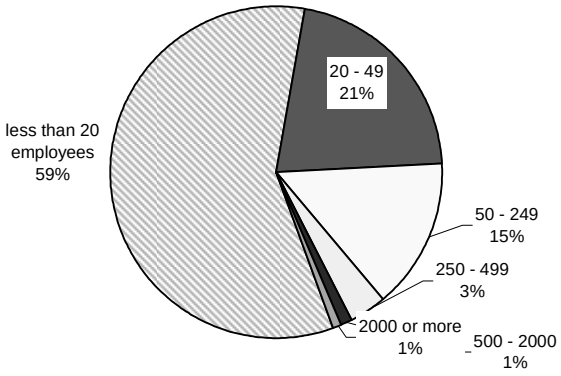
Biotech R&D expenditure by firm size class, 2003

Percentage breakdown – PPP$ 1,342.0 million



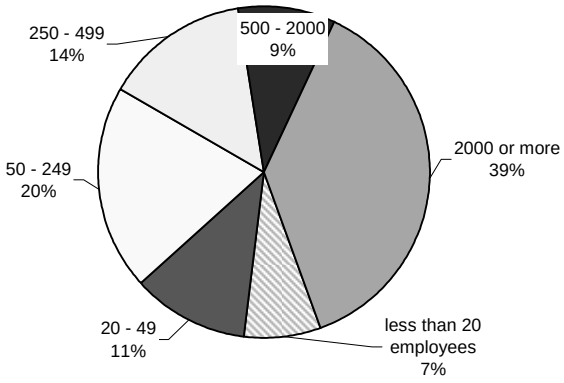
Firms undertaking biotech R&D by size, 2003

Percentage breakdown - 458 firms – **core**[1]

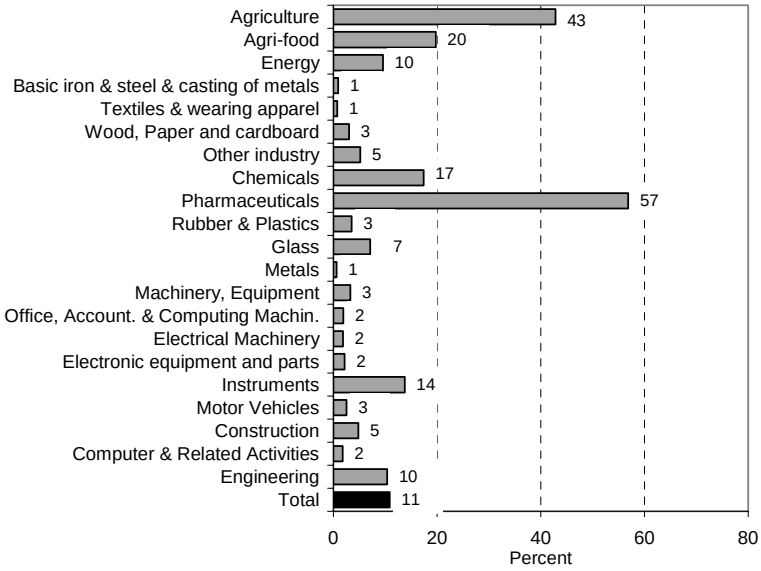


Biotech R&D expenditure by firm size class, 2003

Percentage breakdown – PPP$ 1,196.6 million – **core**[1]



Percent of biotech-active R&D firms over total R&D active firms in each sector, 2003



1. Core refers to firms where biotechnology R&D constituted over 75% of their total R&D expenditures.

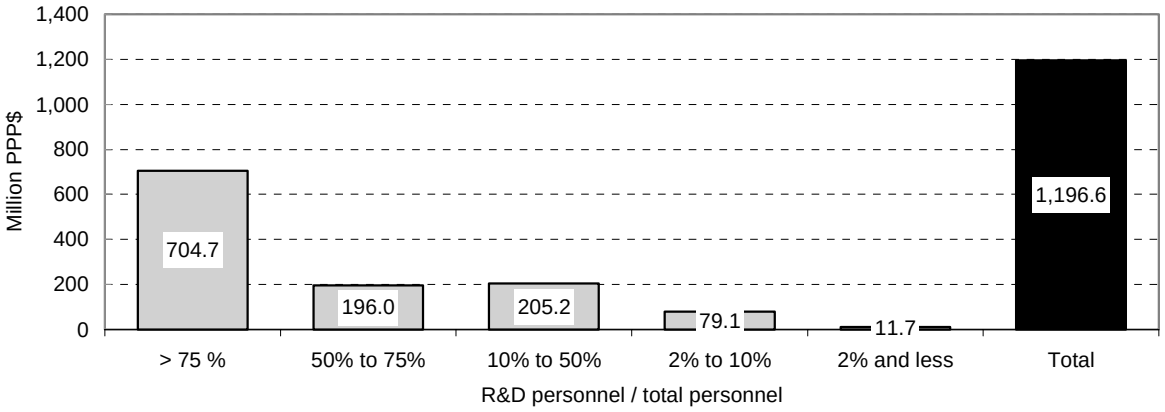
Source : *Ministère de l'éducation nationale, de la recherche et de la technologie*, R&D survey, November 2005.

France

Based on responses to the R&D survey

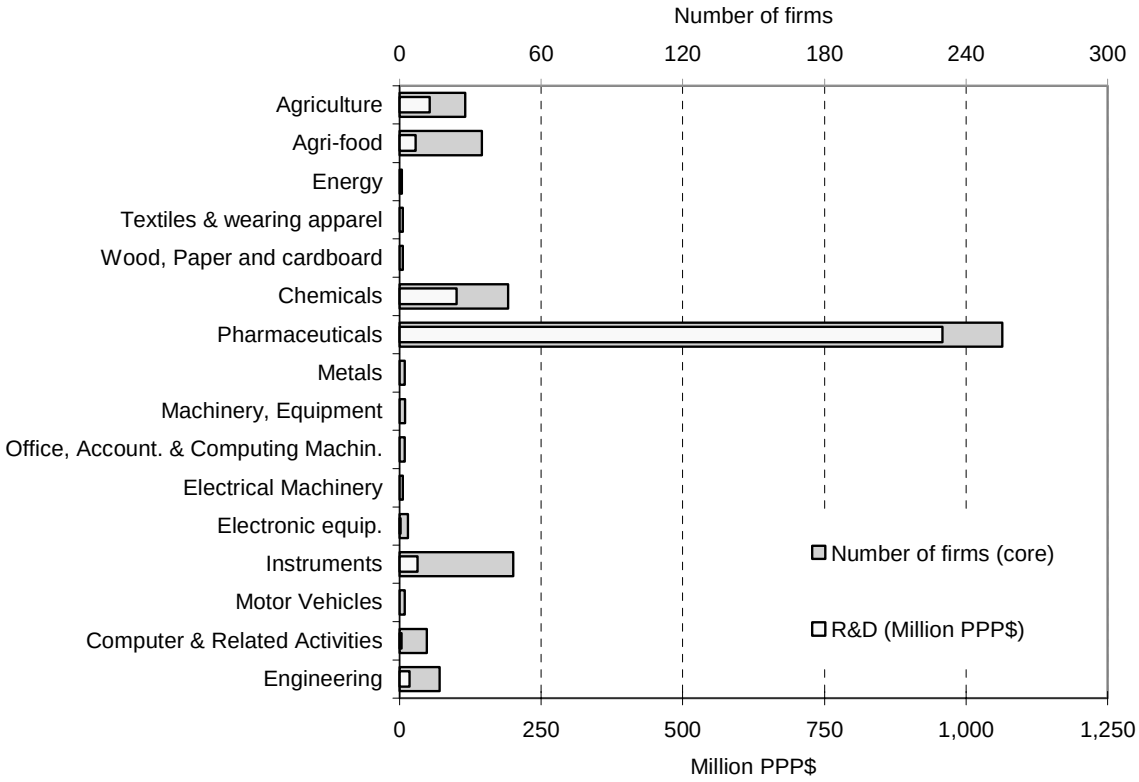
Biotech R&D expenditure - core firms - by share of R&D employees over total employees, 2003

Breakdown of PPP$ 1,196.6 million



Number of firms undertaking biotech R&D - core firms - and R&D, by sector, 2003

Breakdown of 458 firms and of PPP$ 1,196.6 million



Source : *Ministère de l'éducation nationale, de la recherche et de la technologie*, R&D survey, November 2005.

BIOTECHNOLOGY IN GERMANY

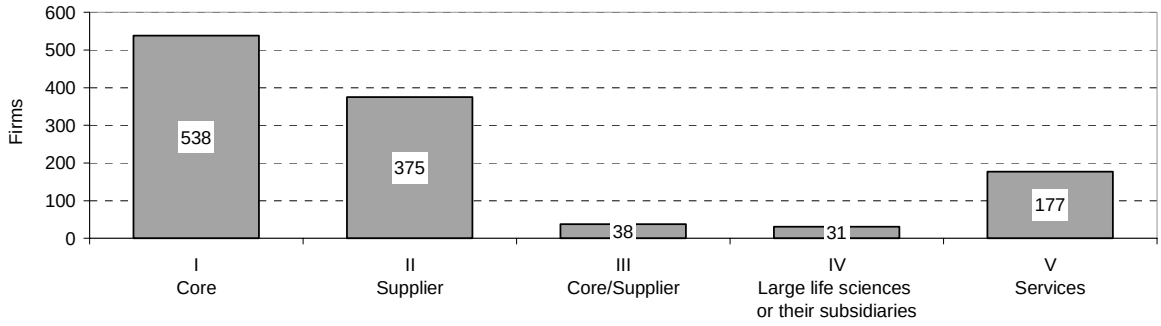
- The German Federal Statistical Office has run three Biotechnology firm surveys, for reference years 2000, 2002 and 2004. All three surveys used the OECD definition of biotechnology. The results presented here are limited to the 2002 and 2004 surveys and were weighted to reflect the total population of biotechnology firms.
- The surveys were conducted on a voluntary basis and the overall response rates were 58% in 2002 and 65% in 2004.
- The survey target population was divided into five categories[7]:
  - Category I: Core biotech firms which mainly apply modern biotechnological procedures (538 firms);
  - Category II: Suppliers to the core biotech firms and research institutions (375 firms);
  - Category III: Firms that are both core biotech firms and suppliers (38 firms);
  - Category IV: Large life sciences firms, or their subsidiaries, with a significant focus on biotechnological activities (31 firms); and
  - Category V: Consultants and financial service providers to biotech (177 firms).
- Categories I, III, and IV combined cover biotech activities, including R&D, that are included in the OECD definition. No further details are given for categories II and V because they are rarely included as biotech firms in other countries, which usually report activities for 'core' biotech firms only or for all firms active in biotech R&D.
- All employment, R&D, and turnover in category I is assumed to be relevant to biotech. Conversely, data for category IV are limited to biotech activities: the R&D data exclude non-biotech R&D. For category III, all employment and R&D is assumed to be relevant to biotech, but the results for turnover exclude non-biotech sales.
- In 2004, there were 607 firms involved in biotech categories I, III and IV combined. Eighty-nine percent of these firms were core biotech firms (538 firms).
- Most core biotech firms in 2004 had less than 100 employees (519 firms or 96%).
- In 2004, there were 24,134 biotech-active employees, of which 11,958 (50%) were employed by core biotech firms and 10,995 (46%) by large life science firms.
- There were an estimated 8,024 biotech R&D employees in 2004, of which 5,438 (68%) were in core biotech firms. Smaller firms had a higher share of employees active in R&D.
- From 2002 to 2004, total biotech employment grew only in the large life sciences firms (16%). Employment fell in the core biotech firms (- 10%) and in the core/supplier firms (- 55%).
- In 2004, an estimated PPP$ 1,346.8 million was spent on biotech R&D: PPP$ 791.7 million (59%) by the core biotech firms and PPP$ 533.7 million (40%) by the large life science firms.
- Total turnover, from biotech sales only, was PPP$ 3,837.5 million, of which PPP$ 2,622.5 million (68%) was by large life science firms and PPP$ 1,107.0 million (29%) by core biotech firms.
- From 2002 to 2004, biotech R&D fell by 30% for core firms and by 10% for large life sciences firms. During the same period, biotech turnover increased by 11% for core firms and 5% for biotech products in large life science firms.
- The firms were asked to classify their activities into three fields: "green" biotech, which covers agricultural and food biotech; "red" biotech, which covers health (human and animal) and bioinformatics; and "grey" biotech, which covers industrial and environmental biotech.
- Most core biotech firms classified their activities as "red" biotech (67%).

[7] The results exclude 49 firms that were not in operation at the time of the survey, including: 34 firms in category I (core), 7 firms in category II (suppliers), 2 firms in category IV (large life sciences) and 6 firms in category V (services).

Germany

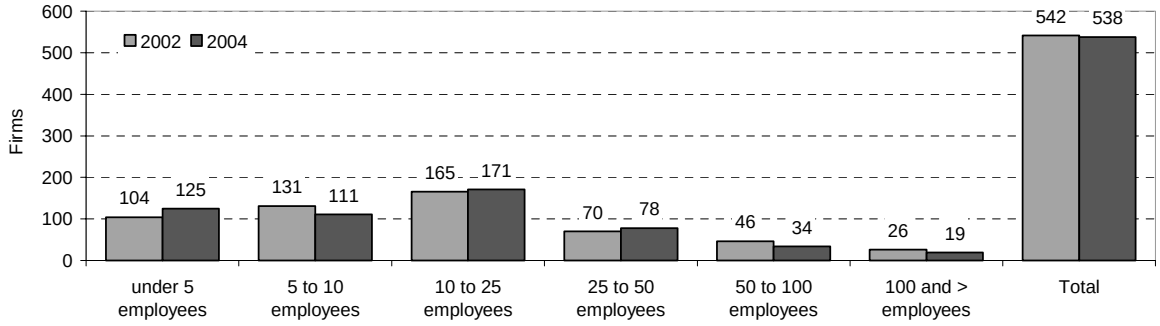
Based on responses to the Biotechnology firm survey

Categories of biotechnology firms,[1] 2004

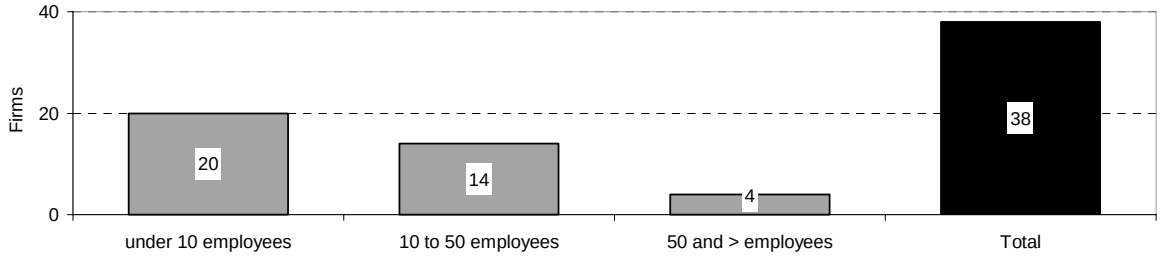


1. Excludes 49 biotechnology firms that were not in operation at the time of the survey.

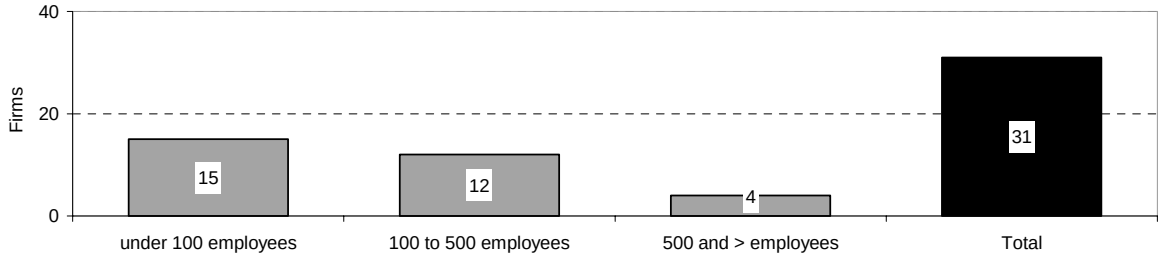
Core biotechnology firms (Category I) by size class, 2002 and 2004



Core/Supplier biotechnology firms (Category III) by size class, 2004



Large life sciences biotechnology firms or their subsidiaries (Category IV) by size class, 2004

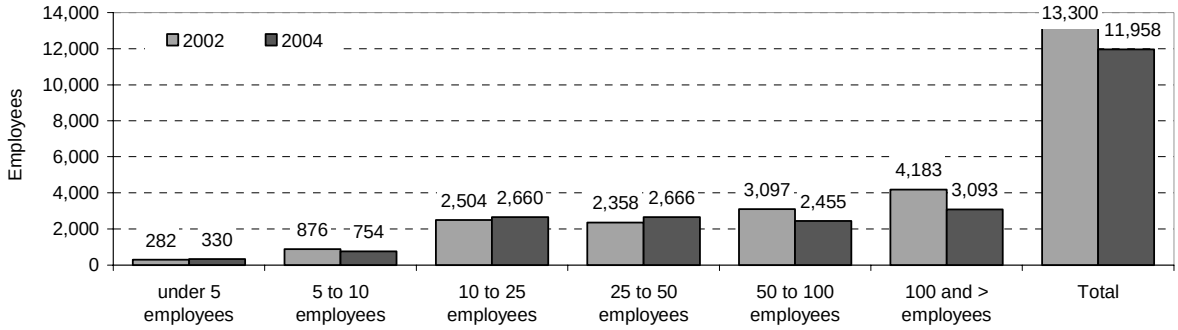


Source: Statistisches Bundesamt (2005), Unternehmen der Biotechnologie in Deutschland — Ergebnisse der Wiederholungsbefragung 2004, October.

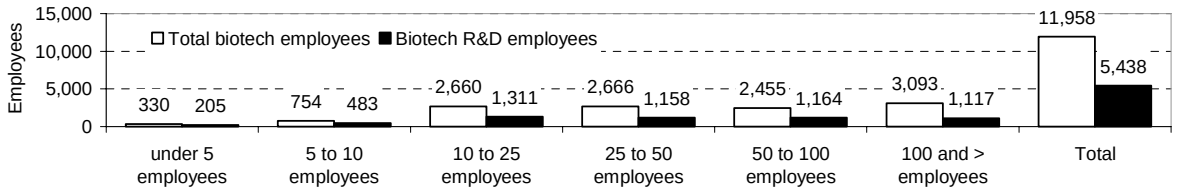
Germany

Based on responses to the Biotechnology firm survey

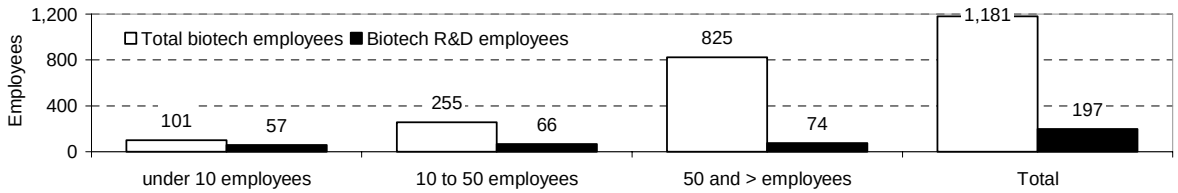
Core biotechnology firms (Category I): biotech employment by size class, 2002 and 2004



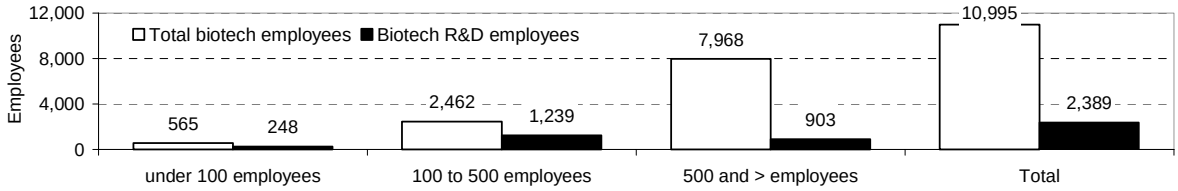
Core biotechnology firms (Category I): biotech R&D employment by size class, 2004



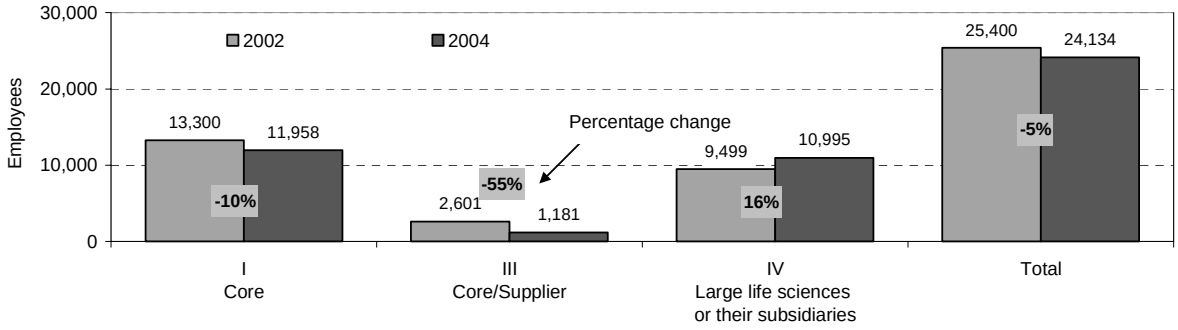
Core/Supplier biotechnology firms (Category III): biotech R&D employment by size class, 2004



Large life sciences biotech firms or their subsidiaries (Category IV): biotech R&D employment by size class, 2004



Total biotechnology employment by firm category, 2002 to 2004

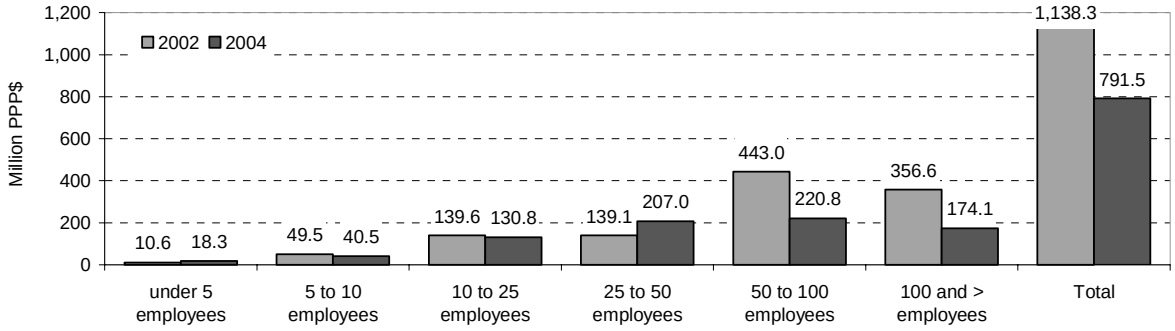


Source: Statistisches Bundesamt (2005), Unternehmen der Biotechnologie in Deutschland — Ergebnisse der Wiederholungsbefragung 2004, October.

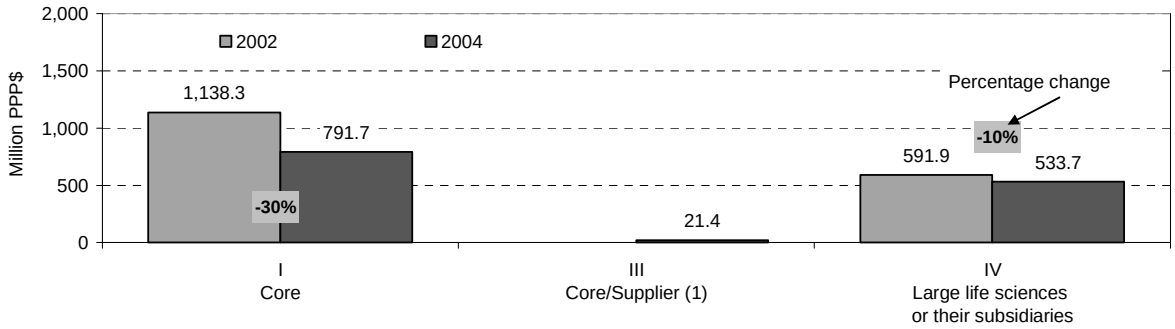
Germany

Based on responses to the Biotechnology firm survey

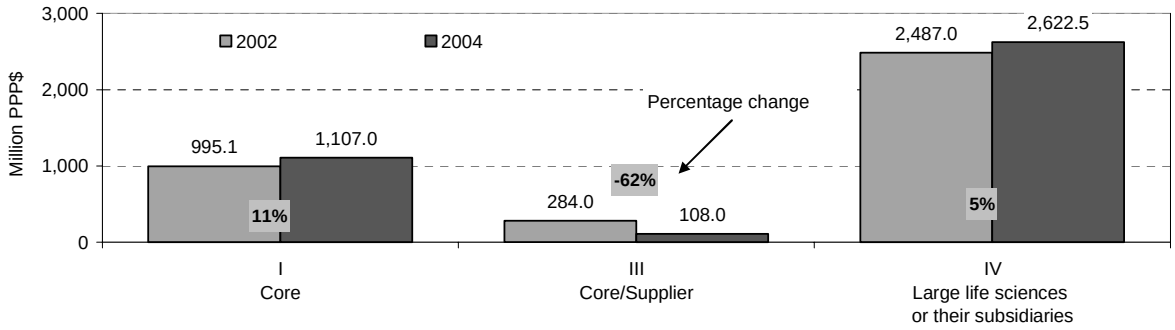
Core biotech firms (Category I): biotech R&D by size class, Million PPP$, 2002 and 2004



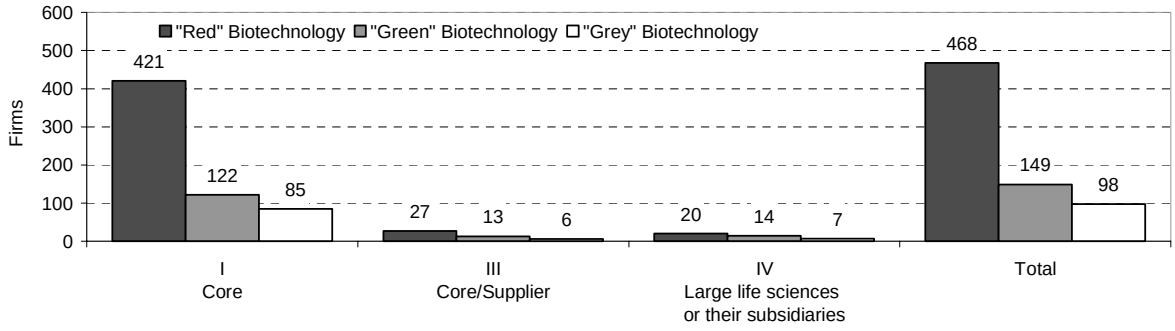
Biotechnology R&D by firm category, Million PPP$, 2002 to 2004



Biotechnology turnover by firm category, Million PPP$, 2002 to 2004



Biotechnology firms by field of activity, [2] 2004



1. Core/Supplier data for 2002 was not available.
2. Firms were allowed multiple responses.

Source: Statistisches Bundesamt (2005), Unternehmen der Biotechnologie in Deutschland — Ergebnisse der Wiederholungsbefragung 2004, October.

