

## BIOTECHNOLOGY

The amount that is spent on biotechnology research and development (R&D) by the business enterprise sector within a country, is a measure of its research focus on biotechnology.

### Definition

The OECD developed both a single definition and a list-based definition of biotechnology. The single definition is deliberately broad: “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.” This definition covers all modern biotechnology but also many traditional or borderline activities. For this reason, the single definition should always be accompanied by the list-based definition.

The (indicative, not exhaustive) list-based definition, which serves as an interpretative guideline to the single definition includes seven categories. Respondents are usually given a write-in option for new biotechnologies that do not fit any of the categories. A firm that reports activity in one or more categories is defined as a biotechnology firm. The seven categories include:

- i) DNA/RNA: Genomics, pharmacogenomics, gene probes, genetic engineering, DNA/RNA sequencing/synthesis/amplification, gene expression profiling, and use of antisense technology;
- ii) 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, signalling, identification of cell receptors;
- iii) Cell and tissue culture and engineering: Cell/tissue culture, tissue engineering (including tissue scaffolds and biomedical engineering), cellular fusion, vaccine/immune stimulants, embryo manipulation;
- iv) Process biotechnology techniques: Fermentation using bioreactors, bioprocessing, bioleaching, biopulping, bioleaching, biodesulphurisation, bioremediation, biofiltration and phytoremediation;
- v) Gene and RNA vectors: Gene therapy, viral vectors;
- vi) Bioinformatics: Construction of databases on genomes, protein sequences; modelling complex biological processes, including systems biology; and
- vii) Nanobiotechnology: Applies the tools and processes of nano/microfabrication to build devices for studying biosystems and applications in drug delivery, diagnostics, etc.

### Comparability

Data availability and comparability depends on how each country collects biotechnology statistics. Biotechnology activities can be measured in three ways: dedicated surveys

#### Overview

The United States spends the most on biotechnology BERD, USD 22 030 million in PPPs, over 7% of total US Business Enterprise R&D (BERD). This accounts for almost 70% of total biotechnology BERD expenditures in the 23 countries for which data are available. Biotechnology BERD as a share of total BERD is an indicator of country's research focus on biotechnology. On average, biotechnology BERD accounted for 5.7% of total BERD. Ireland spends the most as a percentage of BERD (15.1%). Belgium and Switzerland follow with 12.6% of BERD.

Biotechnology R&D intensity (biotechnology R&D as a percentage of industry value added) is highest in Denmark (0.389%), followed by Switzerland (0.384%) and Belgium (0.264%).

of firms active in biotechnology; adding questions on biotechnology to the national R&D survey of firms; and, constructing databases with information on biotechnology firms from secondary sources, and/or data-linking exercises.

A biotechnology firm is a firm engaged in biotechnology using at least one biotechnology technique (as defined in the OECD list-based definition of biotechnology) to produce goods or services and/or to perform biotechnology R&D. Some firms may be large, with only a small share of total economic activity attributable to biotechnology. These firms are captured by biotechnology firm surveys. Two subgroups of biotechnology firms are largely defined by the data collection method:

- i) Dedicated biotechnology firm; firms whose main activity involves the application of biotechnology techniques to produce goods or services and/or to perform biotechnology R&D. These firms are captured by biotechnology firm surveys; and
- ii) Biotechnology R&D firm: Firms that perform biotechnology R&D. Dedicated biotechnology R&D firms, a subset of this group, are firms that devote 75% or more of their total R&D to biotechnology R&D. These firms are captured by R&D surveys.

Countries that collect biotechnology statistics through their R&D surveys may underestimate biotechnology activity, as firms that use biotechnology but do not perform biotechnology R&D are excluded.

Although every effort has been made to maximise comparability across countries, caution must be used in comparing biotechnology activities among countries when the data are obtained from studies with very different methodologies. Factors such as differences in the definition of biotechnology, whether or not all firms innovate, low response rates, whether or not results were imputed to account for non-respondents or extrapolated to the total population will affect comparability.

### Sources

- Key biotechnology indicators, [www.oecd.org/sti/biotechnology/indicators](http://www.oecd.org/sti/biotechnology/indicators).

### Further information

#### Analytical publications

- OECD (2011), *OECD Science, Technology and Industry Scoreboard 2011*, OECD Publishing.
- OECD (2009), *OECD Biotechnology Statistics 2009*, OECD Publishing.

#### Methodological publications

- OECD (2009), “*Guidelines for a Harmonised Statistical Approach to Biotechnology Research and Development in the Government and Higher Education Sectors*”, OECD Working Party of National Experts on Science and Technology Indicators, unclassified document DSTI/EAS/STP/NESTI(2009)1/FINAL.
- OECD (2005), “*A Framework for Biotechnology Statistics*”, OECD Working Party of National Experts on Science and Technology Indicators.
- OECD (2002), *Frascati Manual 2002: Proposed Standard Practice for Surveys on Research and Experimental Development*, The Measurement of Scientific and Technological Activities, OECD Publishing.

### Websites

- OECD Key Biotechnology Indicators, [www.oecd.org/sti/biotechnology/indicators](http://www.oecd.org/sti/biotechnology/indicators).