BIOTECHNOLOGY IN ICELAND

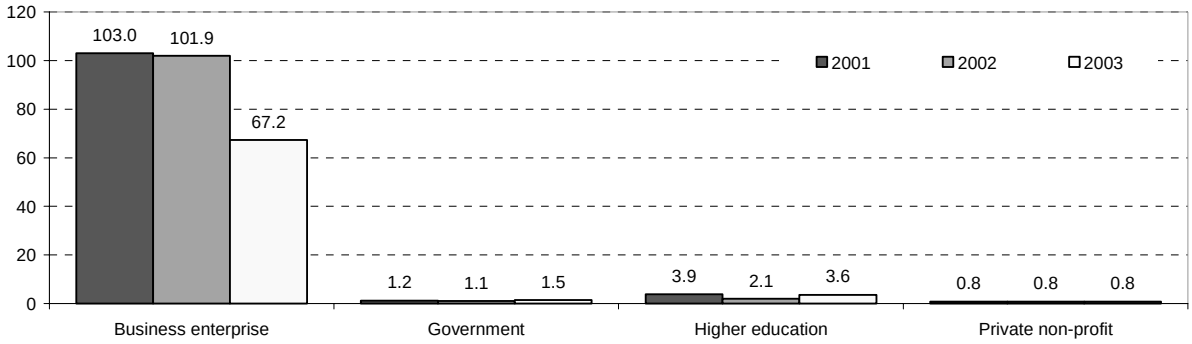
- In 2003, the Ministry of Education, Science and Culture commissioned RANNIS, The Icelandic Centre for Research, to run a one-off survey to measure R&D in biotechnology.
- The survey covered 2001 to 2003 and was the first of its kind in Iceland. The survey achieved an overall response rate of 100%.
- The survey provided both the OECD single and list-based definitions of biotechnology.
- The survey covered: the business enterprise sector, the government sector, the higher education sector and the private non-profit sector.
- Combined, the sectors spent PPP$ 73.1 million on biotechnology R&D in 2003. Ninety-two percent of this amount was undertaken by the business enterprise sector.
- In 2003, 23 firms were undertaking biotechnology R&D. These firms spent PPP$ 67.2 million on biotechnology R&D.
- In 2003, total business enterprise R&D expenditure by all firms in Iceland was PPP$ 130.7 million, over half of which was spent on biotechnology R&D.
- Source of funding data shows that 86% of business enterprise R&D funds were financed from abroad in 2003.
- Combined, the biotechnology-active sectors employed 1,484 employees (headcount data). This figure represents total employment by the sectors, as no data was collected for biotechnology employment alone. Over half of these employees were in the business enterprise sector (969 or 65%).
- Six hundred and forty-two employees had R&D-related duties (headcount data). The business enterprise sector had the largest share of R&D biotechnology personnel (71%). Combined, the government sector, the higher education sector and the private non-profit sector had 29% of all R&D personnel.
- When calculated in full-time equivalents, 568.1 employees worked on biotechnology R&D in 2003. Seventy-four percent of these biotechnology R&D FTEs were in the business enterprise sector (422 FTEs).
- Over half of all biotechnology R&D FTEs were women (58% or 330.2 women).
- In 2003, Diagnostics and Therapeutics were the main activities for the largest number of performers. Silviculture is the only activity with no performers.
- Health-related activities were the main focus of biotechnology R&D in 2003, with 88% of total biotechnology R&D dedicated to health (PPP$ 64.1 million). Ninety-seven percent of this amount came from the business enterprise sector.

See annex tables for additional information.

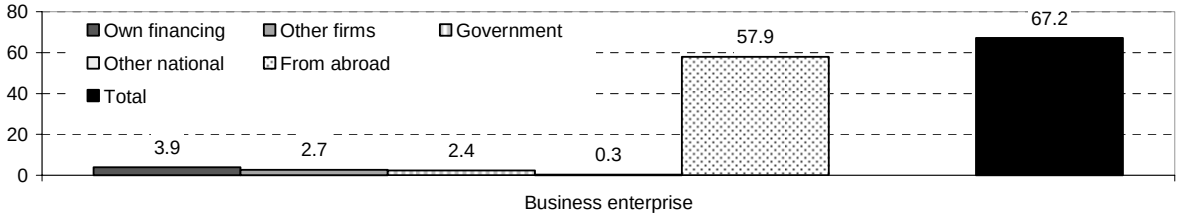
Iceland

Based on RANNIS Biotechnology R&D survey

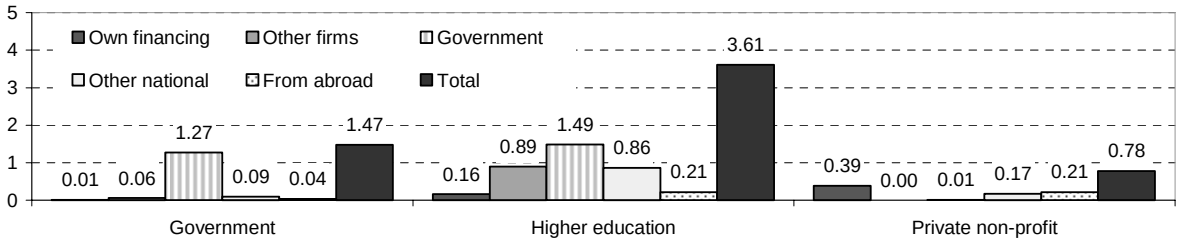
Biotechnology R&D by sector, Million PPP$, 2001-2003



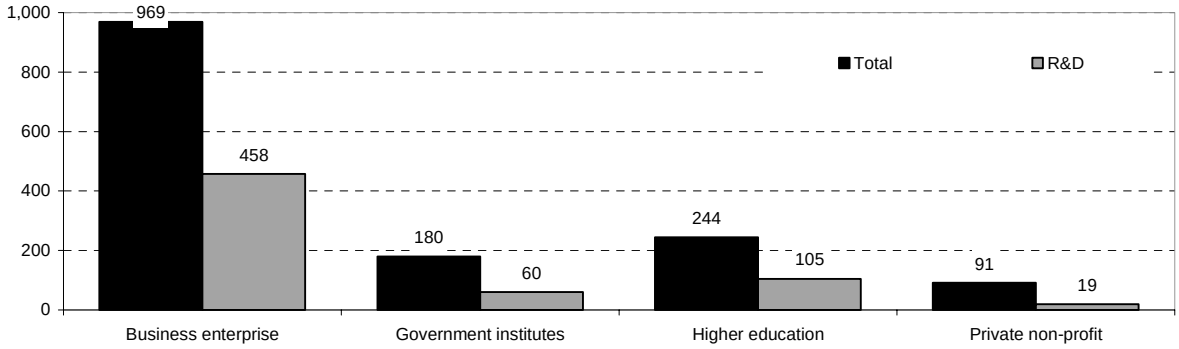
Biotechnology R&D by the business enterprise sector by source of funds, Million PPP$, 2003



Biotechnology R&D by performer and source of funds, Million PPP$, 2003



Number of employees by performing sector, headcount, 2003

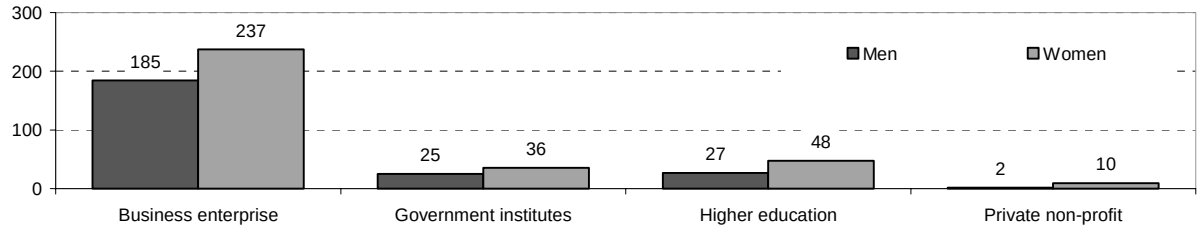


Source: RANNIS, The Icelandic Centre for Research, January 2006.

Iceland

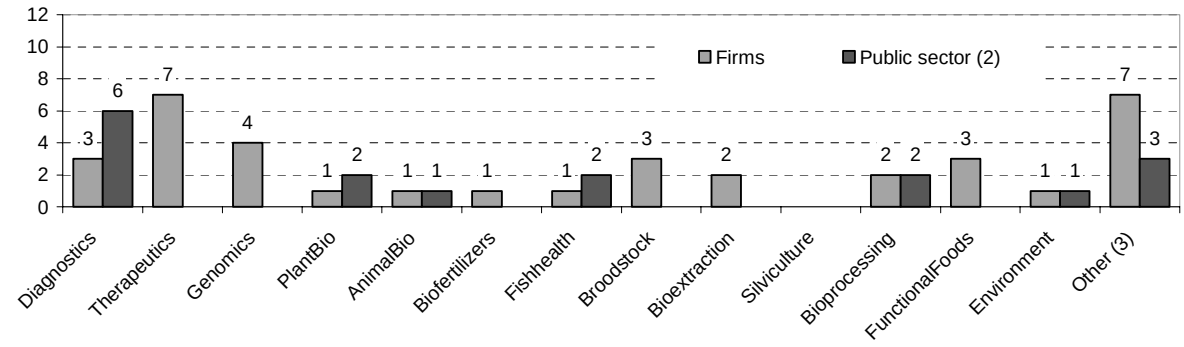
Based on RANNIS Biotechnology R&D survey

Full-time equivalent biotechnology R&D employees by performing sector, 2003

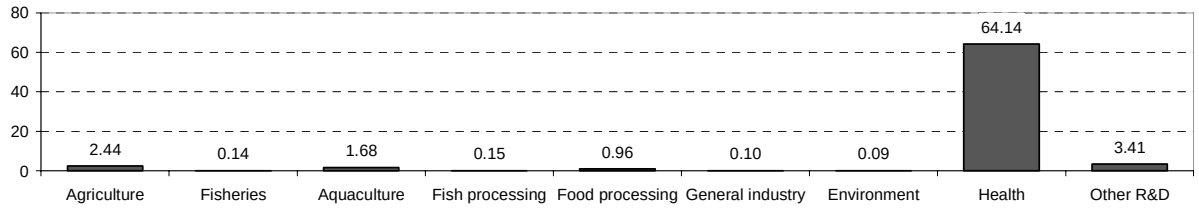


Source: RANNIS, The Icelandic Centre for Research, January 2006.

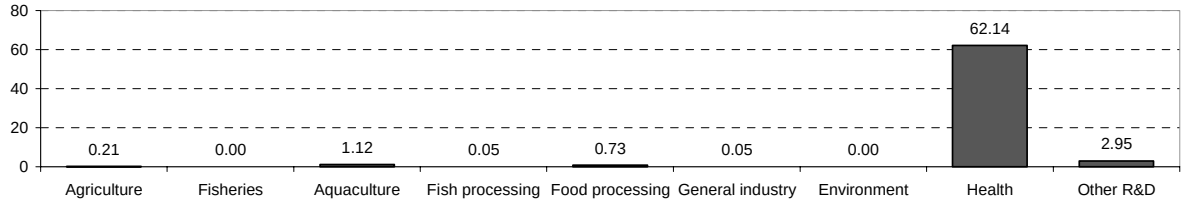
Main activities[1] of biotechnology-active performers, 2003



Total biotechnology R&D by application field, Million PPP$, 2003



Business enterprise biotechnology R&D by application field, Million PPP$, 2003



1. Multiple responses were allowed.
2. Public sector includes: the government sector, the higher education sector and the private non-profit sector.
3. Other referred to: DNA micro array synthesis and service research, Medicinal herbs, Production of recombinant proteins in plants (molecular farming), Blood drawing and data collection, Cosmetics, Functional ingredients for food, drug and health sectors, Software development for Biotech industry, Production of hydrogen from thermophilic bacteria, Molecular epidemiology; genetic screening; in vitro tissue models; screening of bioactive substances, Molecular epidemiology; genetic screening; in vitro tissue models; screening of bioactive substances.

Source: RANNIS, The Icelandic Centre for Research, January 2006.

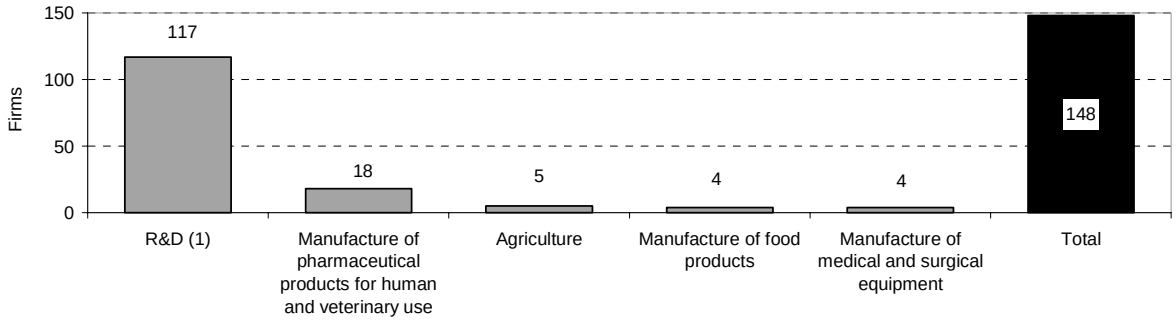
BIOTECHNOLOGY IN ISRAEL

- In 2004, the Israeli Central Bureau of Statistics ran a survey on biotechnology firms in Israel for 2002. The survey used the OECD definition of biotechnology.
- The survey was mandatory and had a response rate of 95.5% and the results were weighted for non-respondents.
- In 2002, 148 firms were engaged in biotechnology in Israel.
- In 2002, 117 (79%) of all biotechnology firms were in the Research & Development sector (Services sector ISIC 73), which included research institutes and start-up companies which did not yet manufacture biotechnological products, but were in various stages of product development.
- Most of the biotechnology firms in Israel were small, 76% had 20 or fewer employees in 2002.
- In 2002, almost half of the firms were engaged in Human health care applications, with 73 firms or 49%. The second largest application was Agriculture and marine biotechnology, with 28 firms or 19%. The Environment and afforestation application was third, with 24 firms or 16%.
- In 2002, expenditure on biotechnology R&D was an estimated PPP$ 251.1 million. This represented 4.9% of total Business Enterprise R&D expenditure (PPP$ 5,095.3 million).
- Firms active in Human health applications were responsible for 61% (PPP$ 152.1 million) of all biotechnology R&D in 2002. Bioinformatics had the second largest share of total biotechnology R&D expenditures, with 15% or PPP$ 37.6 million.
- Biotechnology firms employed 3,892 persons, 3,427 (88%) of whom worked on biotechnology-related tasks. A quarter of these employees had PhDs (25%), while 39% had Bachelor's and Master's degrees. Of the employees working on biotechnology-related tasks 47% were in R&D.
- In 2002, 55% of all biotechnology employees worked in Human health applications (1,879 employees).
- In 2002, biotechnology firms generated PPP$ 331.8 million in sales. Fifty-two percent of biotechnology sales came from Human health applications (PPP$ 174.0 million).
- Seventy-five percent of biotechnology sales is generated from exports (PPP$ 250.5 million).
- The biotechnology firms raised PPP$ 186.1 million from external sources of finance, of which 96% was raised by the R&D sector.
- Venture capital accounted for 5.6% of the total funding from external sources.

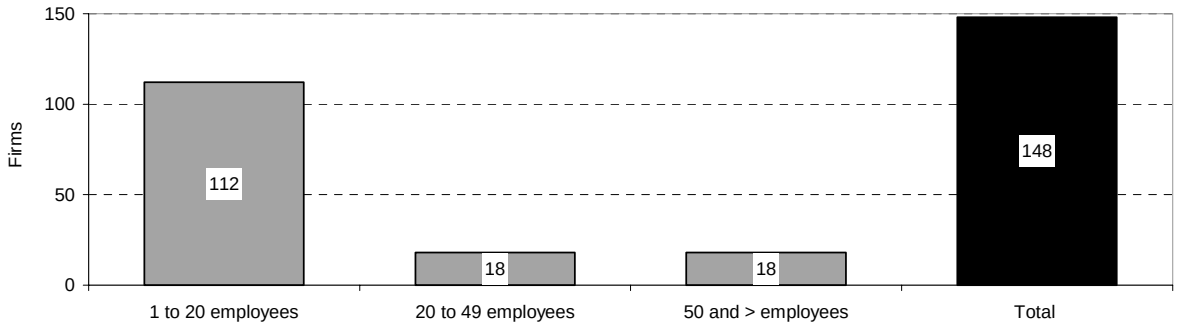
Israel

Based on responses to the Biotechnology firm survey

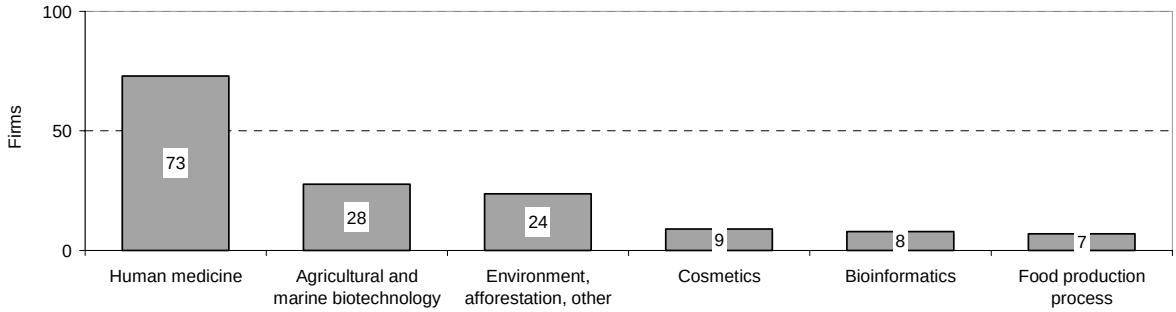
Biotechnology firms in the business enterprise sector, 2002



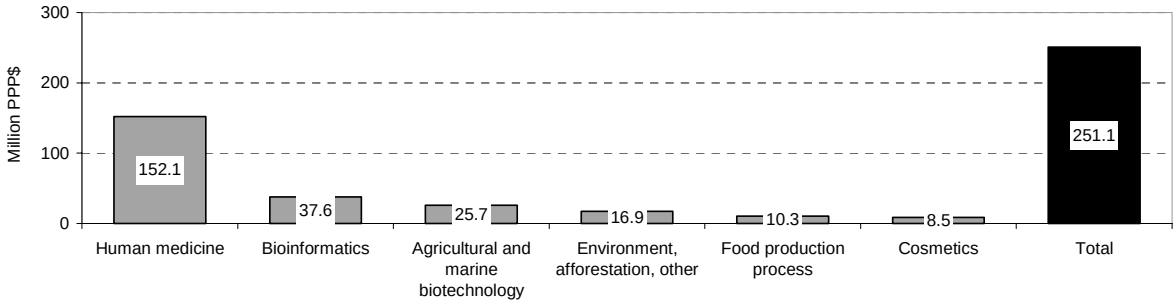
Biotechnology firms by size class, 2002



Biotechnology firms by application field,[2] 2002



R&D expenditures of biotech firms by application field, Million PPP$, 2002



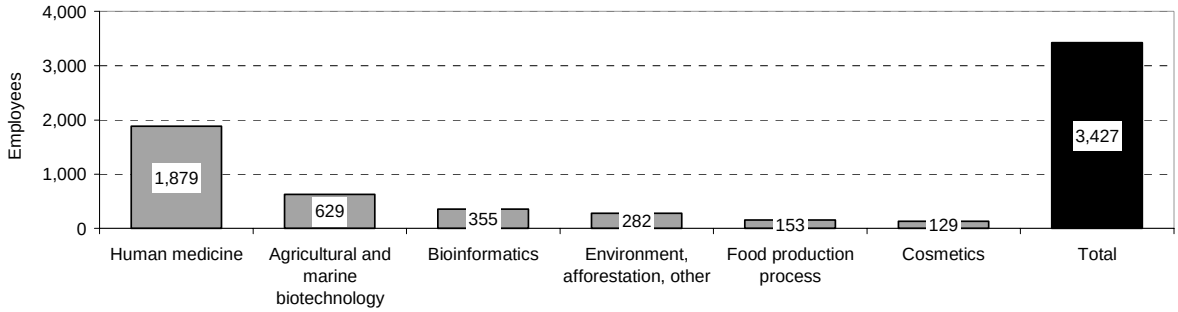
1. R&D includes: Research institutes, start-up companies which do not yet manufacture biotechnological products, but are in various stages of product development.
2. Some firms are active in more than one application field.

Source: Israel Central Bureau of Statistics (2005), Survey of biotechnology in Israel for 2002, December.

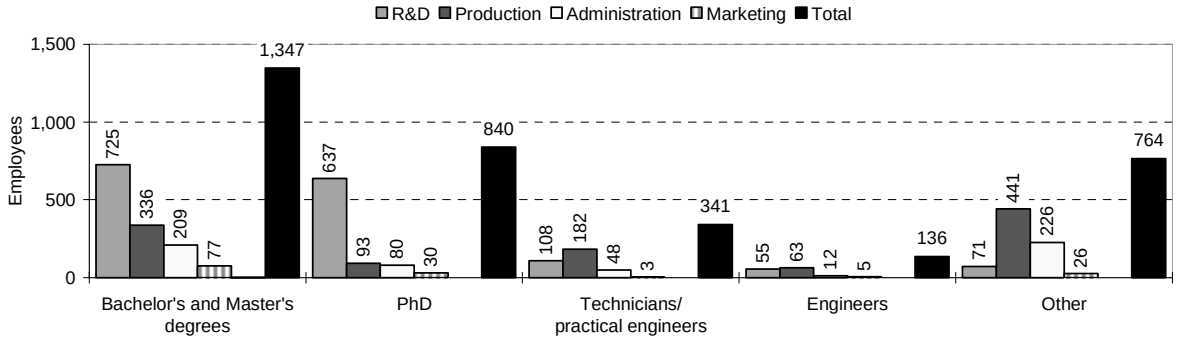
Israel

Based on responses to the Biotechnology firm survey

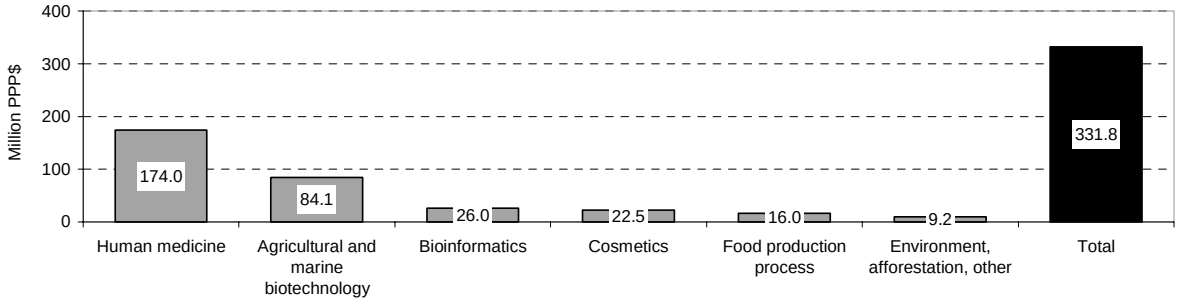
Number of employees by application field, 2002



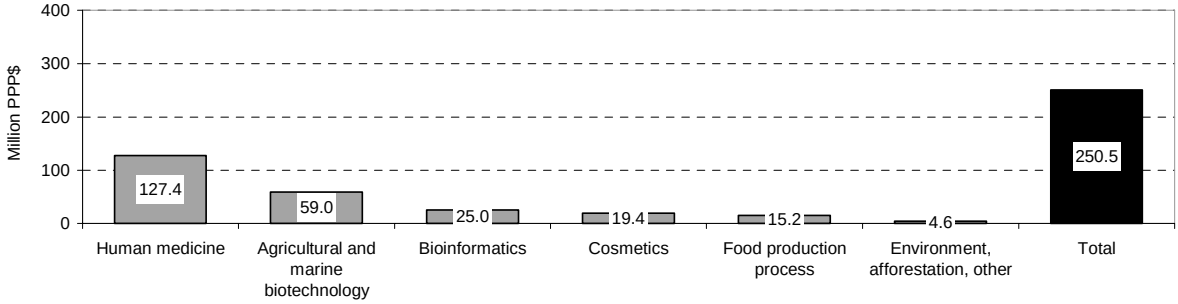
Number of employees by type of work and level of education, 2002



Biotechnology sales by application field, Million PPP$, 2002



Biotechnology exports by application field, Million PPP$, 2002



Source: Israel Central Bureau of Statistics (2005), Survey of biotechnology in Israel for 2002, December.

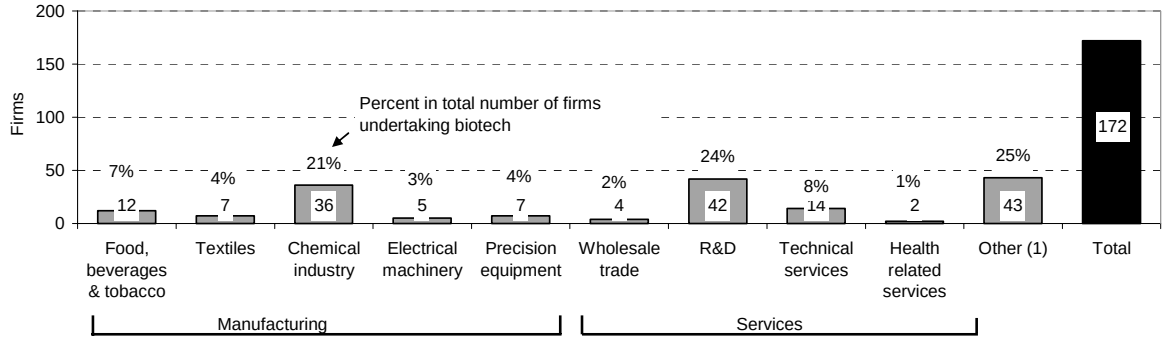
BIOTECHNOLOGY IN ITALY

- The National Institute of Statistics (ISTAT) added a question on biotechnology R&D to their annual business enterprise R&D survey as of 1991. As of 2002, the survey included the OECD definition of biotechnology.
- The business enterprise R&D survey is a mandatory census-based survey. The survey does not apply any size cut-off for R&D performers.
- In 2003, the overall rate of response was 49.6%. The results of the Italian business R&D survey are not weighted for non-response.
- In 2003, 172 firms reported performing biotechnology R&D in Italy.
- The European Classification of Economic activities (NACE) was used to categorise firms into different sectors.
- In 2003, 67 of the biotechnology R&D active firms were in the Manufacturing sector and 62 in the Services sector.
- In 2003, the largest number of biotechnology R&D active firms was in the Research & Development sector, with 42 firms, followed by the Chemical industry, with 36 firms.
- In 2003, total R&D expenditure on biotechnology amounted to PPP$ 236.2 million, or 2.8% of all business enterprise R&D expenditure (PPP$ 8,309.8 million).
- Forty-four percent of all biotechnology R&D expenditure was undertaken by firms in the Research & Development sector. Firms in the Chemical Industry sector, which includes Pharmaceuticals, undertook 20% of all biotechnology R&D.
- The Health related services sector had the largest proportion of biotechnology R&D over total R&D (39.4%), however, this represented only 1.4% of total biotechnology R&D expenditure.
- R&D on process biotechnology techniques (bio-reactors, fermentation, bio-catalysis, industrial bio-processes, and environmental bio-technologies) accounted for 38% of biotechnology R&D expenditures. All but the sector health-related services conducted R&D on process biotechnology.
- The Research & Development sector reported using the widest array of biotechnology techniques.

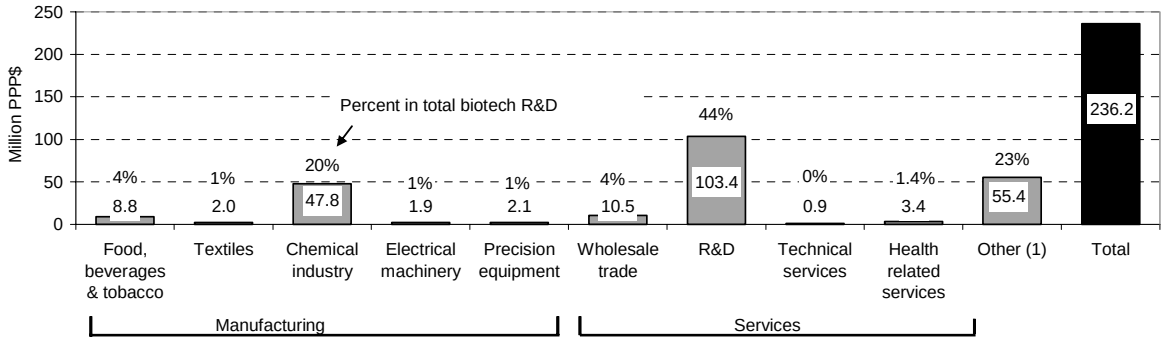
Italy

Data based on the R&D survey

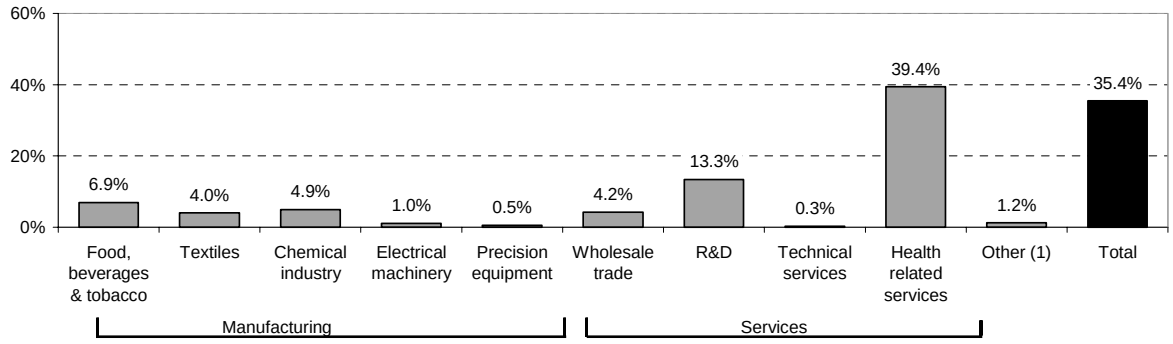
Distribution of 172 biotechnology R&D active firms in the business enterprise sector, 2003



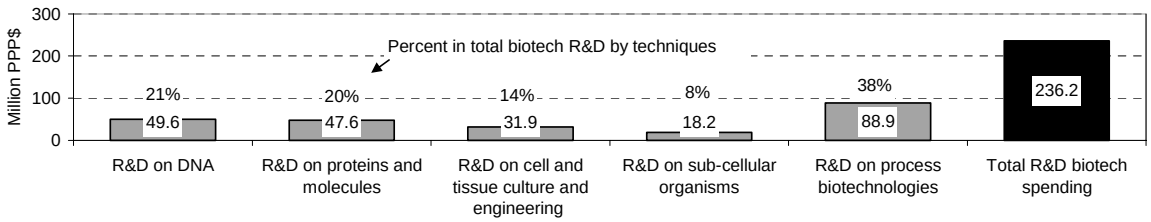
Distribution of biotechnology R&D by sector, Million PPP$, 2003



Proportion of biotechnology R&D over total R&D by sector, 2003



Distribution of biotechnology R&D by techniques, Million PPP$, 2003



1. "Other" includes NACE sectors 11,23,25,27,28,29,30,32,34,35,41,45,50,72,90.

Source: ISTAT (2006), March 2006.

BIOTECHNOLOGY IN JAPAN

- The Japanese Bioindustry Association (JBA) has been running a Biotechnology Industry Survey since 1997. Since 2000, the survey has been conducted under contract by the Ministry of Economy, Trade and Industry (METI). This has increased the survey response rate significantly: in 1999 the response rate was 37.9%, and in 2003 it was 75.7% with responses received from 1,162 firms; there was no weighting for non-respondents.
- The survey scope covers "traditional and/or modern biotechnology". The former includes traditional fermentation, cultivation, mutagenesis and pollution treatment technology which explains why the data are skewed towards the Food/drink sector. Modern biotechnology includes recombinant DNA, cell fusion, tissue culture and biomimetic technology.
- The largest share of Japanese firms were in the Food or drink manufacture sector (21%), followed by the Chemical industry sector (11%) and the Pharmaceuticals sector (11%).
- Sixty-one percent of the firms had less than 300 employees.
- Conventional Fermentation, Cultivation and Mutagenesis Technologies accounted for 77% of total production.
- Traditional biotechnology products accounted for 82% of biotechnology production, while modern biotechnology products accounted for 18%. Production is measured as the value of domestic shipments, which was PPP$ 45,626.3 million for traditional biotechnology products and PPP$ 9,886.3 million for modern biotechnology products.
- Food products accounted for 62% of total production by biotechnology firms and for 75% of traditional biotechnology shipments.
- Pharmaceuticals, Diagnostic Reagents & Medical Instruments represented 58% of all products using modern biotechnology.
- Domestic production of modern biotechnology products increased from PPP$ 8,359.2 million in 2000 to PPP$ 9,886.3 million in 2003. The share of total modern biotechnology production from rDNA-based products increased from 36.2% in 2000 to 39.9% in 2003.

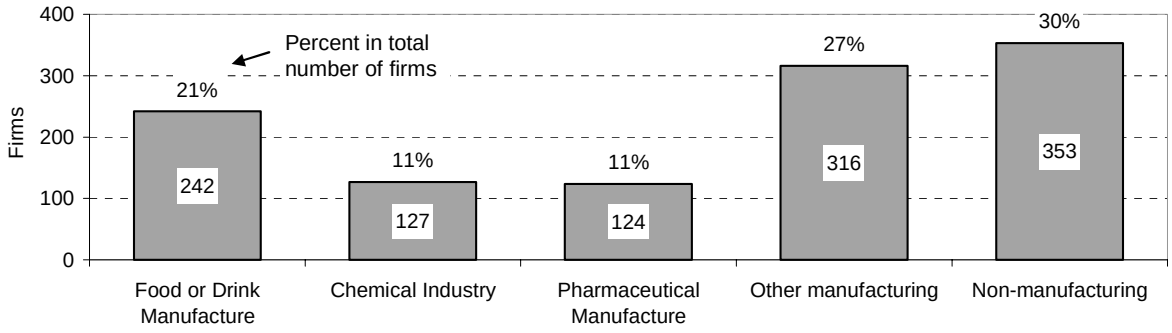
See annex tables for additional information.

Japan

Based on responses to the Biotechnology industry survey

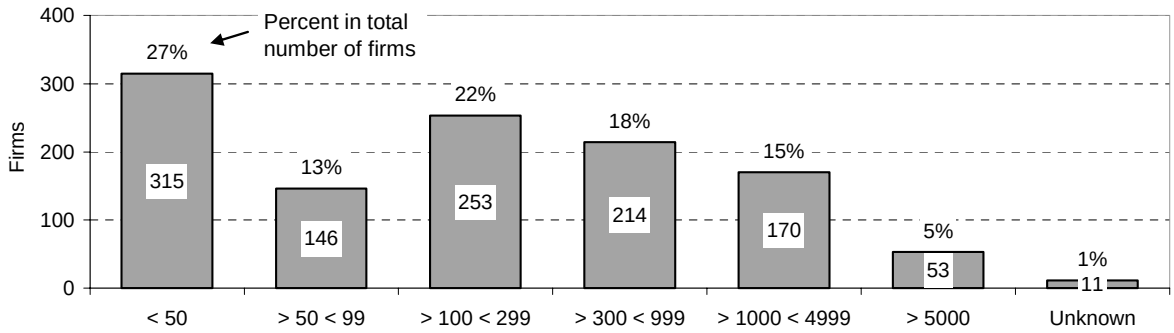
Breakdown of biotechnology-active firms[1] in the business enterprise sector, FY 2003

Based on principal sales activity of 1,162 firms

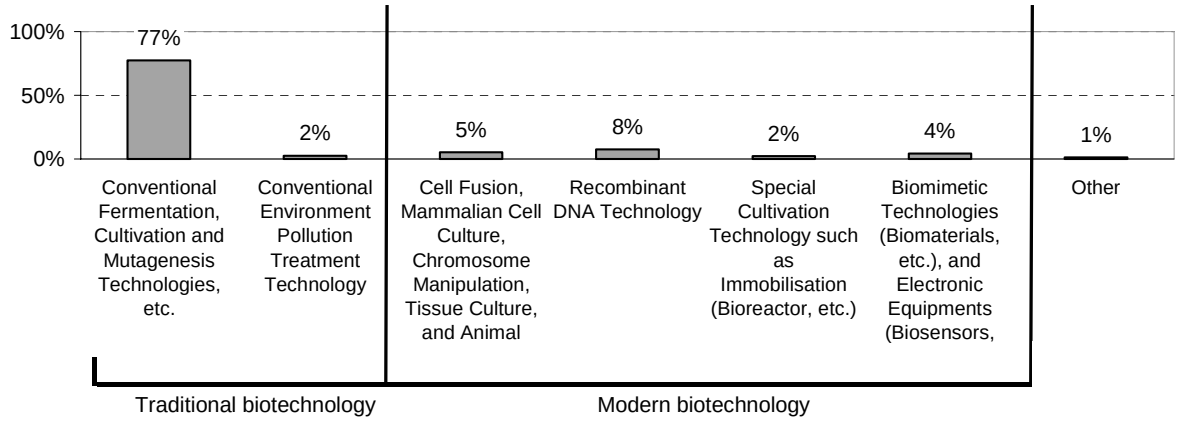


Biotech firms by size class, FY 2003

Determined by the number of employees



Total production by major technologies used by biotech firms, FY 2003



1. Firms were asked to classify themselves by industrial sector based on their principal sales; therefore the sector in which they are classified may not be the one in which they were active in biotechnology.

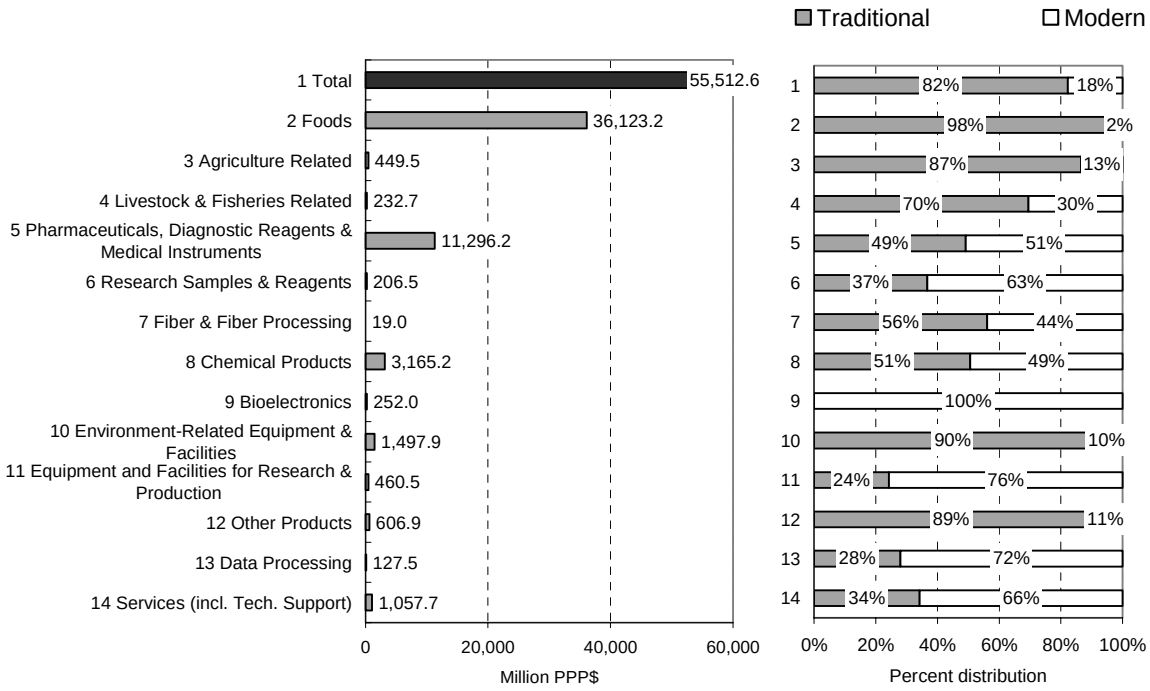
Source: Based on data from the Japan Bioindustry Association (JBA), August 2005.

Japan

Based on responses to the Biotechnology industry survey

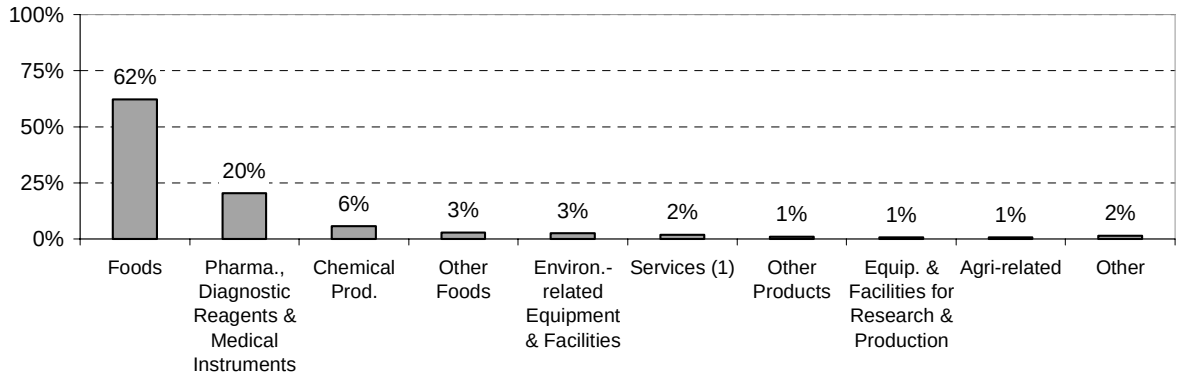
Annual total domestic production of biotech firms, FY 2003

Domestic shipments in biotech products - PPP$ 55,512.6 million



Annual total domestic production of biotech firms, FY 2003

Domestic shipments of biotech products - PPP$ 55,512.6 million



1. Including technical support.

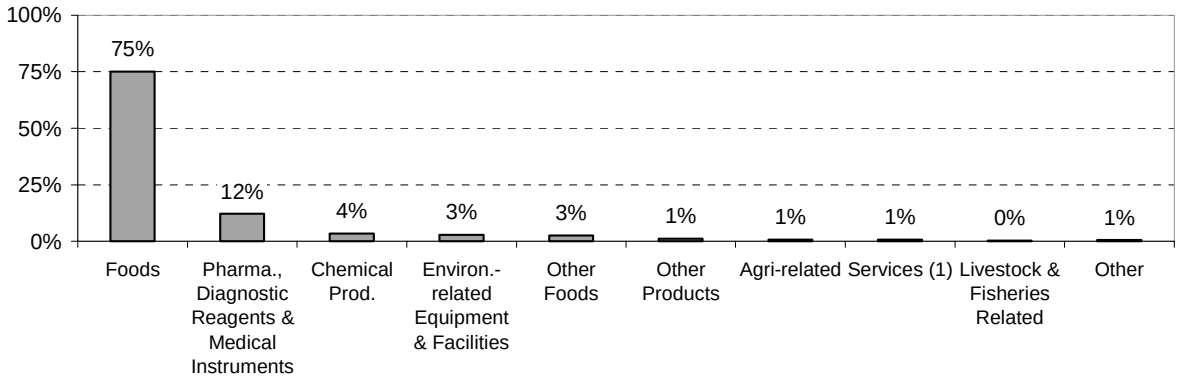
Source: Based on data from the Japan Bioindustry Association (JBA), August 2005.

Japan

Based on responses to the Biotechnology industry survey

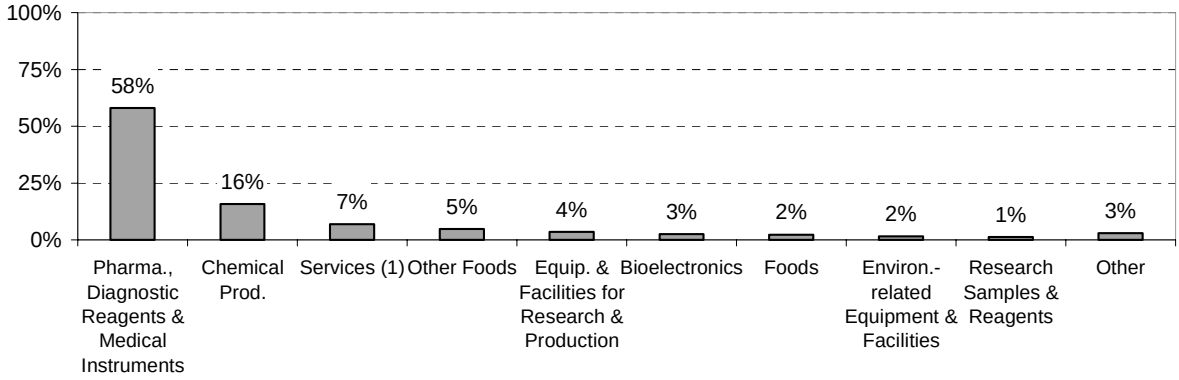
Annual domestic production of biotech firms: traditional biotechnology, FY 2003

Domestic shipments in biotech products - PPP$ 45,626.3 million



Annual domestic production of biotech firms: modern biotechnology, FY 2003

Domestic shipments in biotech products - PPP$ 9,886.3 million



1. Including technical support.

Source: Based on data from the Japan Bioindustry Association (JBA), August 2005.

BIOTECHNOLOGY IN KOREA

Biotechnology Survey

- The Korean Ministry of Commerce, Industry and Energy (MOCIE) has been running an annual biotechnology firm survey since 2002.
- This survey is conducted on a voluntary basis and achieved an overall response rate of 100%.
- This survey, which is limited to the manufacturing sector, provides a single definition of biotechnology and uses the Korean Bio-industry classification system.
- The Korean Bio-industry classification system classifies biotechnology firms into eight sectors: Biopharmaceutical, Biochemical, Biofood, Bioenvironmental, Bioelectronics, Bioprocess and equipment, Bioenergy and bioresource, and Bioassay, bioinformatics and R&D services.
- The survey focused on 'modern' biotechnology.
- In 2004, there were 640 firms active in biotechnology in Korea.
- Thirty percent of these firms were in the Biopharmaceutical sector, followed by 25% in the Biofood sector.
- In 2004, 69% or 422 of all biotechnology firms were small, with less than 50 employees.
- Biofoods dominated production by biotechnology firms (43%), followed by Biopharmaceuticals (40%).
- In 2004, biotechnology firms reported employing 12,138 employees. This figure represents total employment by the 640 firms, as no data was collected for biotechnology employment alone.
- The largest share of employees worked in the Biopharmaceutical sector (36%), followed by the Biofood sector (29%).
- Over half of the employees had R&D-related duties (54% or 6,554 employees).
- The firms were asked to classify the biotechnology they used within 13 categories: Genetic engineering, Protein engineering, Other macromolecule engineering, Cell and tissue engineering, Systems biology and bioinformatics, Metabolic engineering, Bioprocess, Bioresource production and utilisation, Environmental biotechnology and bioenergy technology, Nanobiotechnology, Bioelectronics, Biosafety and bioefficiency, and Other biotechnology.
- In 2004, Bioprocess technology was used most frequently. Twenty-four percent of all biotechnology firms used it in the R&D stage, and 14% in the production stage.

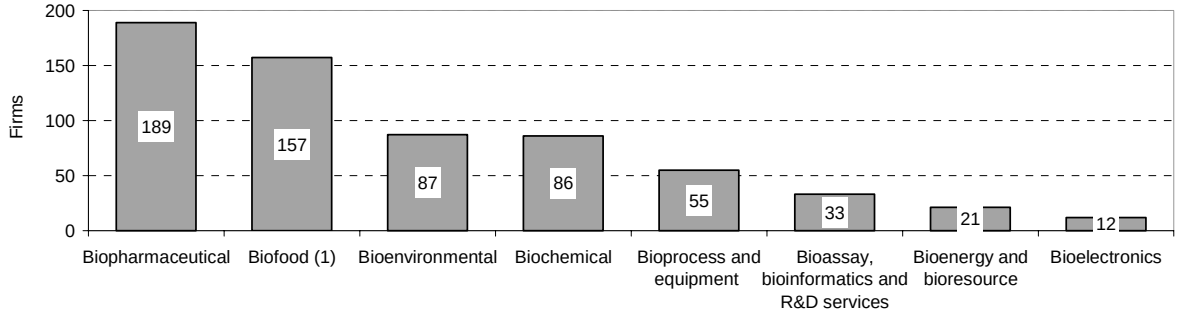
Research and Development Survey

- The data that follow are not based on the same survey; the firms referred to below are not the same 640 biotechnology-active firms referred to above.
- Combined, firms, public research institutes and universities spent PPP$ 1,663 million on biotechnology R&D in 2004. These data are based on the results of the 2004 Survey of R&D in Science and Technology run by the Korean Ministry of Science and Technology.
- Firms undertook the largest share of R&D expenditure (42%), followed by universities (36%) and public research institutes (22%).
- According to the Korean Ministry of Science and Technology, the Korean government invested PPP$ 1,186.6 million on biotechnology R&D in 2005.
- The average annual growth rate of government biotechnology R&D expenditures was 27% from 2001 to 2005.

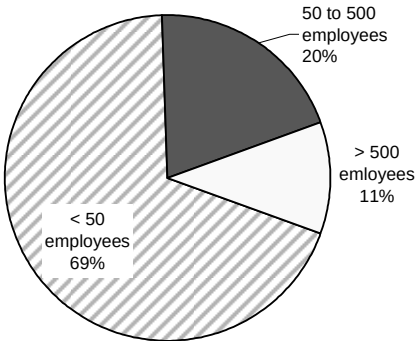
Korea

Based on the Bio-industry Survey

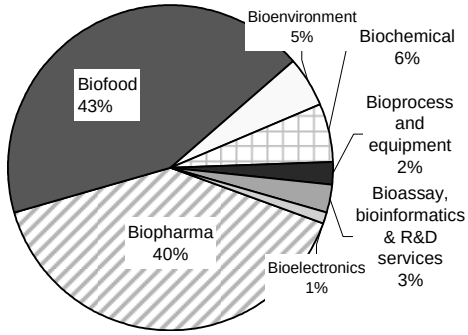
Biotechnology firms by application field, 2004
Breakdown of 640 firms



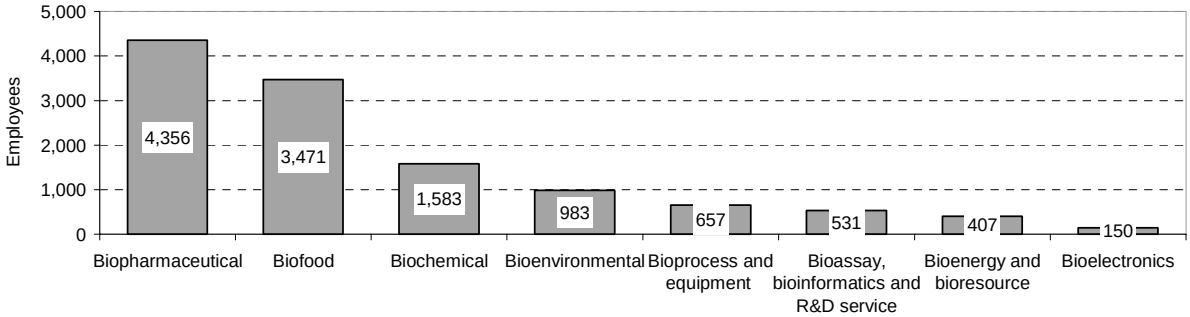
Biotech firms by size class, 2004
Breakdown of 640 firms



Biotech firms: production by field of activity, 2004
Breakdown of 640 firms



Biotech employment by application field, 2004
Breakdown of total employment – 12,138 employees – of 640 firms



1. The major products of the Korean biofood sector are amino acids, such as lysine, which is produced by modern fermentation. The definition of bio-foods excludes traditional fermented products such as yoghurt and soy sauce.

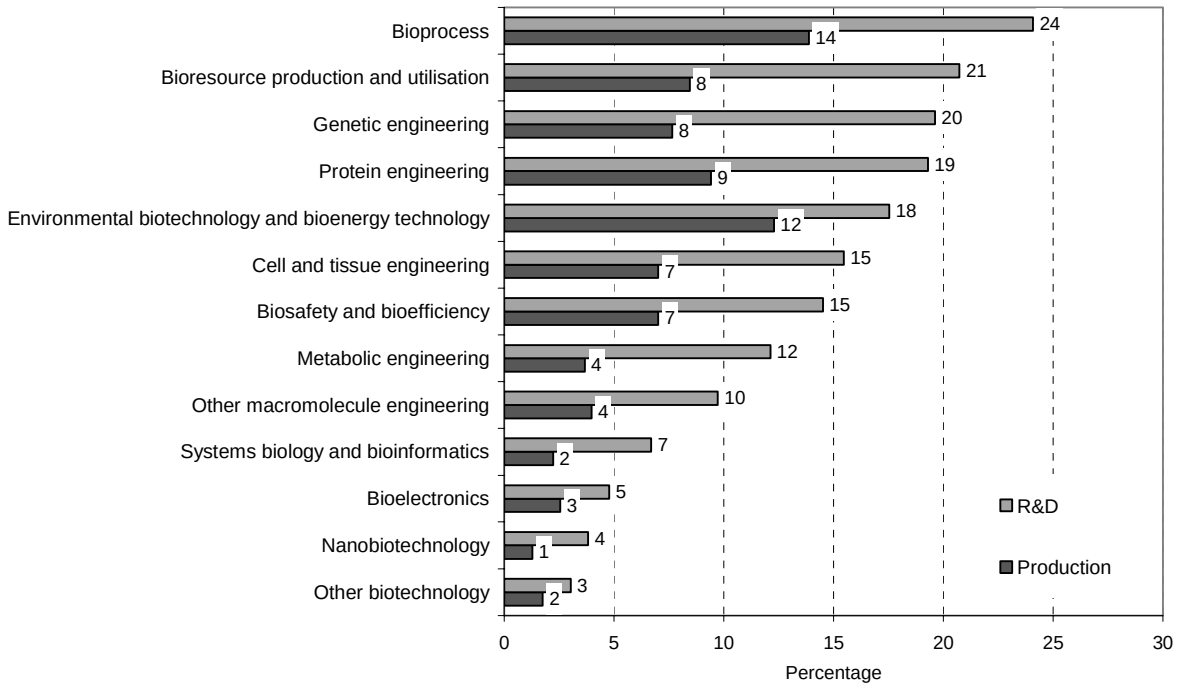
Source: KIET/MOCIE (2005), Statistics on the 2004 Korean Bio-industry, December.

Korea

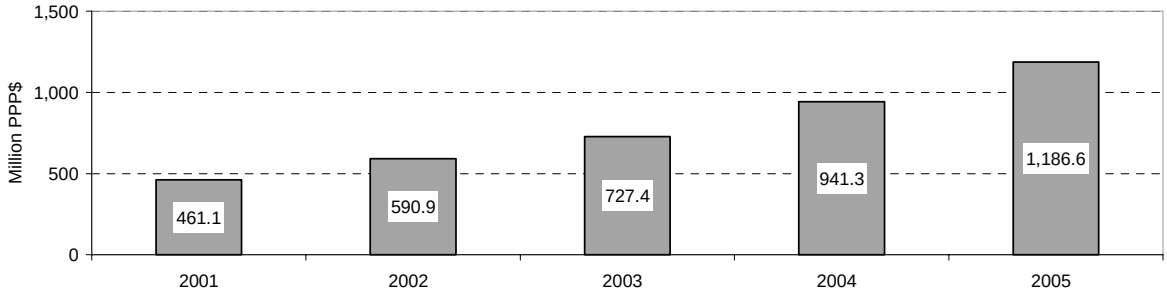
Based on the Bio-industry Survey

Biotechnologies use by biotechnology firms,[1] 2004

Percent of biotech firms using each of the 13 categories of biotechnology



Government biotechnology R&D expenditures, Million PPP$, 2001 to 2005



1. Firms were allowed multiple responses.

Source: Ministry of Science and Technology.

BIOTECHNOLOGY IN NEW ZEALAND

Biotechnology Survey

- Statistics New Zealand has run biotechnology surveys in 1999, 2004 and 2005. Only the last two surveys adopted the OECD definition of biotechnology. Therefore, no data from the 1999 survey are given because they are not comparable with the 2004 and 2005 results.
- The biotechnology survey is mandatory and covers both the public and private sectors. The overall response rates were 94% for 2004 and 93% for 2005. No imputation was conducted.
- The surveys' target population, referred to as organisations, includes: firms, institutions receiving public funding for biotechnology R&D, Crown Research institutes, universities, microbiology units in metropolitan hospitals and the New Zealand Blood Service.
- Full details on the 2004 survey methodology and results are available on line at: http://www.stats.govt.nz/NR/rdonlyres/FDD38C83-2F57-42C1-AE2D-84CCD7D4D143/0/BiotechNZ2004.pdf. Full results for the 2005 survey are forthcoming.
- In 2004, 129 biotechnology organisations had used one or more biotechnology techniques in the last three years.
- In the 2005 survey the period under review was reduced to two years. In 2005, 135 biotechnology organisations had used one or more biotechnology techniques in the last two years while 126 organisations were currently using or intended to use one or more biotechnology techniques in the next two years.
- In 2005, 84 of 126 organisations were in the private sector, the remaining 42 were in the public sector.
- In 2005, 50% of firms reported using one or more biotechnologies for applications in 'Innovative foods & human nutrition' and 46% for 'Biomedical science and drug discovery'.
- In the public sector, 71% of organisations used one or more biotechnologies for applications both in 'Impacts & integration of emergent technology' and for 'Environmental technologies'.
- Most biotechnology techniques were used in the R&D stage, 62% in 2004 and 66% in 2005.
- Of the total 750 biotechnology techniques used in all stages (R&D, part of production process, part of product sold), 52% are due to the public sector in 2004.
- In 2005, the biotechnology sector employed 2,424 people, of which 34% had PhDs and 39% had postgraduate or undergraduate degrees (headcount data). The private sector employed 38% of all employees (918 employees) in 2005.
- Although total biotechnology employment grew by 7% from 2004 to 2005, there was an 8% fall in the number of employees with PhDs. Technical and trade employees grew by 92% from 183 in 2004 to 352 in 2005.
- In 2004, PPP$ 288.5 million was spent on biotechnology. Biotechnology organisations generated PPP$ 452.8 million in income.
- In 2005, expenditure on biotechnology increased to an estimated PPP$ 344.3 million but income fell slightly to PPP$ 449.5 million.

Research and Development Survey

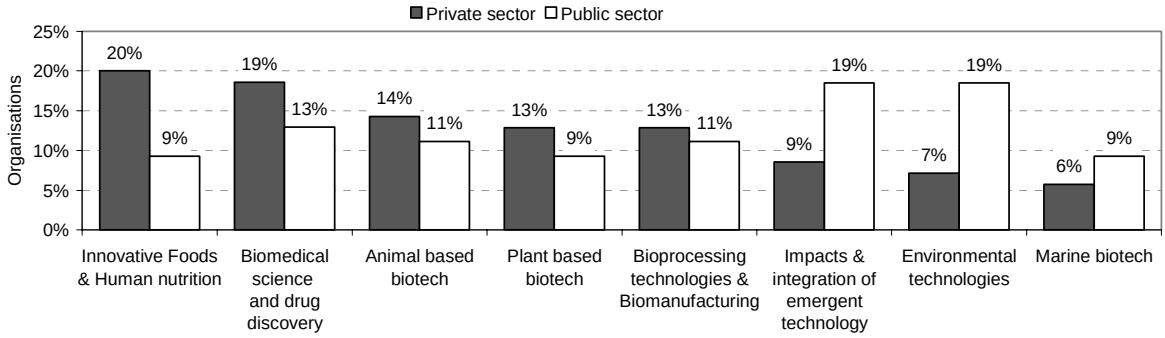
- Statistics New Zealand included a question on biotechnology in their 2004 R&D survey covering business, government and university spending on R&D. This survey included the OECD definition of biotechnology.
- The 2004 R&D survey is mandatory and the overall response rate was 84%. Results were weighted for non-respondents.
- Biotechnology R&D was performed in 2004 by 116 businesses, 11 government sector institutes, and 8 universities.
- In 2004, almost 23% of total R&D was allocated to biotechnology. Just over 20%, PPP$ 94.9 million, of all business enterprise R&D was for biotechnology R&D. The higher education sector allocated PPP$ 57.5 million (19%) to biotechnology R&D and the government sector PPP$ 91.2 million (30%) of its R&D budget to biotechnology.

See annex tables for additional information.

New Zealand

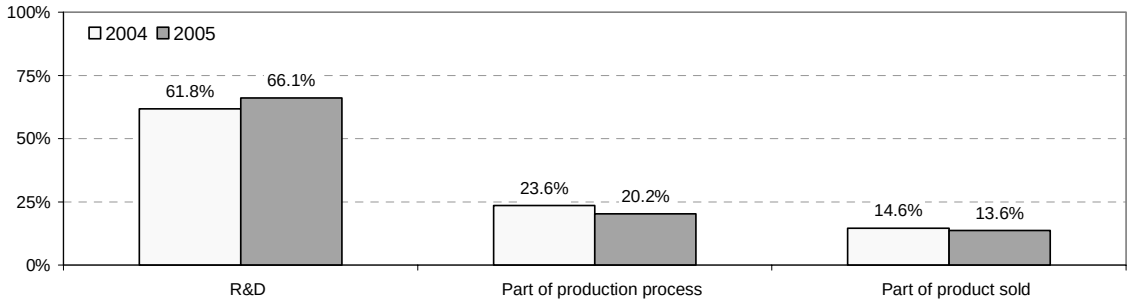
Based on responses to the Biotechnology survey

Distribution of 84 private sector and 42 public sector organisations[1] by application field,[2] 2005

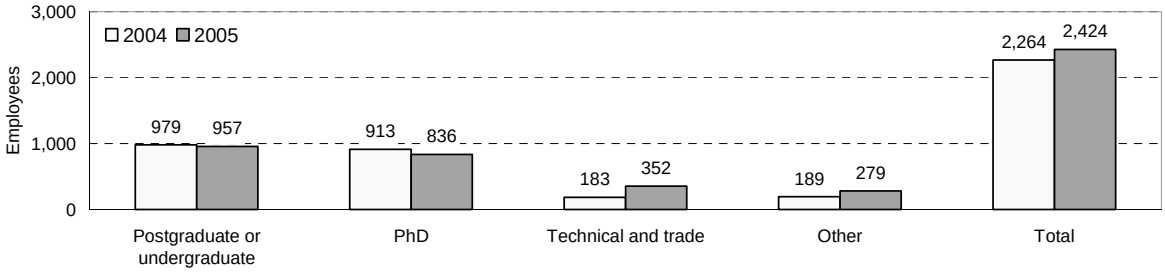


Biotechnology use by development stage, 2004 and 2005

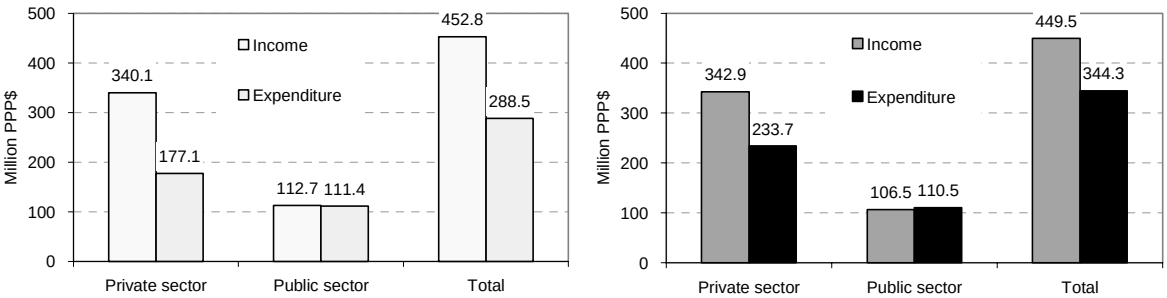
Share of 750 biotechnologies in use in 2004 and 861 in use in 2005



Biotechnology employees by qualification, headcount, 2004 and 2005



Biotech income and expenditure,[3] Million PPP$, 2004 and 2005



1. Based on data from 126 organisations. Public sector includes universities.
2. Firms and organisations can be active in more than one application field.
3. Figures exclude university data. In 2005, higher education income was PPP$ 89.9 million and expenditure was PPP$ 83.2 million. The 2004 Biotechnology survey did not capture higher education income and expenditure data.

Source: Statistics New Zealand (2005), Biotechnology in New Zealand 2004, July and Statistics New Zealand (Forthcoming), Biotechnology in New Zealand 2005.

BIOTECHNOLOGY IN NORWAY

Higher Education and Research Institute sectors Research and Development Survey

- The Norwegian Institute for Studies in Research and Higher Education (NIFU) collects R&D data for the higher education sector and the research institute sector – both government institutes and institutes serving the business enterprise sector. In 2001 and 2003 NIFU included a special questionnaire on biotechnology R&D – using the OECD definition of biotechnology – within their regular R&D survey.
- The R&D survey for the higher education sector and the research institute sector is a biennial survey run on a voluntary basis. The response rate to the 2003 survey was 80%. In general, results were corrected for non-response, however the results from the biotechnology R&D questions were not corrected.
- This special questionnaire covered 82 institutes in the higher education and 22 institutes in the research sector. Fourteen of the 22 research institutes were classified in the government sector, the remaining eight were research institutes serving enterprises.

Business Enterprise Research and Development Survey

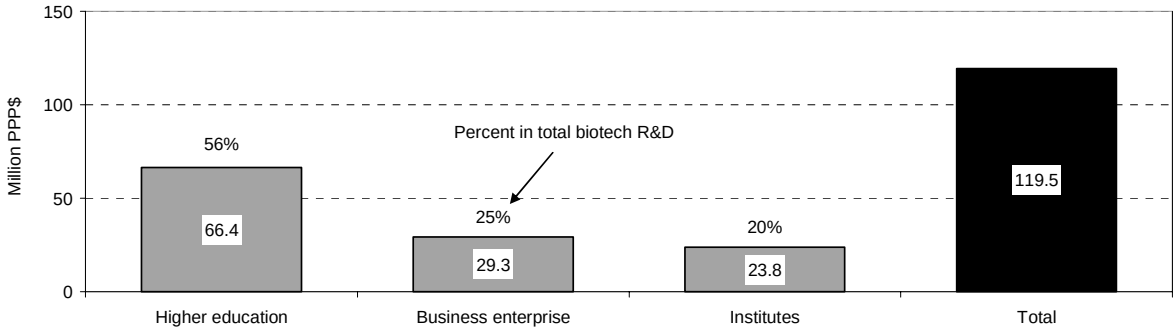
- Statistics Norway, the agency that collects R&D data for the business enterprise sector, added a question on biotechnology to their R&D survey in 1985. The OECD definition was used as of the 2003 R&D survey.
- The business enterprise R&D (BERD) survey is run on an annual basis. The biotechnology question however, is only included biennially. The survey is mandatory. The response rate to the 2003 BERD survey was 95%. For small enterprises, results are weighted for non-respondents. For the very small number of non-respondents among larger enterprises, other information is used to create estimates. The survey excludes firms with less than 10 employees.
- In 2003, biotechnology R&D expenditure in the Norwegian higher education, institute and business enterprise sectors amounted to PPP$ 119.5 million, or 4% of total R&D expenditure (PPP$ 2,964.4 million). About 56% of these R&D funds were spent by the higher education sector, 25% by the industrial sector, and the remainder by the institute sector (20%).
- In 2003, R&D expenditures on biotechnology in the higher education and institute sectors amounted to PPP$ 90.2 million; of this amount PPP$ 37.9 million (42%) was spent on gene technology. The business enterprise sector spent PPP$ 29.3 million on biotechnology R&D.
- Over 70% of biotechnology R&D expenditure in 2003 came from public sources.
- In the higher education and institute sectors combined, the Human biomedicine and biopharmacy field was allocated the most R&D resources in 2003 (PPP$ 31.3 million).
- In the business enterprise sector, the Research & Development sector (Services sector NACE 73) had the highest R&D expenditures on biotechnology (PPP$ 11.2 million), followed by the chemical sector (PPP$ 10.2 million).
- In 2003, 1,440 biotechnology researchers worked in the higher education and institute sector; about half of these were women.

See annex tables for additional information.

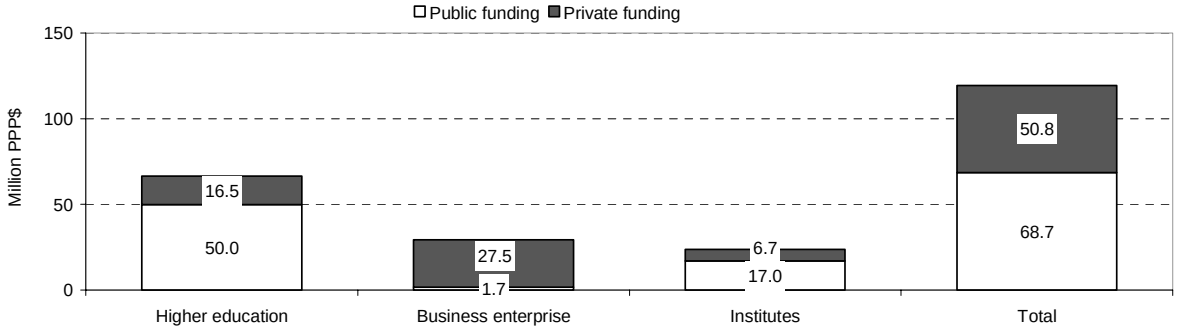
Norway

Based on responses to the R&D surveys

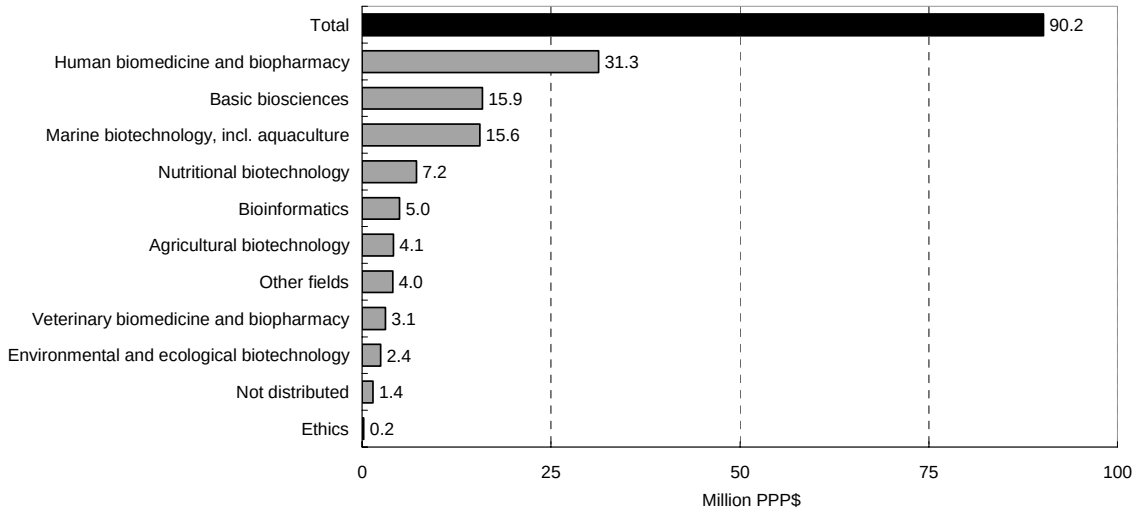
Biotechnology R&D by sector, Million PPP$, 2003



Biotechnology R&D by source of funding, Million PPP$, 2003



Fields of biotechnology R&D in the HE and institutes sector, Million PPP$, 2003



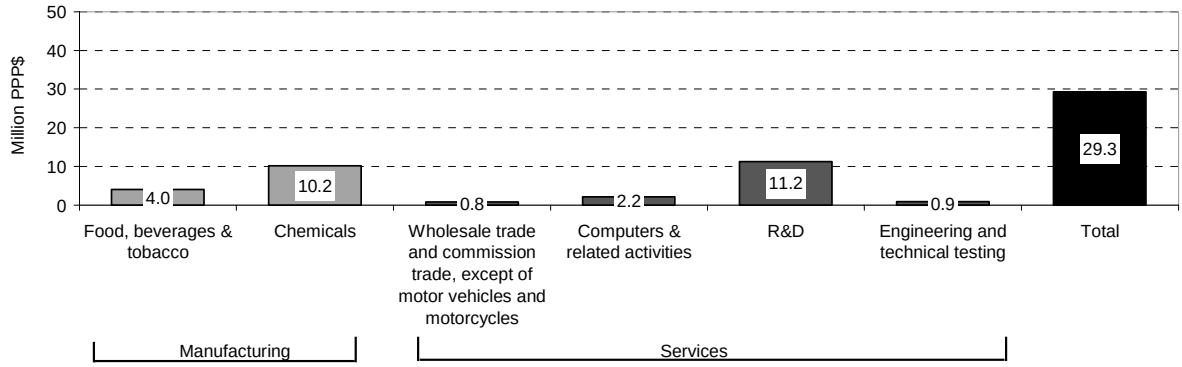
Sources: NIFU (2005), *Bioteknologisk FoU 2003: Ressursinnsats I universitets- og høgskolesektoren og instituttsektoren*, April; Statistics Norway (2005), Special extraction from the 2003 Business Enterprise R&D survey, September.

Norway

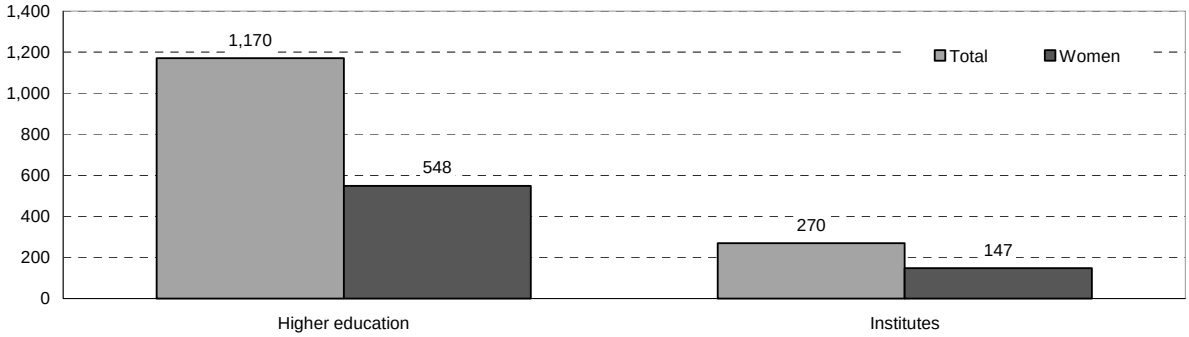
Based on responses to the R&D surveys

Biotech R&D expenses in the business enterprise sector by industry, Million PPP$, 2003

European Classification of Economic activities (NACE)



Researchers in biotechnology in the higher education and institute sector, 2003



Sources: NIFU (2005), *Bioteknologisk FoU 2003: Ressursinnsats I universitets- og høgskolesektoren og instituttsektoren*, April; Statistics Norway (2005), Special extraction from the 2003 Business Enterprise R&D survey, September.

BIOTECHNOLOGY IN POLAND

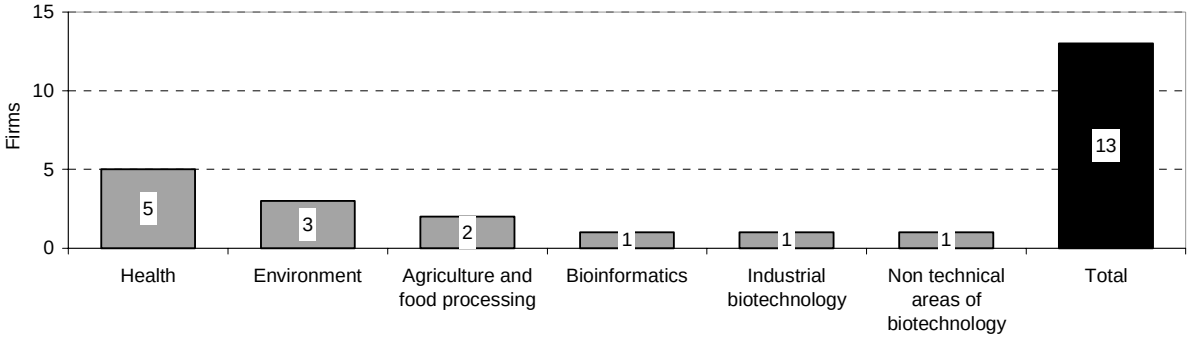
- In 2005, the Ministry of Education and Science (formerly the Ministry of Scientific Research and Information Technology) ran a biotechnology firm survey for reference year 2004.
- This survey was the first of its kind and included the OECD definition of biotechnology.
- The survey was mandatory. The survey response rate was 34% and there was no weighting for non-respondents.
- In 2004, there were 13 biotechnology firms in Poland.
- Firms were classified into six areas of application: Bioinformatics, Environment, Health, Agriculture & Food processing, Industrial biotechnology and Non-technical areas of biotechnology.
- In 2004, 5 firms were classified in the Health area, 3 firms were classified in Environment, 2 firms were in Agriculture & Food processing, and the Bioinformatics and Industrial biotechnology areas had 1 firm each.
- In 2004, biotechnology firms spent PPP$ 8.7 million on biotechnology, 54% of which was spent on biotechnology R&D and 36% on biotechnology capital (instruments, equipment, land and buildings).
- In 2004, total business enterprise R&D expenditure by all firms in Poland was PPP$ 807.9 million, 0.58% of which was spent on biotechnology R&D.
- In 2004, the 13 biotechnology firms employed 946 biotechnology persons (headcount data), of these 109 (12%) had biotechnology R&D responsibilities.

Poland

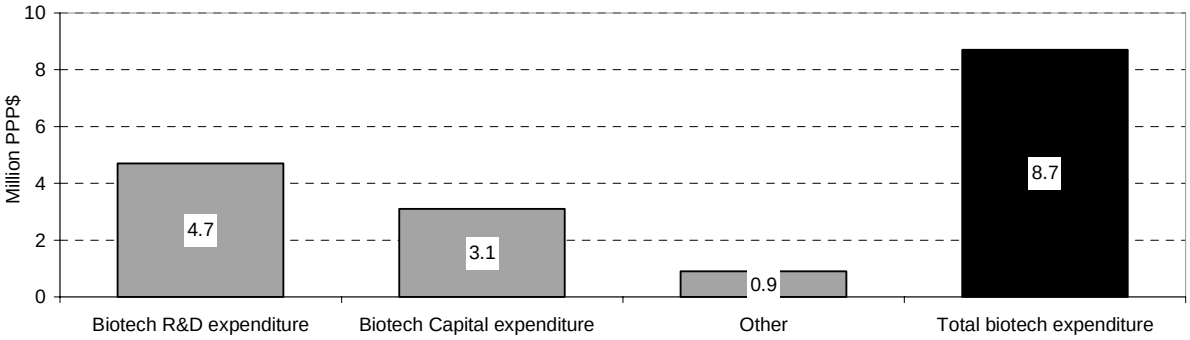
Based on responses to Biotechnology Firm survey, 2004

Biotechnology firms by application field, 2004

Breakdown – 13 firms

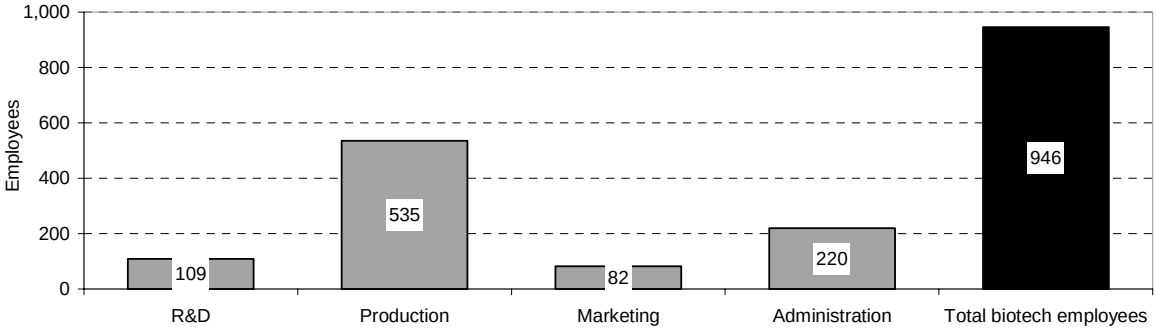


Expenditure on innovation activities in biotechnology, Million PPP$, 2004



Biotech employment by type of work, 2004

Headcount



Source: Ministry of Education and Science, January 2006.

BIOTECHNOLOGY IN SOUTH AFRICA

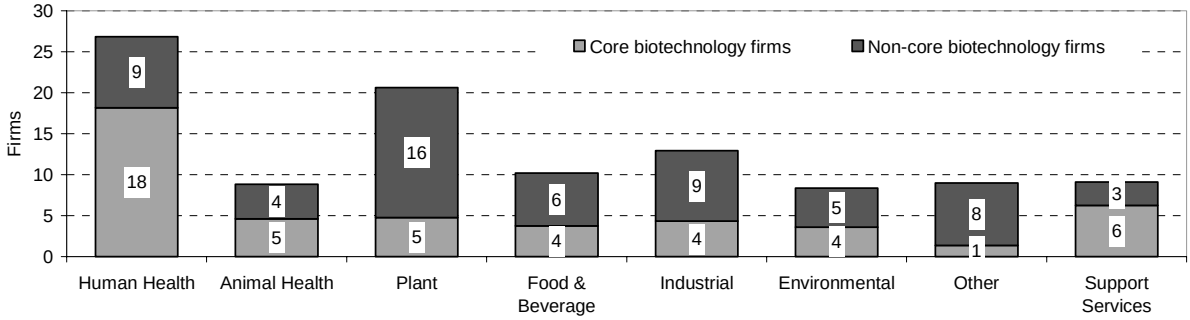
- In 2003, the South African Department of Science and Technology (DST) and eGoli Bio, a Life Sciences Incubator, commissioned a National Biotechnology Survey.
- This survey, covering reference year 2002-03, was the first of its kind in South Africa.
- The survey was modeled on the recommendations of the OECD *Ad hoc* Biotechnology Statistics group and provided both the OECD list-based definition of biotechnology and a modified single definition.
- The survey scope covered: research groups, firms, research projects, and support service groups. Support service groups included venture capital and private equity firms, government and non-governmental organisations and private organisations.
- The survey focused on 'modern' biotechnology.
- The survey had an overall response rate of approximately 72%; results were not extrapolated to reflect the entire population.
- In 2002-03, 106 firms -- 47 core and 59 non-core -- were involved in biotechnology in South Africa. Traditional biotechnology firms (brewing, food & beverage, wine) were excluded unless they used modern technologies.
- In the company survey, financial data was requested for financial year 2002-03.
- Biotechnology turnover in the business sector was estimated to be at least PPP$ 123 million in 2002-03.
- Biotechnology R&D was estimated to be PPP$ 83.6 million for the business sector in 2002-03.
- Only 43% of all core and non-core biotechnology firms responded to the employment question. Combined, these firms reported having 1,020 employees with biotechnology-related duties in 2002-03. This figure constitutes a lower bound estimate of biotechnology employment.
- Most core biotechnology firms were in the human health sector (18 firms), followed by the support services sector (6 firms).
- Eighty-nine percent of biotechnology firms had less than 50 employees in 2002-03.
- The firms were asked to classify the biotechnology used within six categories: 1st Generation, 2nd Generation, 3rd Generation, Natural Products, Technology Platforms and Support Services. For more information on the methodology undertaken by the South African Department of Science and Technology a study was released in 2004 and is available on line, at: http://www.oecd.org/dataoecd/7/37/36036991.pdf.
- Over half of the core and non-core biotechnology firms in South Africa were using first generation biotechnology through the application of modern technologies.
- In 2002-3, there were 622 research groups undertaking biotechnology-related activities. These groups were broken down further into 'biotech' (296), 'potential biotech' (205) and 'biotech services' (178).
- In 2002-03, most research groups were in the human health sector followed by the plant sector.
- Combined, biotechnology firms and research groups were responsible for about 154 biotechnology products in 2002-03. The majority of these were human health products (22%) followed by support services products (20%).
- In 2002-03, 911 biotechnology research projects were identified, including projects undertaken by both research groups and firms.
- The dominant sector for research projects was plant biotechnology followed by human health.

South Africa

Based on National Biotechnology Survey

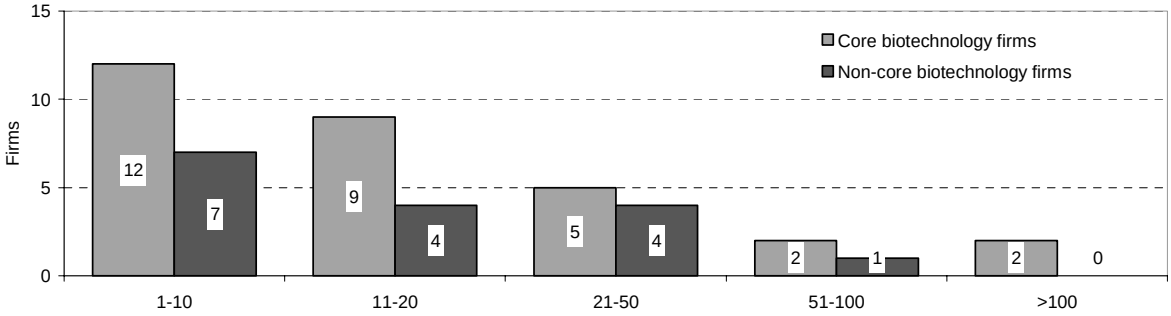
Biotechnology firms by application field, 2002-03

Breakdown of the 106 firms: 47 core and 59 non-core firms



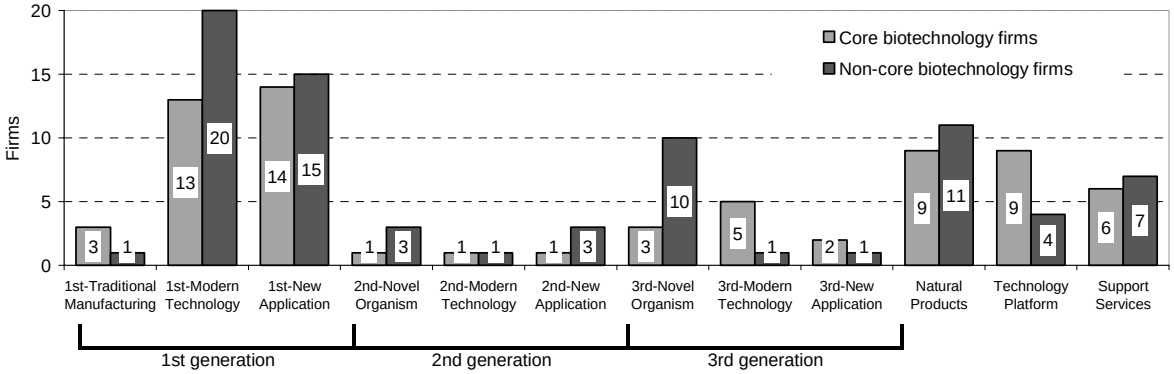
Biotechnology firms by size class of number of employees, 2002-03

Breakdown of 46 firms: 30 core and 16 non-core firms



Biotechnology firms by type of biotechnology,[1] 2002-03

Breakdown of the 106 firms: 47 core and 59 non-core firms



1. Some firms appear in more than one type of biotechnology.

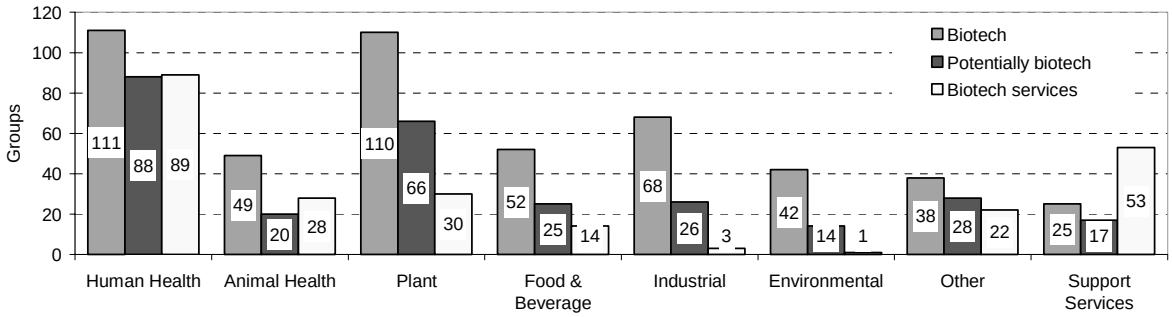
Source: DST and eGoli (2004), South African National Biotechnology Audit: 2003, January.

South Africa

Based on responses to government R&D survey

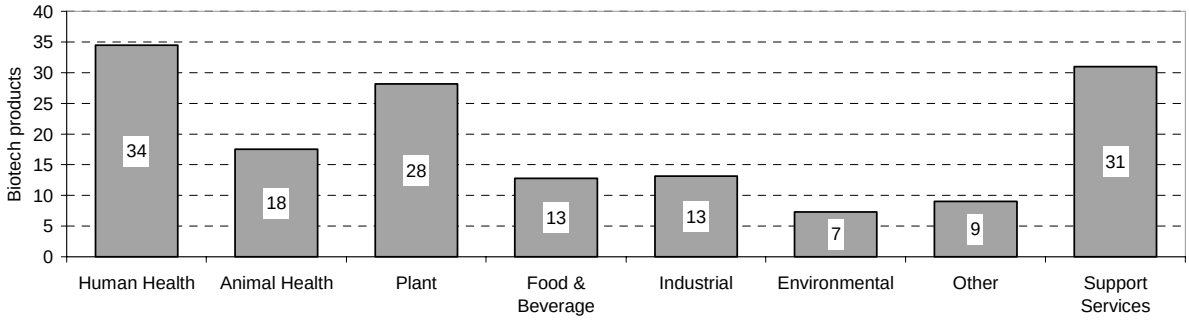
Research groups by type of biotechnology,[1] 2002-03

Breakdown of the 622 research groups involved in biotech-related activities



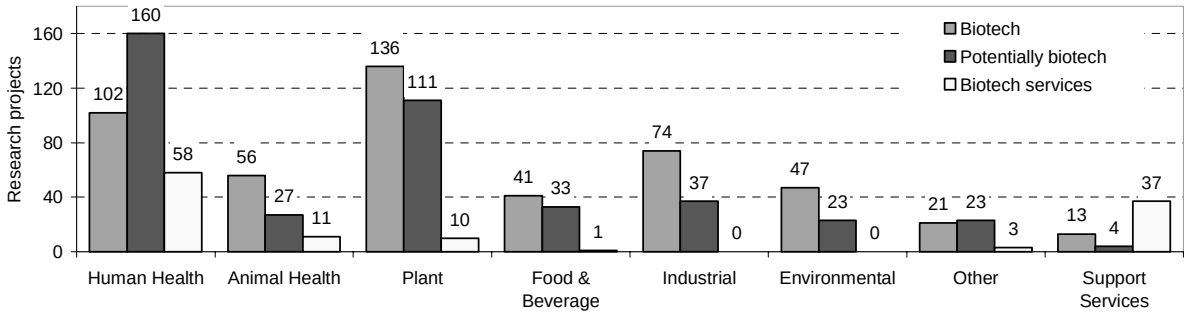
Biotech products and/or services on the market – firms and research groups – by application, 2002-03

Distribution of 154 biotechnology products and/or services



Biotechnology research projects by application field, 2002-03

Distribution of 911 biotechnology research projects



1. Some groups appear in more than one type of biotechnology.

Source: DST and eGoli (2004), South African National Biotechnology Audit: 2003, January.

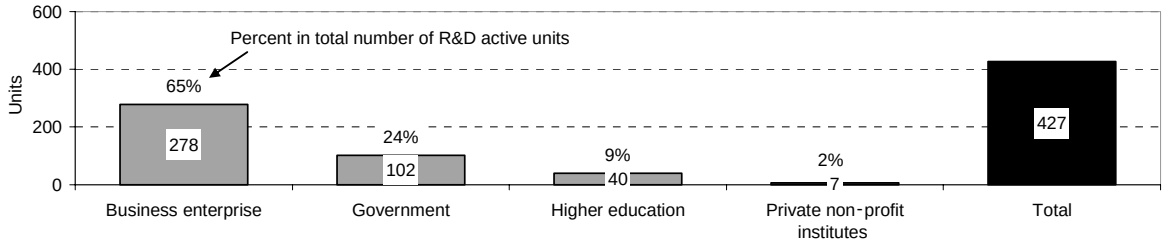
BIOTECHNOLOGY IN SPAIN

- The National Statistics Institute (INE) added a module on biotechnology R&D activities to its 2004 R&D and Innovation survey. The survey included the OECD definition of biotechnology.
- The survey is annual and mandatory.
- The response rate to the 2004 survey was 86% and the results were weighted for non-respondents.
- The survey covers the whole economy, including both the public and private sector.
- According to the 2004 survey, 278 firms, 102 government sector institutes, 40 universities, and 7 private non-profit institutes carried out biotechnology R&D.
- In 2004, total public and private sector R&D expenditure on biotechnology amounted to PPP$ 656.3 million.
- In 2004, the government sector had the largest share of total biotechnology R&D expenditure, with 36% or PPP$ 238.8 million. The higher education sector had the second largest share of total biotechnology R&D expenditure, with 33% or PPP$ 213.8 million, the business enterprise sector was third, with 30% or PPP$ 198.7 million.
- The remaining results focus on the firms performing biotechnology R&D.
- In 2004, 278 firms reported performing biotechnology R&D in Spain, which represented 5% of all firms undertaking R&D.
- In 2004, R&D expenditure on biotechnology by firms amounted to PPP$ 198.7 million, or 3.1% of all business enterprise R&D expenditure (PPP$ 6,336.1 million).
- In 2004, 83% of R&D expenditure on biotechnology by firms was spent on current expenditures and 17% on capital investments.
- On average, biotechnology firms spent about 36% of their total R&D budget on biotechnology R&D.
- Source of funding data shows that 96% of business enterprise R&D funds were financed from national funds in 2004.
- In all sectors, 9,444 FTEs were active in biotechnology R&D, of which 6,446 (68%) were researchers and the remainder were technicians and assistants. The business sector accounted for 25% of all FTEs active in biotechnology and 20.8% of all researchers.
- In 2004, 2,387 full-time equivalent employees worked on biotechnology R&D in the enterprise sector. Fifty-six percent of these biotechnology R&D FTEs were Researchers (1,340 FTEs).
- Over half of all biotechnology R&D FTEs employed by the business enterprise sector were women (55% or 1,324 women). Fifty-four percent of all FTE Researchers working on biotechnology R&D were women (724 FTEs).

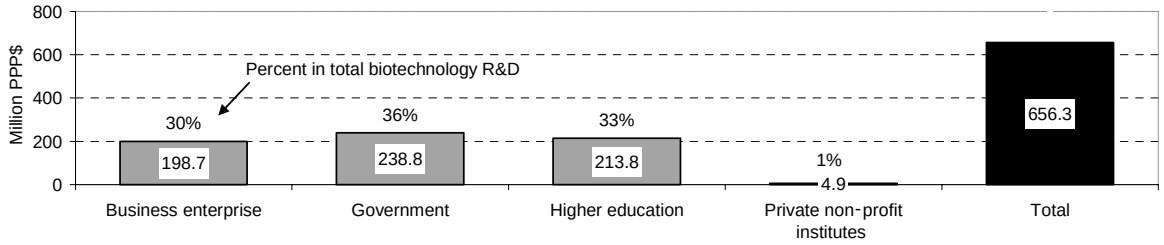
Spain

Data based on the Biotechnology R&D survey

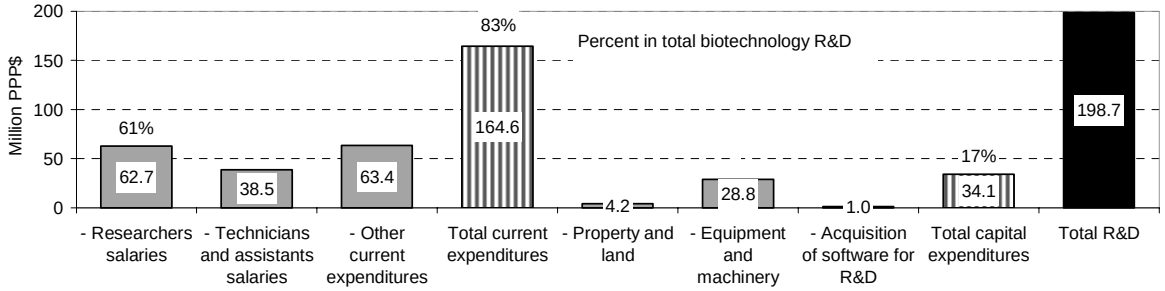
Distribution of biotechnology R&D active units by sector, 2004



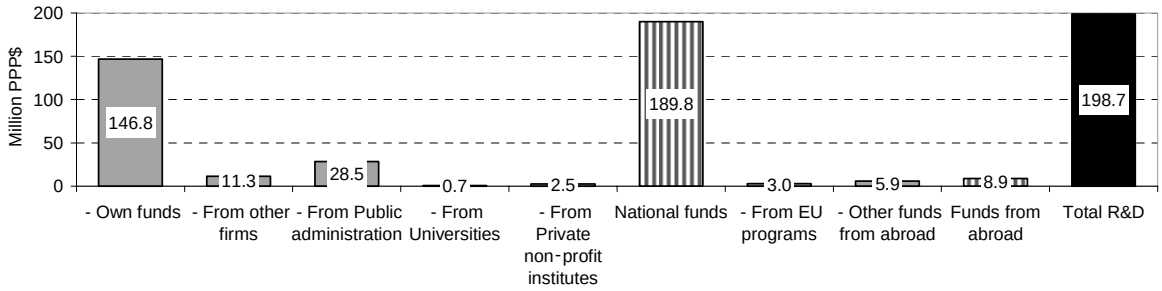
Distribution of biotechnology R&D by sector, Million PPP$, 2004



Distribution of firm biotechnology R&D by type of expenditure, Million PPP$, 2004



Distribution of firm biotechnology R&D by source of funds, Million PPP$, 2004

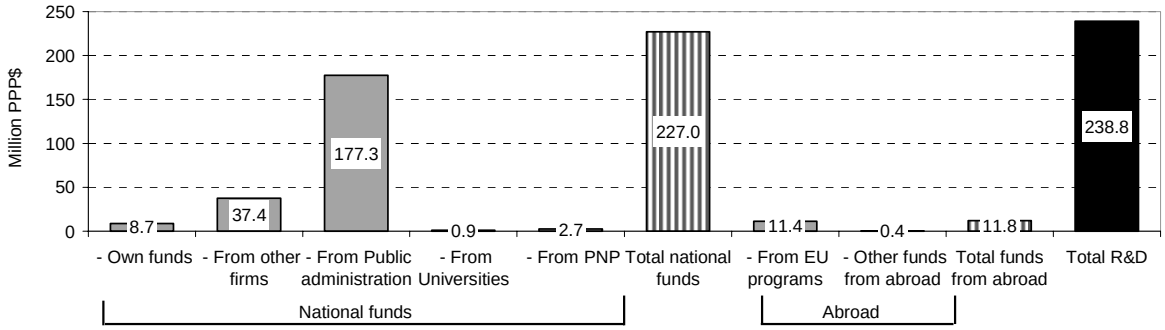


Source: INE (2006), Statistics on the use of Biotechnology 2004, March.

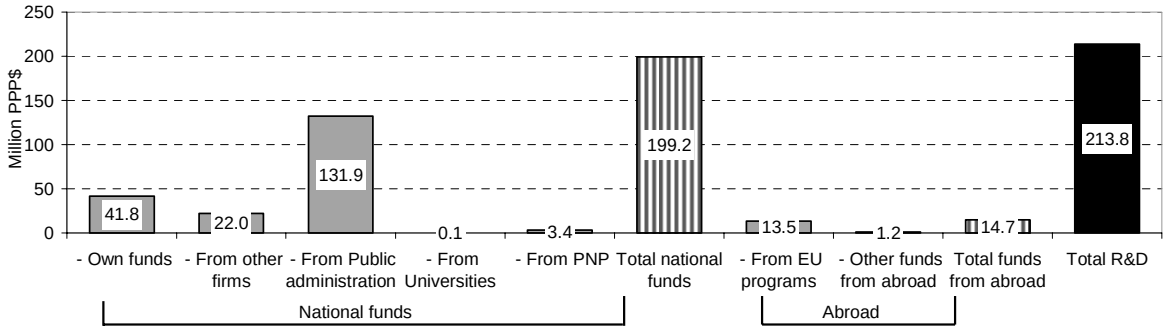
Spain

Data based on the Biotechnology R&D survey

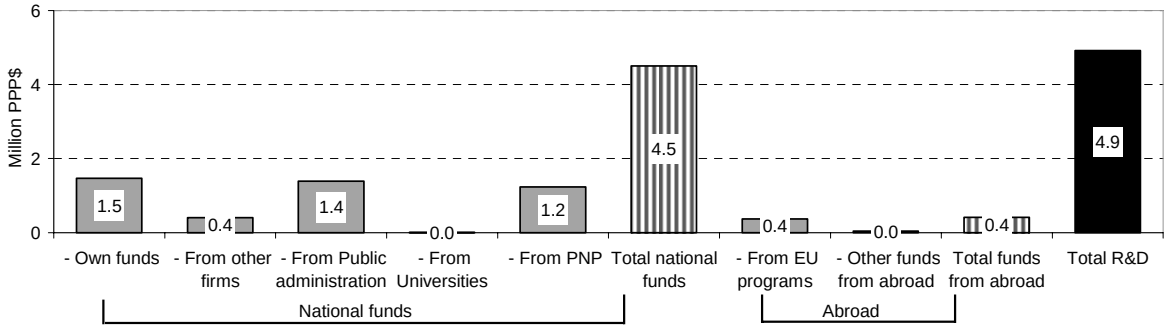
Distribution of government biotechnology R&D by source of funds, Million PPP$, 2004



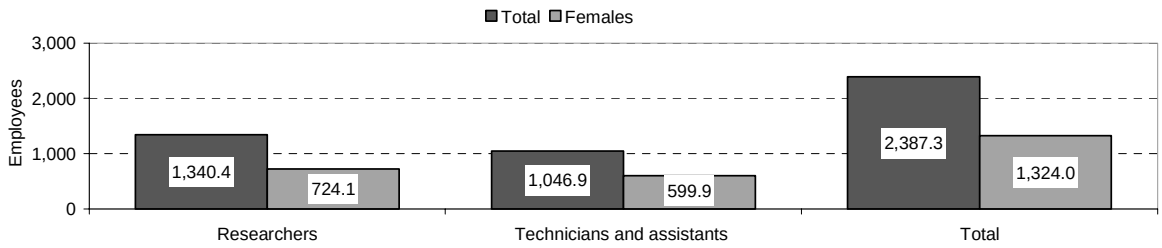
Distribution of higher education biotechnology R&D by source of funds, Million PPP$, 2004



Distribution of private non-profit institutes' biotechnology R&D by source of funds, Million PPP$, 2004



Full time equivalent staff in firms working on biotechnology R&D, 2004



Source: INE (2006), Statistics on the use of Biotechnology 2004, March.

BIOTECHNOLOGY IN SWEDEN

- Two Swedish agencies collect biotechnology data: Statistics Sweden and VINNOVA, the Swedish Agency for Innovation Systems.

Statistics Sweden

- Statistics Sweden first added a question on biotechnology R&D personnel to its Business Enterprise R&D (BERD) survey in 1997. No definition of biotechnology was included in any of the surveys. Statistics Sweden plans to include the OECD definition of biotechnology in the 2005 BERD survey.
- The BERD survey is run on a biennial basis and is mandatory since 2001.
- The response rate to the most recent BERD survey, for 2003, was 94% and the results were weighted for non-respondents. The survey was limited to firms with 50 or more employees.
- The 2003 BERD survey estimates 1,648 full-time equivalents (FTEs) working on biotechnology R&D in 58 firms. Seventy-five percent are in the manufacturing sector.
- Statistics Sweden added a question on biotechnology R&D expenditures to its biennial higher education and government sector R&D surveys in 1997. Neither survey included a definition of biotechnology.
- The higher education R&D survey is run on a voluntary basis. The response rate to the 2003 survey was 88% for the economic data and the results were not weighted for non-respondents.
- In the latest higher education sector survey, for 2003, about 1.3% of total R&D expenditure in this sector was devoted to biotechnology.
- 2003 data for government sector biotechnology R&D were not released.

Swedish Agency for Innovation Systems

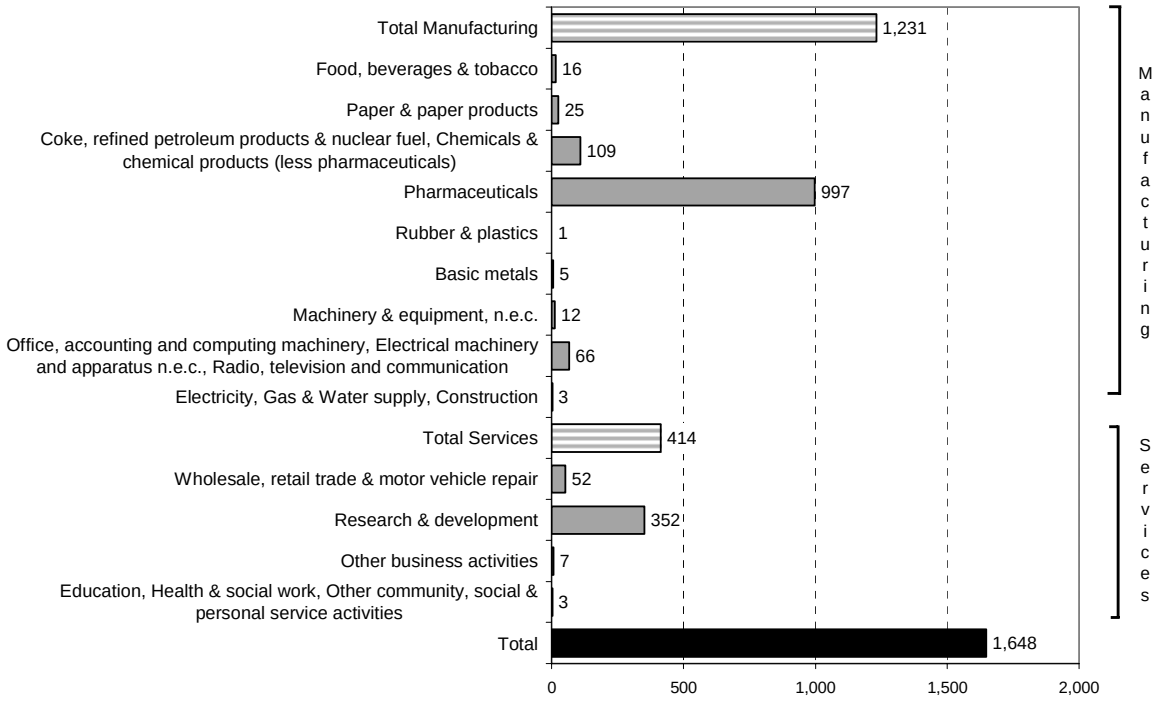
- In 2004, VINNOVA, in collaboration with regional organisations, undertook a mapping of firms working in the areas of biotechnology, pharmaceuticals and medical technology in Sweden. This updates earlier studies for 1997 and 2000. Relevant firms were identified from regional organisations, government agencies, industrial research institutes, venture capital companies, etc. Firms were categorised according to business field, focus (R&D, production, consultancy or marketing and sales), national or international market focus and other parameters. About 75% of the companies were contacted to make sure that they were accurately categorised.
- The study was released in February 2005 and is available on line (in Swedish), at: http://www.vinnova.se/main.aspx?ID=0B01F8AE-24D3-44A3-8180-9154F8ABCFA6.
- In 2003, VINNOVA identified 213 biotechnology firms employing 8,632 persons in Sweden. One hundred and fifty-eight of these firms had less than 50 employees (74%). The study includes biotechnology units and spin-offs from two large pharmaceutical firms active in Sweden: Pharmacia and Astra/Astra-Zeneca. However, the activities of the two parent firms in Sweden were not included. The number of firms was up from 136 firms in 1997, for an average annual growth rate of 7.8%. The average annual growth rate for employees over the same period was 12.4%.
- From 1997 to 2003, the sectors with the greatest rise in the number of firms were 'Biotech tools and supplies' (14.6%) and 'Drug discovery & development' (12.2%).
- From 1997 to 2003, the sectors with the greatest rise in employment were 'Biotech medical technology' (50.8%) and 'Drug discovery & development' (28.2%).
- In 1997, 2000 and 2003, the fields with the largest number of biotechnology firms were, respectively, 'Drug discovery & development' (60 firms in 2003) and 'Biotech tools & supplies' (59 firms in 2003).
- In 2003, the sector that employed the largest number of persons was 'Biotech tools & supplies', with 2,644 employees, representing 31% of total biotechnology employment. In 1997, 'Biotech tools & supplies' represented 37% of total biotechnology employment.

See annex tables for additional information.

Sweden

1. Based on responses to the R&D surveys

Full-time equivalents working on biotechnology R&D in the business enterprise sector, 2003
Based on responses to the R&D survey of firms with 50 or more employees



Biotechnology R&D expenditures in higher education, 2003

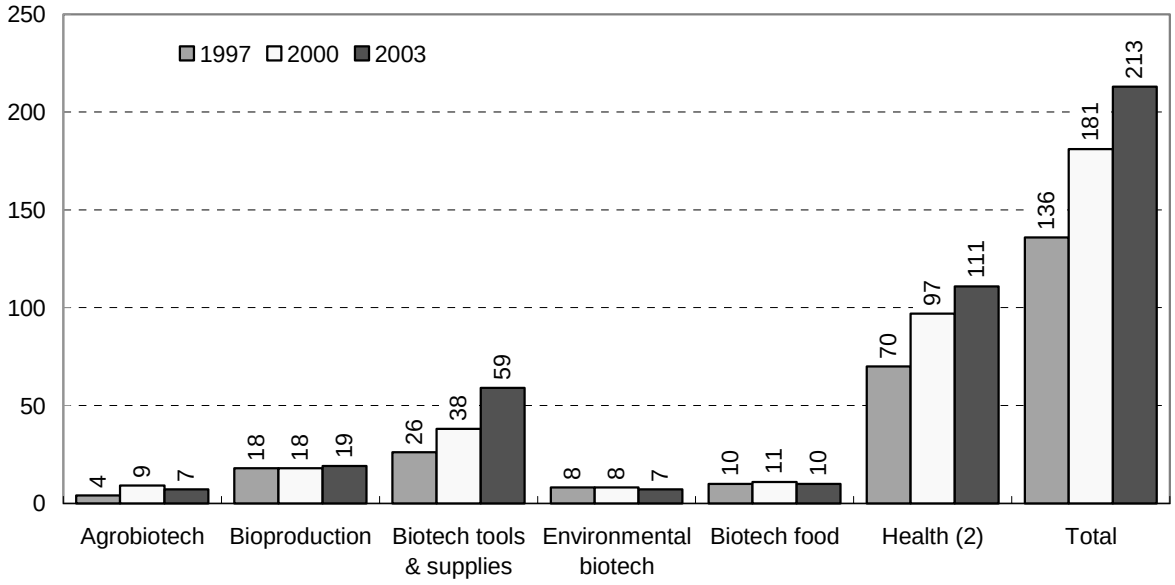
	Biotech R&D in higher education	Higher Education R&D	Proportion of sector R&D
	Million PPP$		%
1997	8.7	1,530.9	0.6%
1999	17.0	1,736.9	1.0%
2001	23.7	2,015.0	1.2%
2003	28.5	2,269.4	1.3%

Sources: Statistics Sweden (2005), Research and Experimental development in the Business Enterprise Sector 2003, March; Statistics Sweden (2005), Research and Experimental Development in the Higher Education Sector 2003, April; OECD (2005), MSTI database, September 2005.

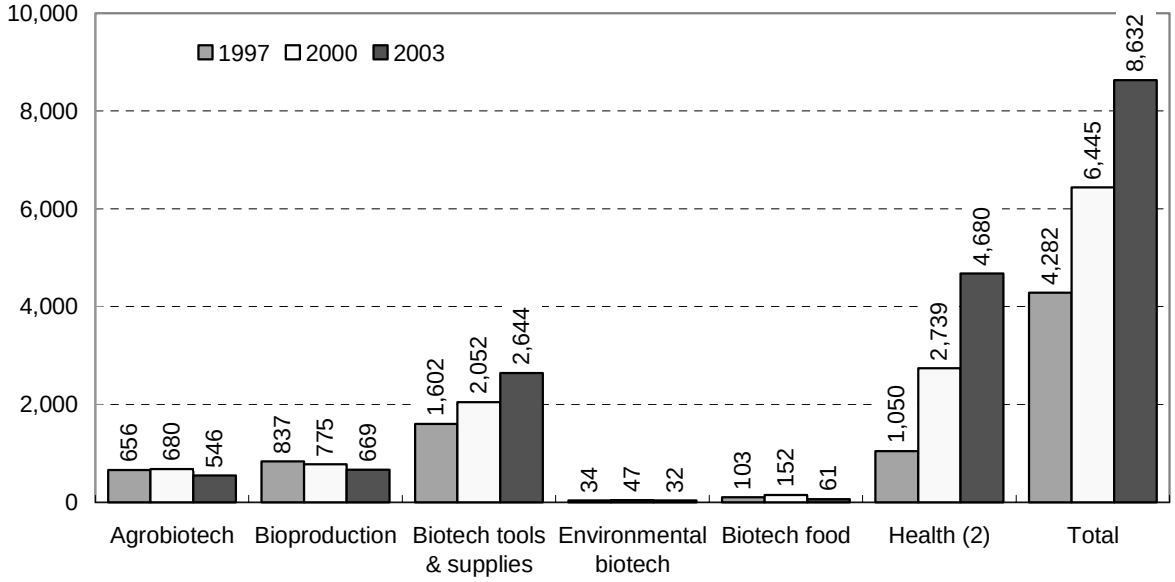
Sweden

2. Based on the VINNOVA study

Number of biotechnology firms by application field,[1] 1997, 2000, and 2003



Number of employees in biotechnology firms by application field,[1] 1997, 2000, and 2003



1. Includes biotechnology units and spin-offs from two large pharmaceutical firms active in Sweden: Pharmacia and Astra/Astra-Zeneca. However, the activities of the two parent firms in Sweden were not included.
2. Health includes: Diagnostics, Drug delivery, Drug discovery & development and Biotech medical technology.

Source: Dolk, T., and A. Sandström (2005), *Nationella och regionala klusterprofiler: Foretag inom bioteknik, lakemedel och medicinsk teknik i Sverige 2004*, VINNOVA, February.

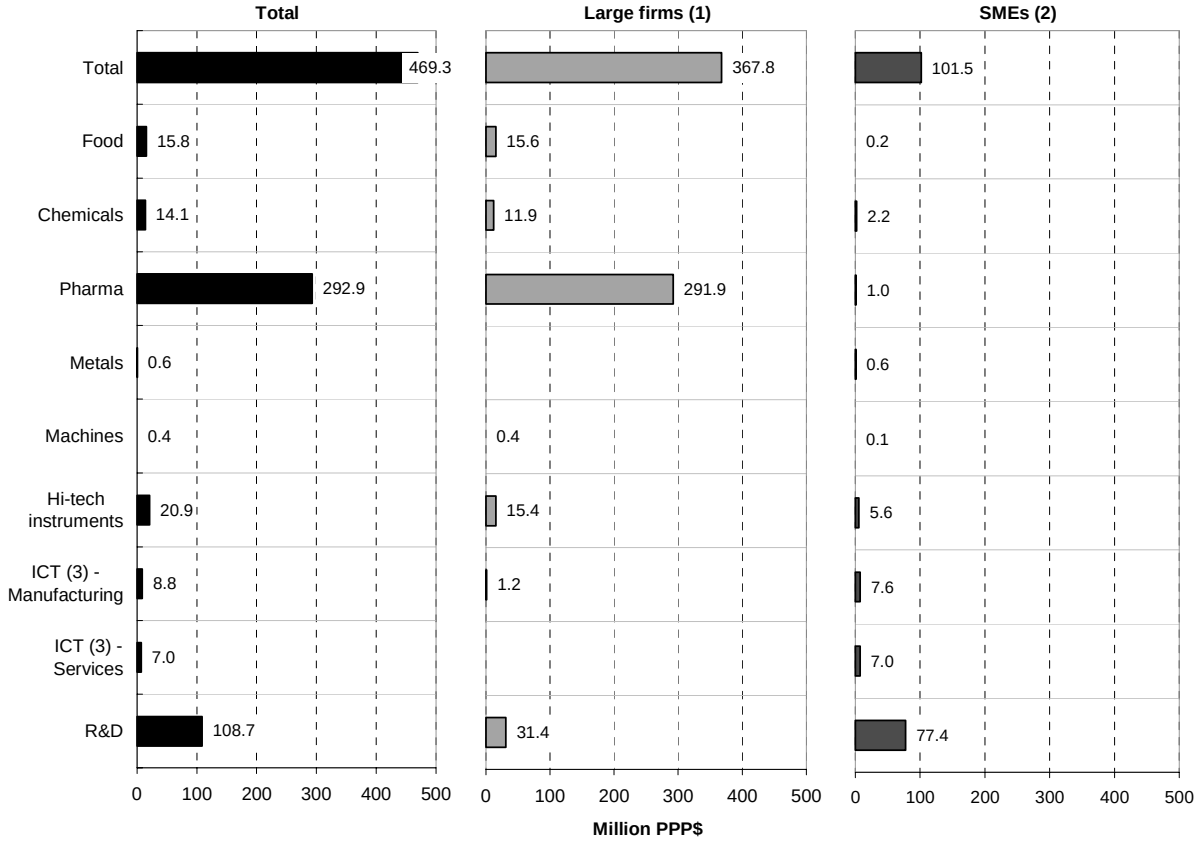
BIOTECHNOLOGY IN SWITZERLAND

- The Swiss Federal Statistics Office business enterprise R&D survey is a voluntary survey run every four years. The results of the survey are corrected for non-response and extrapolated to reflect the entire population.
- A question on biotechnology was added to the 2000 business enterprise R&D survey; the question was again included in the 2004 survey, this time with the OECD definition.
- In 2004, the overall response rate was 81%.
- In 2004, 157 firms reported undertaking biotechnology R&D.
- In 2000, intramural biotechnology R&D in the business enterprise sector accounted for 3.8%, or PPP$ 159.1 million, of total business enterprise R&D expenditures. By 2004, this amount had almost trebled to PPP$ 469.3 million and accounted for 6.8% of total business enterprise R&D expenditures.
- Over half of the PPP$ 469.3 million spent on biotechnology R&D in 2004 was spent by the Pharmaceuticals sector (62% or PPP$ 292.9 million). The Research & Development sector spent the second largest amount on biotechnology R&D (23% of total, or PPP$ 108.7 million).
- Firms with 100 or more employees were responsible for 78% of all biotechnology R&D expenditures in 2004.
- In 2004, Small and Medium-Sized Enterprises (SMEs) spent 76% of their resources in the Research & Development sector (PPP$ 77.4 million out of PPP$ 101.5 million). SMEs are defined by the Swiss Federal Statistics Office as firms with less than 100 employees.
- For firms with over 100 employees, the Pharmaceuticals sector was responsible for the largest share of biotechnology R&D expenditures (79% of all biotechnology R&D spent by large firms or PPP$ 291.9 million out of PPP$ 367.8 million).

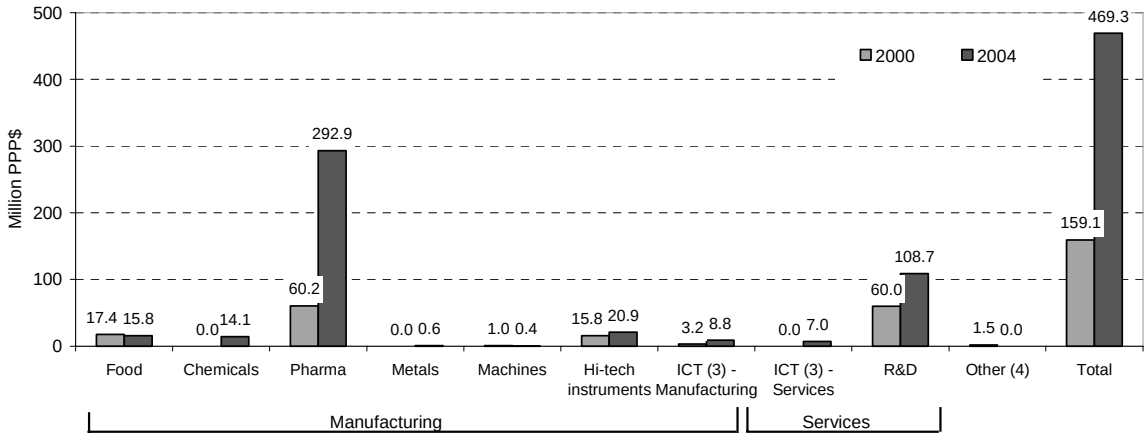
Switzerland

2004 data based on responses to the R&D survey

Biotechnology R&D in the business enterprise sector, Million PPP$, 2004



Evolution of biotechnology R&D in the business enterprise sector, Million PPP$, 2000 and 2004



1. ICT: Information and Communications Technologies.
2. Small and Medium-Sized Enterprises: firms with less than 100 employees.
3. Large firms: firms with more than 100 employees.
4. Other: includes manufacturing and services sectors.

Source: *Office fédéral de la statistique (2005), R-D dans l'économie privée en Suisse en 2004*, December.

BIOTECHNOLOGY IN THE UNITED KINGDOM

- In the United Kingdom, several agencies have made efforts to collect data on biotechnology, including: the Department of Trade and Industry (DTI) and the Office of National Statistics (ONS).

Department of Trade and Industry

- DTI commissioned Critical I Limited, a consulting agency, to collect data on biotechnology. To date, three reports have been produced covering different periods: 2001, 2001 to 2002 and 2001 to 2003.
- The scope of the study was limited to "those companies whose primary commercial activity depends on the application of biological organisms, systems or processes, or on the provision of specialist services to facilitate the understanding thereof."
- In 2003, there were 455 firms involved in biotechnology in the United Kingdom. These firms spent PPP$ 2,008.4 million on R&D. This figure represents total R&D expenditures undertaken by the 455 firms, as no data was collected for biotechnology R&D alone.
- Over half of the firms involved in biotechnology in 2003 were in the human healthcare sector (53% or 239). These firms spent PPP$ 1,746.8 million on R&D, or 87% of total R&D expenditures.
- In 2003, healthcare sector revenues represented 70%, or PPP$ 4,004.2 million, of total revenues (PPP$ 5,758.9 million). Again, these data represent total revenues and not just biotechnology revenues.
- In 2003, the 455 firms employed 22,405 full-time equivalent employees, 59% of which were working in the healthcare sector.

Office of National Statistics

- The ONS has been collecting data on biotechnology in its annual government R&D survey since 1993. The survey collects data on central government budget provision for R&D expenditure. The surveys provided a definition of biotechnology.
- In 2003, the UK government spent PPP$ 211.8 million on biotechnology R&D, which represented 1.6% of total government R&D.

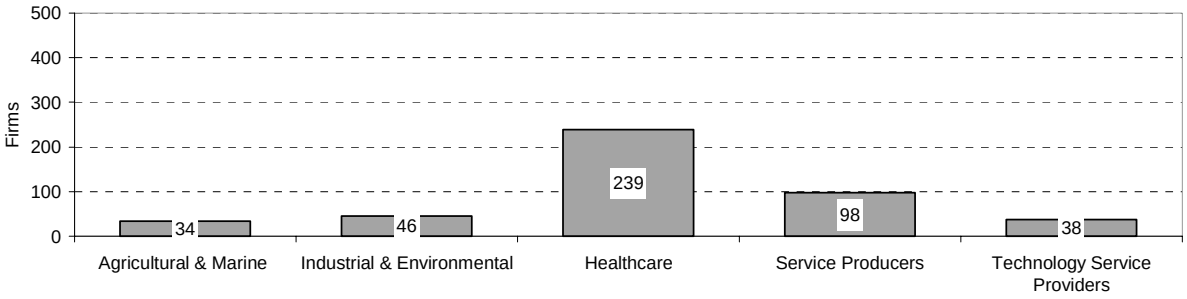
See annex tables for additional information.

United Kingdom

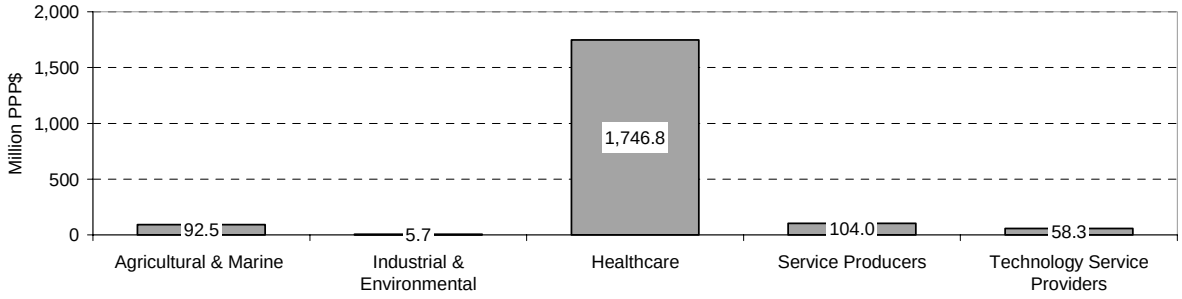
Based on Critical I Limited

Firms involved in biotechnology by primary application field, 2003

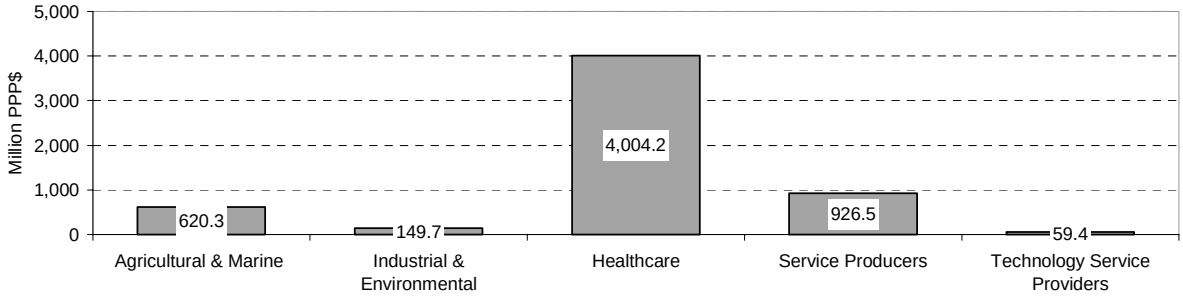
Breakdown of the 455 firms



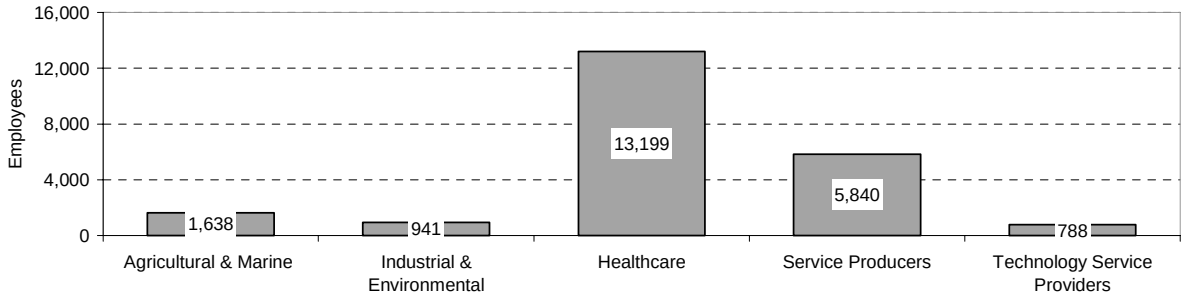
R&D by primary application field, Million PPP$, 2003



Revenues by primary application field, Million PPP$, 2003



Full-time equivalent employees by primary application field, 2003

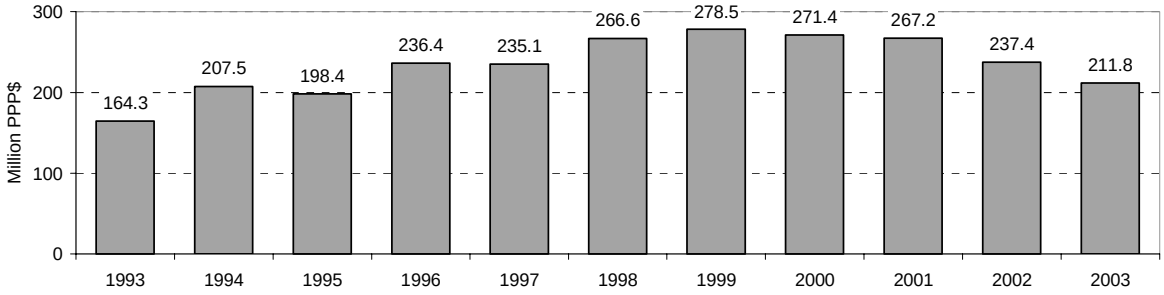


Source: DTI (2005), Comparative statistics for the UK, European and US biotechnology sectors, analysis year 2003, February.

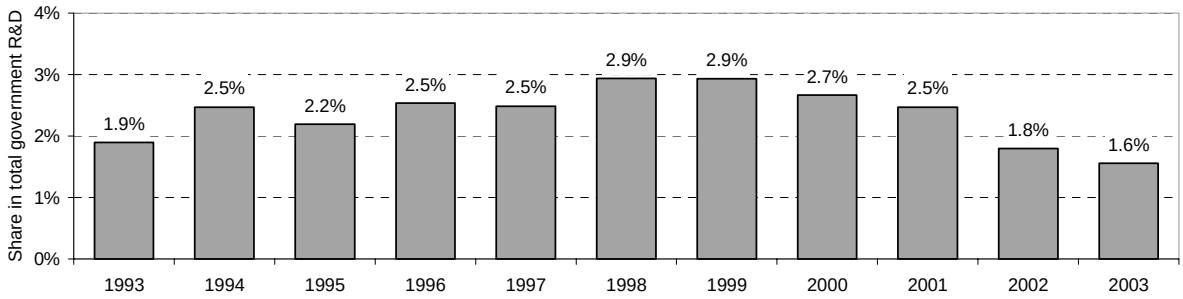
United Kingdom

Based on responses to government R&D survey

Government expenditure on biotechnology R&D, Million PPP$, 1993 to 2003



Share of government expenditure on biotech R&D over total government R&D, 1993 to 2003



Source: ONS (2006) Special extraction, February.

BIOTECHNOLOGY IN THE UNITED STATES

- In the United States, several agencies have made efforts to collect data on biotechnology, including: the National Science Foundation (NSF) and the Department of Commerce.

National Science Foundation

- The NSF first added a biotechnology question to its annual business enterprise R&D survey in 2001. Firms were asked to estimate the percent of total R&D expenditures devoted to biotechnology. The surveys provided a definition of biotechnology. As of 2003, the OECD definition of biotechnology was provided.
- The overall response rate to the business R&D survey was 81.4%, but the section that collects data on biotechnology R&D was not mandatory. There was no weighting for non-respondents on the biotechnology R&D question.
- In 2003, 2,196 firms were undertaking biotechnology R&D, representing 6% of all R&D-active firms. These firms spent PPP$ 14,232 million on biotechnology R&D, or 7% of total business enterprise R&D expenditures.
- The majority of firms undertaking biotechnology R&D in 2003 were in the non-manufacturing sector: 73% or 1,609 firms. These firms were responsible for spending 62% of all biotechnology R&D expenditures; the remainder was spent by the manufacturing sector.
- The Scientific and R&D services sector in the non-manufacturing branch (North American Industry Classification System (NAICS) code 5417) had the highest share of biotechnology R&D expenditures: 36% of all biotechnology R&D expenditures. The Pharmaceuticals and medicines sector in the manufacturing branch (NAICS code 3254) had the second largest share, with 32% of total biotechnology R&D expenditures.
- Ninety percent of the firms undertaking biotechnology R&D were Small and Medium-Sized Enterprises (SMEs) with fewer than 250 employees. However, these SMEs accounted for only PPP$ 3,614 million of biotechnology R&D, or 25% of the total.

Department of Commerce

- In 2002, the Department of Commerce launched the first US biotechnology firm survey, covering 2001.
- This survey did not represent all US firms engaged in biotechnology, and therefore underestimated biotechnology activity in US industries; however, it still provides insight into biotechnology activities.
- In 2001, the survey identified 1,031 firms engaged in biotechnology-related activities in the United States.
- Over half of all biotechnology firms that responded to the employment question (59% or 600 of 1,025) had 50 or fewer employees. Ninety percent of biotechnology firms had 500 or fewer employees.
- In 2001, over three-quarters of biotechnology firms (76% or 780) indicated that their primary or secondary area of activity was human health applications (HH).
- In 2001, 884 firms reported biotechnology R&D expenditures of PPP$ $16.4 billion, representing about 10% of all US industry R&D in that year. Ninety percent of all biotechnology R&D was spent in the human health application area.
- Biotechnology sales were PPP$ 50.5 billion or 8.9% of total sales by biotechnology firms in 2001.
- In 2001, biotechnology firms employed 1.1 million employees, of which approximately 11% (66,000) had biotechnology-related responsibilities. Over half of the employees with biotechnology-related responsibilities were scientists (55%).

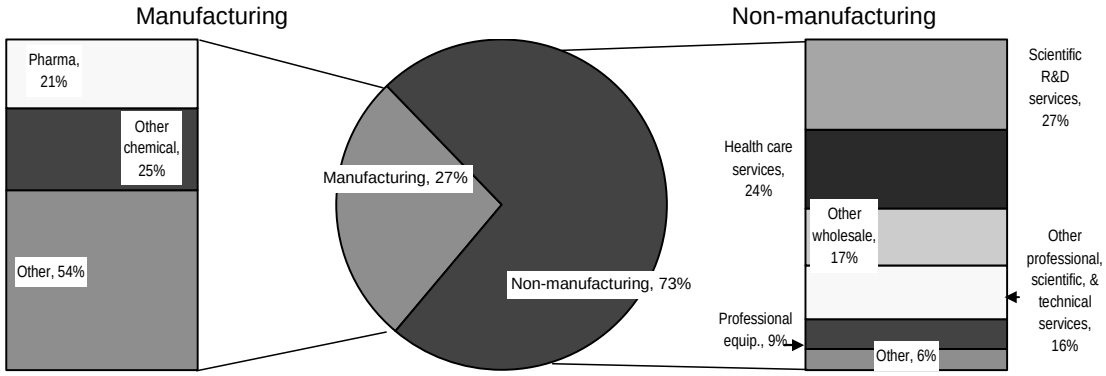
See annex tables for additional information.

United States

1. Based on responses to R&D survey

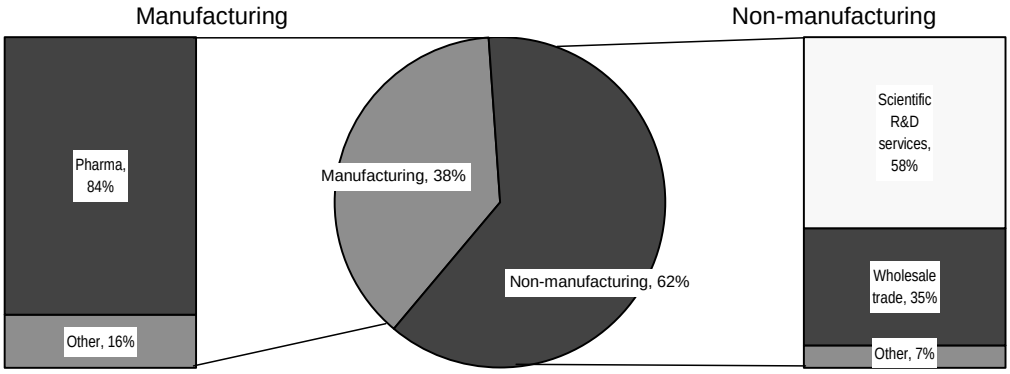
Firms undertaking biotechnology R&D in the business enterprise sector (NAICS), 2003

Breakdown of the 2,196 firms undertaking biotechnology R&D



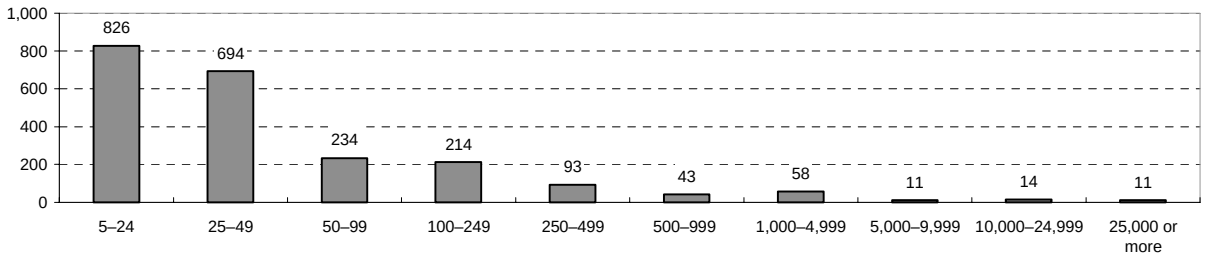
Biotechnology R&D expenditure by sector (NAICS), 2003

Breakdown of the PPP$ 14,232 million spent on biotechnology R&D



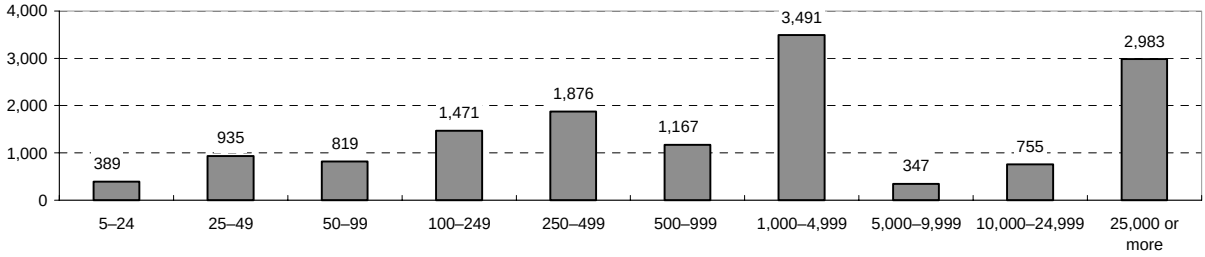
Firms undertaking biotechnology R&D by size class of number of employees, 2003

Breakdown of the 2,196 firms undertaking biotech R&D



Biotechnology R&D expenditure by size class of number of employees, Million PPP$, 2003

Breakdown of the PPP$ 14,232 million spent on biotechnology R&D



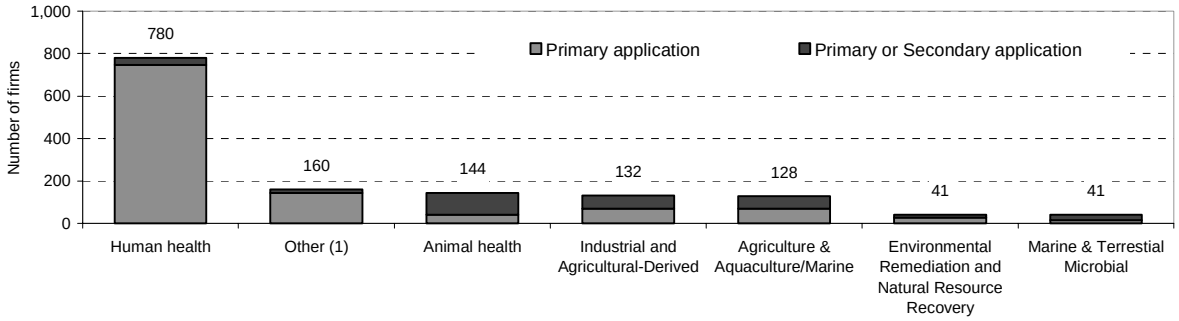
Source: National Science Foundation (Forthcoming), Research and Development in Industry: 2003.

United States

2. Based on responses to US biotechnology firm survey, 2001

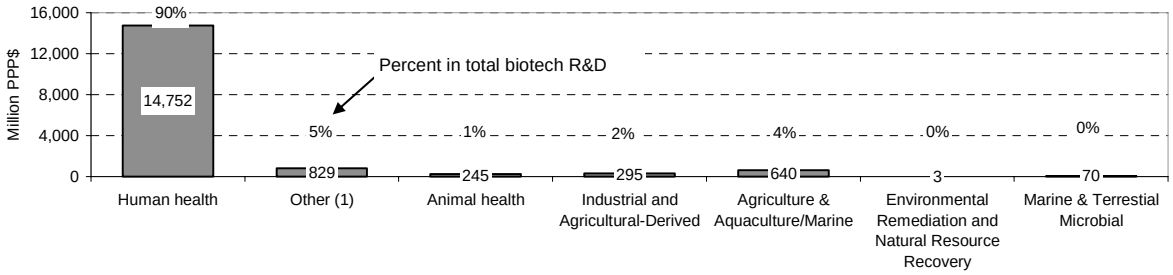
Biotechnology firms by application field, 2001

Breakdown of the 1,031 biotechnology firms



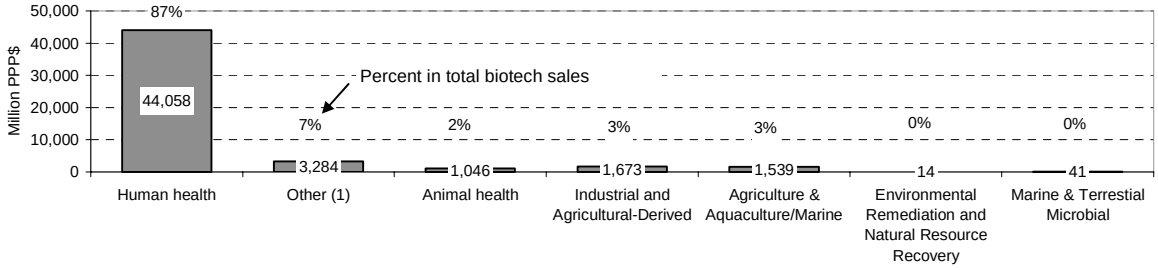
Biotechnology R&D by application field, Million PPP$, 2001

Breakdown of the PPP$ 16,440 million spent on biotechnology R&D and % distribution



Biotechnology sales by application field, Million PPP$, 2001

Breakdown of the PPP$ 50,472 million spent on biotechnology sales and % distribution



1. “Other” firms may manufacture biotechnology research tools such as hardware and software, biosensors, synthetic DNA and protein products, biochemical polymers, and other tools to assist researchers working in multiple biotechnology applications.

Source: U.S. Department of Commerce (2003), A Survey of the Use of Biotechnology in U.S. Industry, October.

ANNEX TABLES

ANNEX TABLES BELGIUM

Table 1. **Number of biotechnology firms by sector, 2003**

Agrofood	11
Pharma	17
R&D and Business Services	14
Human Health Services	7
Other	24
Total	**73**

Table 2. **Number of biotechnology firms by size class, Employees, 2003**

1 - 9 employees	30
10 - 49	16
50 - 99	12
100 - 199	4
200 - 499	6
500 or more	5
Total	**73**

Table 3. **Use and development of biotechnologies, 2003**
Percentage of firms that reported using or developing biotechnology techniques

	Under development	Currently use	Plan to use within the next 3 years
DNA - the coding	30.6	47.2	10.8
Proteins and molecules	36.1	54.2	3.6
Cell tissue culture	34.7	38.9	5.4
Process technologies	36.1	44.4	2.8
Sub-cellular organisms	9.7	18.1	5.2
Bioinformatics	22.2	31.9	8.5
Nanotechnologies	9.7	5.6	7.9
Environmental biotechnology	13.9	18.1	5.3
Other	4.2	4.2	1.5

Source: Belgian Federal Office for Scientific, Technical and Cultural Affairs (Forthcoming), The Biotechnology Industry in Belgium, National Report to the OECD, TIP Case Study on Biotechnology, First phase report.

ANNEX TABLES DENMARK

Table 1. **Number of biotechnology firms,[1] 1997 to 2003**

	1997	1998	1999	2000	2001	2002	2003
Core biotech	61	74	97	131	156	174	181
Firms with significant biotech activities	66	68	76	79	82	85	86
Total biotech firms	**127**	**142**	**173**	**210**	**238**	**259**	**267**

Table 2. **Biotechnology R&D in Denmark,[2] Million PPP$, 1997 to 2003**

	1997	1998	1999	2000	2001	2002	2003
Private	359.6	472.0	468.1	529.0	593.1	669.3	726.8
Public	88.2	94.4	103.0	125.0	125.9	130.9	131.3
Total	**447.7**	**566.4**	**571.1**	**654.0**	**719.0**	**800.1**	**858.1**

Table 3. **Intramural and extramural biotechnology R&D in the private sector,[2] Million PPP$, 1997 to 2003**

	1997	1998	1999	2000	2001	2002	2003
Intramural	359.6	472.0	468.1	529.0	593.1	669.3	726.8
Extramural	95.1	118.7	152.2	240.3	330.7	330.2	322.4

1. Core biotechnology firms are firms that are active in biotechnology R&D and for which biotechnology is their primary activity. Whereas firms with significant biotech activities perform biotechnology R&D.
2. For the private sector, data for 2000 was estimated based on the average of 1999 and 2001. Private sector data is unweighted. R&D data was not estimated for biotechnology firms where R&D data was not available for any year. For the public sector, data for 1998 was estimated based on the average of 1997 and 1999.

Source: Danish Centre for Studies in Research and Research Policy, October 2005.

ANNEX TABLES FINLAND

Table 1. **Total and biotechnology R&D expenditures, Million PPP$, 2003**

	Total R&D	Biotechnology R&D	
	Million PPP$		Percent in total
Business enterprise sector			
Firms active in biotech R&D	232.6	88.3	38.0
Other firms	3,436.3	..	..
Total business enterprise sector	**3,668.9**	**88.3**	**2.4**
Government sector			
Units active in biotech R&D	359.5	17.3	4.8
Other	176.4	..	..
Total government sector	**536.0**	**17.3**	**3.2**
Higher education sector			
Units active in biotech R&D	873.7	87.4	10.0
Other	141.7	..	..
Total higher education sector	**1,015.4**	**87.4**	**8.6**
Total	**5,220.3**	**192.9**	**3.7**

Table 2. **R&D personnel in R&D active firms, 2003**

	R&D personnel total	of which persons with a PhD	other university	other education
	Number	Percent		
Firms undertaking biotech R&D	2,394	13.2	34.5	52.2
Other firms with R&D activities	37,695	4.5	37.8	57.7
Total	**40,089**	**5.0**	**37.6**	**57.4**

Source: Statistics Finland (2005), Science and Technology in Finland 2004, March.

ANNEX TABLES FRANCE

Table 1. **Total number of firms undertaking biotechnology R&D, 2003**

	Biotech R&D Million PPP$	Share of biotech R&D in total BERD	Number of firms that undertook biotech R&D	Share of number of firms that undertook biotech R&D in total number of R&D firms	Share of BERD of firms undertaking biotech R&D in total BERD
		(%)		(%)	(%)
less than 20 employees	98.2	12.4	371	15.1	15.1
20 - 49	144.0	18.2	147	11.1	21.0
50 - 249	268.9	11.8	145	7.7	20.1
250 - 499	180.4	9.1	39	6.9	12.3
500 - 2000	161.8	3.5	40	7.2	16.7
2000 or more	488.8	3.7	13	8.0	6.2
Total	**1,342.0**	**5.6**	**755**	**10.9**	**10.8**

Table 2. **Firms where over 75% of the R&D budget was devoted to biotechnology, 2003**

	Biotech R&D millions PPP$	Share of biotech R&D in total BERD	Number of firms that undertook biotech R&D	Share of number of firms that undertook biotech R&D in total number of R&D firms
		(%)		(%)
less than 20 employees	89.3	11.3	267	10.9
20 - 49	135.5	17.1	98	7.3
50 - 249	240.5	10.6	68	3.6
250 - 499	171.0	8.7	16	2.8
500 - 2000	110.7	2.4	5	0.9
2000 or more	449.6	3.4	4	2.6
Total	**1,196.6**	**5.0**	**458**	**6.6**

Source : *Ministère de l'éducation nationale, de la recherche et de la technologie*, R&D survey, November 2005.

ANNEX TABLES FRANCE

Table 3. **Firms that undertook biotechnology R&D, by sector, 2003**

	Firms that undertook biotech R&D	Biotech R&D Million PPP$
Agriculture	52	67.5
Agri-food	78	53.9
Energy	5	5.8
Iron & Steel	1	0.2
Textiles & wearing apparel	1	0.1
Wood, Paper and cardboard	4	0.8
Other manufacturing	6	0.2
Chemicals	89	121.7
Pharmaceuticals	311	1,010.3
Rubber & Plastics	10	0.3
Glass	2	1.6
Metals	2	0.1
Machinery, Equipment	23	7.3
Office, Account. & Computing Machin.	2	0.4
Electrical Machinery	5	1.0
Electronic equipment and parts	7	2.1
Instruments	80	38.4
Motor Vehicles	4	0.3
Construction	5	0.4
Computer & Related Activities	23	3.8
Engineering	45	25.8
Total	**755**	**1,342.0**

Table 4. **Firms where over 75% of the R&D budget was devoted to biotechnology, by sector, 2003**

	Firms that undertook biotech R&D	Biotech R&D Million PPP$
Agriculture	28	53.5
Agri-food	35	28.1
Energy	1	0.2
Textiles & wearing apparel	1	0.1
Wood, Paper and cardboard	1	0.3
Chemicals	46	100.3
Pharmaceuticals	255	958.5
Metals	2	0.1
Machinery, Equipment	2	0.1
Office, Account. & Computing Machinery	2	0.4
Electrical Machinery	1	0.5
Electronic equip.	3	1.4
Instruments	48	31.7
Motor Vehicles	2	0.3
Computer & Related Activities	12	3.4
Engineering	17	17.7
Total	**458**	**1,196.6**

Source : *Ministère de l'éducation nationale, de la recherche et de la technologie*, R&D survey, November 2005.

ANNEX TABLES ISRAEL

Table 1. **Biotechnology firms in Israel, 2002**

	Total	R&D (Start-ups and research institutes)	Manufacture of medical and surgical equipment	Manufacture of pharmaceutical products for human and veterinary use	Agriculture and manufacture of food products
No. of firms engaged in biotechnology	148	117	4	18	9
Employed persons in biotechnology	**3,427**	**1,929**	**31**	**1,030**	**437**
Of those: by level of education					
- Ph.D. and above	844	600	10	206	28
- First and second degrees, incl. engineers	1,482	934	7	428	113
- Practical engineers and other technicians	1,101	374	3	407	317
Financial data (Million PPP$)					
Wage expenses in companies engaged in biotechnology	161.3	101.93	1.61	47.45	10.35
R&D Expenses for biotechnology	251.1	183.83	4.29	48.00	15.02
Biotechnology sales	331.8	69.47	0.87	165.68	95.79
- From Biotechnology exports	250.5	63.04	0.84	107.80	78.82
Investments in biotechnology (1, 2)	65.0	34.62	0.03	15.91	14.44
External funding sources (Million PPP$)					
Total funding (1)	**186.1**	**179.2**	**1.16**	**4.29**	**1.41**
Distribution of types of funding					
- Chief Scientists grant	22.67	18.13	0.18	3.03	1.32
- International foundations	2.41	2.33	0.00	0.00	0.08
- Venture capital funds	10.36	9.09	0.00	1.26	0.01
- Strategic investors	6.76	6.76	0.00	0.00	0.00
- Private fundraisers	44.31	43.34	0.97	0.00	0.00
- Raising capital on the stock market	57.41	57.41	0.00	0.00	0.00
- Fundraising from a government source	3.71	3.71	0.00	0.00	0.00
- Parent company	38.46	38.46	0.00	0.00	0.00

1. Data without imputation.
2. Investments include: investment in fixed assets in the field of biotechnology including: buildings (not including land value), structures, engineering work, machines, installations and equipment.

Source: Israel Central Bureau of Statistics (2005), Survey of biotechnology in Israel for 2002, December.

ANNEX TABLES JAPAN

Table 1. **Industrial breakdown of firms active in biotechnology, 2000 to 2003**
Based on principal sales activity of firm[1]

Industry Classification		Financial year 2000	2001	2002	2003
		Number			
Agriculture + Forestry + Fisheries		29	27	21	27
Mining		1	1	0	0
Manufacturing	Food or Drink Manufacture	203	207	222	242
	Fibre, Pulp, Paper and Paper Processing	30	26	27	30
	Chemical Industry (excl. pharmaceuticals)	110	105	114	127
	Pharmaceutical Manufacture	115	112	115	124
	Petroleum Products and Coal Products	11	10	11	10
	Steel and Non-Ferrous Metals	6	4	5	6
	Machinery Industry (incl. Plant and Waste Treatment	53	52	59	64
	Electrics and Electronic Industry	41	43	43	53
	Precision Machinery Industry	28	35	37	39
	Other Manufacturing Industry	96	90	93	114
Electric Power, Gas, Heat and Water Supply		1	2	1	1
Construction		23	20	20	22
Services		152	149	180	218
Other		40	52	28	41
No data on sector		7	33	41	44
Total		**946**	**968**	**1,017**	**1,162**

Table 2. **Japanese biotechnology firms by size class, 2000 to 2003**
Determined by the number of employees

Employees	2000	Financial year 2001	2002	2003
	Number of companies			
< 50 employees	209	238	237	315
50 - 99	127	129	138	146
100 - 299	225	216	224	253
300 - 999	179	176	196	214
1,000 - 4,999	145	153	162	170
> 5,000	60	50	51	53
No reply	1	6	9	11
Total	**946**	**968**	**1,017**	**1,162**
Survey sent to	na	1,536	1,536	1,535
Response rate (percent)	na	63.0%	66.2%	75.7%

1. Firms were asked to classify themselves by industrial sector based on their principal sales; therefore the sector in which they are classified may not be the one in which they were active in biotechnology.

Source: Based on data from the Japan Bioindustry Association (JBA), August 2005.

ANNEX TABLES JAPAN

Table 3. **Annual total domestic production of biotech firms, 2000 to 2003**
Domestic shipments of biotech products

	Financial year			
	2000	2001	2002	2003
	Million PPP$			
Foods	28,894.1	30,444.7	32,696.5	34,488.2
Other Foods	1,004.1	877.4	1,334.5	1,635.0
Agriculture Related	156.5	542.4	315.2	449.5
Livestock and Fisheries Related	206.7	200.5	233.3	232.7
Pharmaceuticals, Diagnostic Reagents and Medical Instruments	7,091.0	9,611.8	10,689.6	11,296.2
Research Samples and Reagents	149.5	173.3	121.8	206.5
Fiber and Fiber Processing	15.6	54.1	18.9	19.0
Chemical Products	2,836.1	3,111.7	2,772.9	3,165.2
Bioelectronics	212.5	207.3	224.3	252.0
Environment-Related Equipment and Facilities	1,370.6	1,220.4	1,371.0	1,497.9
Equipment and Facilities for Research and Production	1,029.2	343.9	300.3	460.5
Other Products	392.7	428.2	432.3	606.9
Data Processing	77.9	126.7	127.9	127.5
Services (incl Technical Support)	351.1	413.1	937.7	1,057.7
Unknown	0.0	25.9	62.4	17.8
Total	**43,787.6**	**47,781.3**	**51,638.5**	**55,512.6**

Table 4. **Annual domestic production of biotech firms: modern biotechnology, 2000 to 2003**
Domestic shipments in biotech products

	Financial year			
	2000	2001	2002	2003
	Million PPP$			
Foods	0.6	42.6	15.8	232.0
Other Foods	66.1	105.6	403.9	471.8
Agriculture Related	62.3	73.9	46.0	60.4
Livestock and Fisheries Related	62.0	98.0	72.3	70.8
Pharmaceuticals, Diagnostic Reagents and Medical Instruments	4,786.9	5,685.6	5,642.1	5,741.2
Research Samples and Reagents	105.2	125.4	119.5	130.6
Fiber and Fiber Processing	4.0	1.9	7.1	8.3
Chemical Products	1,991.8	2,010.9	1,958.7	1,560.6
Bioelectronics	212.5	206.9	223.9	252.0
Environment-Related Equipment and Facilities	40.0	184.4	144.6	154.3
Equipment and Facilities for Research and Production	822.0	284.4	140.8	348.6
Other Products	38.1	63.3	6.8	68.1
Data Processing	77.9	109.4	65.3	91.8
Services (incl Technical Support)	90.0	169.5	535.1	695.9
Unknown	0.0	0.3	469.4	0.0
Total	**8,359.2**	**9,162.1**	**9,851.3**	**9,886.3**

Source: Based on data from the Japan Bioindustry Association (JBA), August 2005.

ANNEX TABLES JAPAN

Table 5. **Major technologies used by Japanese biotechnology firms, 2000 to 2003**
Domestic shipments of biotech products

		Financial year 2000	2001	2002	2003
		Million PPP$			
Traditional biotech	Conventional Fermentation, Cultivation and Mutagenesis Technologies, etc.	35,924.8	38,734.3	40,659.5	43,679.9
	Conventional Environment Pollution Treatment Technology using Micro-organisms (Activated Sludge Processing, Methane Fermentation, and Composting, etc.)	1,687.4	1,164.1	1,291.8	1,359.9
Modern biotech	Cell Fusion, Mammalian Cell Culture, Chromosome Manipulation, Tissue Culture, and Animal Cloning Technologies, etc.	2,786.5	2,465.7	2,530.8	2,861.1
	Recombinant DNA Technology	3,023.8	3,666.2	3,957.6	4,275.4
	Special Cultivation Technology such as Immobilisation (Bioreactor, etc.)	1,053.4	1,200.9	857.0	1,284.6
	Biomimetic Technologies (Biomaterials, etc.), and Electronic Equipments (Biosensors, etc.), Analysers, and Software using Biological Knowledge	1,495.5	1,829.3	1,794.2	2,282.3
	No Reply	1,371.7	1,009.5	547.5	681.3
	Total	**47,343.1**	**50,070.0**	**51,638.5**	**56,424.6**

Source: Based on data from the Japan Bioindustry Association (JBA), August 2005.

ANNEX TABLES NEW ZEALAND

Table 1. **Biotechnology use by development stage,[1,2] 2004**

	Number in development stage				
	R&D	Part of production process	Part of product sold	Total	*Of which public*
DNA - The coding	93	27	24	147	90
Proteins and molecules	123	33	27	183	90
Cell and tissue culture, and engineering	105	36	27	168	99
Process biotechnologies	75	66	24	165	63
Sub-cellular organisms	18	3	0	24	15
Other	48	9	9	63	33
Total	**465**	**177**	**111**	**750**	**390**

Table 2. **Biotechnology use by development stage,[3] 2005**

	Number in development stage			
	R&D	Part of production process	Part of product sold	Total
DNA – the coding	156	42	27	228
Proteins and molecules	150	21	27	198
Cell and tissue culture, and engineering	105	33	27	165
Process biotechnologies	69	57	24	150
DNA and RNA vectors	24	6	0	27
Other	66	15	12	93
Total	**573**	**174**	**117**	**861**

Table 3. **Biotechnology R&D expenditures by sector, Million PPP$, 2004**

Sector	Biotechnology R&D	Total R&D in sector	Proportion of sector R&D
	Million PPP$		%
Business	94.9	454.2	20.9
Government	91.2	309.4	29.5
Higher education	57.5	305.1	18.8
Total	**243.6**	**1,068.7**	**22.8**

1. All counts in the survey were random rounded to base 3 to protect confidentiality, so actual figures may differ from those stated. Figures may not sum to totals due to rounding.
2. Each biotechnology in use refers to the combination of one of six main biotechnology techniques by stage of use. For example, table 1 shows that DNA coding biotechnologies were used 93 times for R&D.
3. Each biotechnology in use refers to the combination of one of six main biotechnology techniques by stage of use. For example, table 2 shows that DNA coding biotechnologies were used 156 times for R&D.

Sources: Statistics New Zealand (2005), Biotechnology in New Zealand 2004, July and Statistics New Zealand (Forthcoming), Biotechnology in New Zealand 2005.

ANNEX TABLES NORWAY

Table 1. **R&D expenditure and biotech R&D by sector and source of funding, Million PPP$, 2003**

Financing Million PPP$	Higher education	Institutes - private non-profit (PNP)	*Of which government sector institutes*	*Of which institutes serving enterprises*	Business enterprise sector (1)	Total
Total R&D	**812.9**	**689.8**			**1,461.7**	**2,964.4**
Public funding	708.4	437.7			86.2	1,232.2
Private funding	104.5	252.1			1,375.5	1,732.2
Biotechnology R&D	**66.4**	**23.8**	15.4	8.3	**29.3**	**143.2**
Public funding	50.0	17.0	12.9	4.1	1.7	85.7
Private funding	16.5	6.7	2.5	4.2	27.5	57.5
Biotech R&D / Total R&D (%)	**8%**	**3%**			**2%**	**5%**

Table 2. **Biotechnology R&D in the higher education and institute sector by field, Million PPP$, 2003**

R&D by field	Higher education sector		Institute sector		Total	
	Million PPP$	%	Million PPP$	%	Million PPP$	%
Human biomedicine and biopharmacy	26.3	39.5	5.0	21.1	31.3	34.7
Veterinary biomedicine and biopharmacy	1.2	1.8	1.9	7.9	3.1	3.4
Agricultural biotechnology	2.7	4.0	1.5	6.2	4.1	4.6
Marine biotechnology, incl. aquaculture	10.3	15.6	5.2	22.0	15.6	17.3
Nutritional biotechnology	3.0	4.5	4.2	17.7	7.2	8.0
Environmental and ecological biotechnology	1.5	2.2	1.0	4.1	2.4	2.7
Basic biosciences	15.7	23.6	0.2	1.0	15.9	17.6
Bioinformatics	3.6	5.4	1.4	5.9	5.0	5.5
Ethics	0.0	0.0	0.2	0.7	0.2	0.2
Other fields	2.3	3.5	1.7	7.1	4.0	4.5
Not distributed	-	-	1.4	5.8	1.4	1.5
Total	**66.4**	**100.0**	**23.8**	**100.0**	**90.2**	**100.0**

1. R&D in the business enterprise sector data are based on the Business Enterprise R&D survey findings.

Sources: NIFU (2005), *Bioteknologisk FoU 2003: Ressursinnsats I universitets- og høgskolesektoren og instituttsektoren*, April; Statistics Norway (2005), Special extraction from the 2003 Business Enterprise R&D survey, September.

ANNEX TABLES SWEDEN

Table 1. **Number of biotechnology firms,[1] 1997 to 2003**

	1997	1998	1999	2000	2001	2002	2003
Agrobiotechnology	4	6	9	9	8	..	7
Bioproduction	18	19	19	18	20	..	19
Biotech tools & supplies	26	26	35	38	40	..	59
Environmental biotech	8	8	8	8	9	..	7
Biotech food	10	11	11	11	11	..	10
Diagnostics	18	21	20	19	18	..	19
Drug delivery	11	10	13	12	13	..	13
Drug discovery & development	30	45	47	51	53	..	60
Biotech medical technology	11	11	14	15	16	..	19
Total	**136**	**157**	**176**	**181**	**188**	..	**213**

Table 2. **Number of employees in biotechnology firms,[1] 1997 to 2003**

	1997	1998	1999	2000	2001	2002	2003
Agrobiotechnology	656	645	672	680	625	586	546
Bioproduction	837	966	829	775	862	738	669
Biotech tools & supplies	1,602	1,679	1,882	2,052	2,241	2,467	2,644
Environmental biotech	34	35	42	47	42	37	32
Biotech food	103	132	139	152	149	105	61
Diagnostics	362	409	388	367	366	342	920
Drug delivery	149	148	162	186	185	205	225
Drug discovery & development	383	634	715	804	1,257	1,871	1,699
Biotech medical technology	156	194	1,180	1,382	1,433	1,588	1,836
Total	**4,282**	**4,842**	**6,009**	**6,445**	**7,160**	**7,939**	**8,632**

1. Includes biotechnology units and spin-offs from two large pharmaceutical firms active in Sweden: Pharmacia and Astra/Astra-Zeneca. However, the activities of the two parent firms in Sweden were not included.

Source: Dolk, T., and A. Sandström (2005), *Nationella och regionala klusterprofiler: Foretag inom bioteknik, lakemedel och medicinsk teknik i Sverige 2004*, VINNOVA, February.

ANNEX TABLES UNITED KINGDOM

Table 1. **Sectors and primary activities used for the classification of firms, 2003**

Activity category	Primary activity
Agricultural & Marine	Animal healthcare, Biopesticides, Crop agriculture, Food technology
Industrial & Environmental	Biocleaning, Bioremediation, Environmental diagnostics, Industrial diagnostics, Water & effluent treatment, Waste recycling
Human healthcare	Biomaterials, Drug delivery, Drug discovery, Gene therapy, Healthcare diagnostics, Genomics, Vaccines
Service providers	Bioprocessing, Chemicals, Contract research, Contract manufacturing
Technology service providers	Bioinformatics, Functional genomics, High throughput screening

Source: DTI (2005), Comparative statistics for the UK, European and US biotechnology sectors, analysis year 2003, February.

ANNEX TABLES UNITED STATES

Table 1 of 2. **Funds for and number of companies that performed industrial biotechnology R&D by industry, 2003**

Industry	NAICS codes	Biotechnology	
		Firms	Million PPP$
All industries	21–23, 31–33, 42, 44–81	**2,196**	**14,232**
Manufacturing industries	31–33	**588**	**5,388**
Food	311	31	67
Beverage and tobacco products	312	3	D
Textiles, apparel, and leather	313–16	1	D
Wood products	321	0	0
Paper, printing, and support activities	322, 323	4	D
Petroleum and coal products	324	1	D
Chemicals	325	291	4,742
Basic chemicals	3,251	21	D
Resin, synthetic rubber, fibers, and filament	3,252	1	D
Pharmaceuticals and medicines	3,254	123	4,526
Other chemicals	other 325	145	D
Plastics and rubber products	326	3	D
Nonmetallic mineral products	327	2	D
Primary metals	331	2	D
Fabricated metal products	332	56	25
Machinery	333	29	23
Computer and electronic products	334	56	172
Computers and peripheral equipment	3,341	0	0
Communications equipment	3,342	5	D
Semiconductor and other electronic components	3,344	20	52
Navigational, measuring, electromedical, and control instruments	3,345	31	D
Other computer and electronic products	other 334	0	0
Electrical equipment, appliances, and components	335	12	6
Transportation equipment	336	2	D
Motor vehicles, trailers, and parts	3361–63	2	D
Aerospace products and parts	3,364	0	0
Other transportation equipment	other 336	0	0
Furniture and related products	337	1	D
Miscellaneous manufacturing	339	95	292
Medical equipment and supplies	3,391	71	271
Other miscellaneous manufacturing	other 339	24	21

* = data less than PPP$ 500,000; D = data withheld to avoid disclosing operations of individual companies.

Source: National Science Foundation (Forthcoming), Research and Development in Industry: 2003.

Table 2 of 2. **Funds for and number of companies that performed industrial biotechnology R&D by industry, 2003** *(cont.)*

Industry	NAICS codes	Biotechnology	
		Firms	Million PPP$
Nonmanufacturing industries	21–23, 42, 44–81	**1,609**	**8,843**
Mining, extraction, and support activities	21	3	D
Utilities	22	1	D
Construction	23	14	*
Wholesale trade	42	461	3,134
Professional and commercial equipment and supplies, including computers	4,214	145	D
Electrical goods	4,216	8	D
Drugs and druggists' sundries	4,222	30	2,767
Other wholesale trade	other 42	277	D
Retail trade	44, 45	1	D
Transportation and warehousing	48, 49	0	0
Information	51	4	28
Publishing	511	4	28
Newspaper, periodical, book, and database	5,111	0	0
Software	5,112	4	28
Broadcasting and telecommunications	513	0	0
Telecommunications	5,133	0	0
Other broadcasting and telecommunications	other 513	0	0
Other information	other 51	0	0
Finance, insurance, and real estate	52, 53	1	D
Professional, scientific, and technical services	54	731	5,570
Architectural, engineering, and related services	5,413	30	256
Computer systems design and related services	5,415	1	D
Scientific R&D services	5,417	439	5,111
Other professional, scientific, and technical services	other 54	262	D
Management of companies and enterprises	55	2	D
Health care services	621–23	383	66
Other non-manufacturing	56, 61, 624, 71, 72, 81	7	D

* = data less than PPP$ 500,000; D = data withheld to avoid disclosing operations of individual companies.

Table 3. **Funds for and number of companies that performed industrial biotechnology R&D by size class, 2003**

Industry	Biotechnology	
	Firms	Million PPP$
All firms	**2,196**	**14,232**
5 – 24 employees	826	389
25 – 49	694	935
50 – 99	234	819
100 – 249	214	1,471
250 – 499	93	1,876
500 – 999	43	1,167
1,000 – 4,999	58	3,491
5,000 – 9,999	11	347
10,000 – 24,999	14	755
25,000 or more	11	2,983

Source: National Science Foundation (Forthcoming), Research and Development in Industry: 2003.

REFERENCES

REFERENCES FOR CROSS-COUNTRY COMPARISONS

R&D, employment and sales

Critical I, Biotechnology in Europe: 2005 Comparative Study, EuropaBIO, Biovision, Lyon, April 13, 2005.
Department of Trade and Industry (DTI), Comparative Statistics for the UK, European and US Biotechnology Sectors: Analysis year 2003, Report by Critical I, London, February 2005.
Genoma España, Spanish Biotechnology: Economic Impacts, Trends and Perspectives, June 2005.

Patents

OECD, *Compendium of Patent Statistics*, OECD, Paris, January 2006.

Agriculture

Clive James, Global Review of Transgenic Crops, ISAAA Briefs, Ithaca, New York, 1997 and 1999.

Clive James, Global Status of Commercialized Biotech/GM Crops, ISAAA, Ithaca, New York, 2004 and 2005.
Data on arable land from FAOSTAT, 2006. Available on line at:
http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=agriculture

Value at producer prices from OECD, *Economic Accounts for Agriculture 2005*.

UNU-MERIT GM Field Trials Database, Maastricht, the Netherlands, March 2006.

Alliances

National Science Foundation (2006), Appendix Table 4-37, Science and Engineering Indicators 2006, Arlington, Virginia. Available on line at: http://www.nsf.gov/statistics/seind06/

Venture capital

OECD, based on data from EVCA (Europe); NVCA (United States); CVCA (Canada); several years.

REFERENCES FOR COUNTRY PROFILES

Australia

ABS (2005), Research and Experimental Development, Businesses 2003-04, cat. No 8104.0, September.

Austria: No official data.

Belgium

Belgian Federal Office for Scientific, Technical and Cultural Affairs (Forthcoming), The Biotechnology Industry in Belgium, National Report to the OECD, TIP Case Study on Biotechnology, First phase report.

Canada

Government of Canada (2005), Canadian Trends in Biotechnology, 2nd edition, September.
Statistics Canada (2005), Biotechnology scientific activities in federal government departments and agencies, 2003-2004, May.
Statistics Canada (2005), Overview of the Biotechnology Use and Development Survey - 2003, April.

China, Shanghai

Ministry of Science and Technology of the People's Republic of China (2005), Shanghai Biotechnology Survey Report 2003, December.

Czech Republic: No official data.

Denmark

Carter Bloch (2004), Biotechnology in Denmark: A Preliminary Report, Danish Centre for Studies in Research and Research Policy, April.

Danish Centre for Studies in Research and Research Policy, October 2005.

Finland

Statistics Finland, March 2006.

Statistics Finland (2005), Science and Technology in Finland 2004, March.

Hermans, R., and T. Luukkonen (2002), Findings of the ETLA Survey on Finnish Biotechnology Firms, ETLA, September.

Hermans, R., M. Kulvik and A-J. Tahvanainen (2005), ETLA 2004 Survey on the Finnish Biotechnology Industry, ETLA, April.

France

Ministère de l'éducation nationale, de la recherche et de la technologie, November 2005.

Germany

Statistisches Bundesamt (2005), *Unternehmen der Biotechnologie in Deutschland — Ergebnisse der Wiederholungsbefragung 2004*, October.

Greece: No official data.

Hungary: No official data.

Iceland

RANNIS, The Icelandic Centre for Research, January 2006.

India: No official data.

Ireland: No official data.

Israel

Israel Central Bureau of Statistics (2005), Survey of biotechnology companies in Israel 2002, December.

Italy

ISTAT (2006), March 2006.

Japan

Japanese Bioindustry Association (JBA) / Ministry of Economy, Trade and Industry (METI), August 2005.

Korea

KIET/MOCIE (2005), Statistics on the 2004 Korean Bioindustry, December.

Luxembourg: No official data.

Mexico: No official data.

Netherlands: No official data.

New Zealand

Statistics New Zealand (2005), Biotechnology in New Zealand 2004, July.

Statistics New Zealand (Forthcoming), Biotechnology in New Zealand 2005.

Statistics New Zealand (2005), Research and Development in New Zealand 2004, September.

Norway

NIFU (2005), *Bioteknologisk FoU 2003: Ressursinnsats I universitets- og høgskolesektoren og instituttsektoren*, April.

Statistics Norway, September 2005.

Poland

Ministry of Education and Science, January 2006.

Portugal: No official data.

South Africa

DST and eGoli (2004), South African National Biotechnology Audit: 2003, January.

Slovak Republic: No official data.

Spain

INE (2006), Statistics on the use of Biotechnology 2004, March.

Sweden

Statistics Sweden (2005), Research and Experimental Development in the Business Enterprise Sector 2003, March.

Statistics Sweden (2005), Research and Experimental Development in the Higher Education Sector 2003, April.

Dolk, T., and A. Sandström (2005), *Nationella och regionala klusterprofiler: Foretag inom bioteknik, lakemedel och medicinsk teknik i Sverige 2004*, VINNOVA, February.

Switzerland

Office fédéral de la statistique (2005), *R-D dans l'économie privée en Suisse en 2004*, December.

Turkey: No official data.

United Kingdom

DTI (2005), Comparative statistics for the UK, European and US biotechnology sectors, analysis year 2003, February.

ONS, January 2006.

United States

National Science Foundation (Forthcoming), Research and Development in Industry: 2002.

National Science Foundation (Forthcoming), Research and Development in Industry: 2003.

U.S. Department of Commerce (2003), A Survey of the Use of Biotechnology in U.S. Industry, October.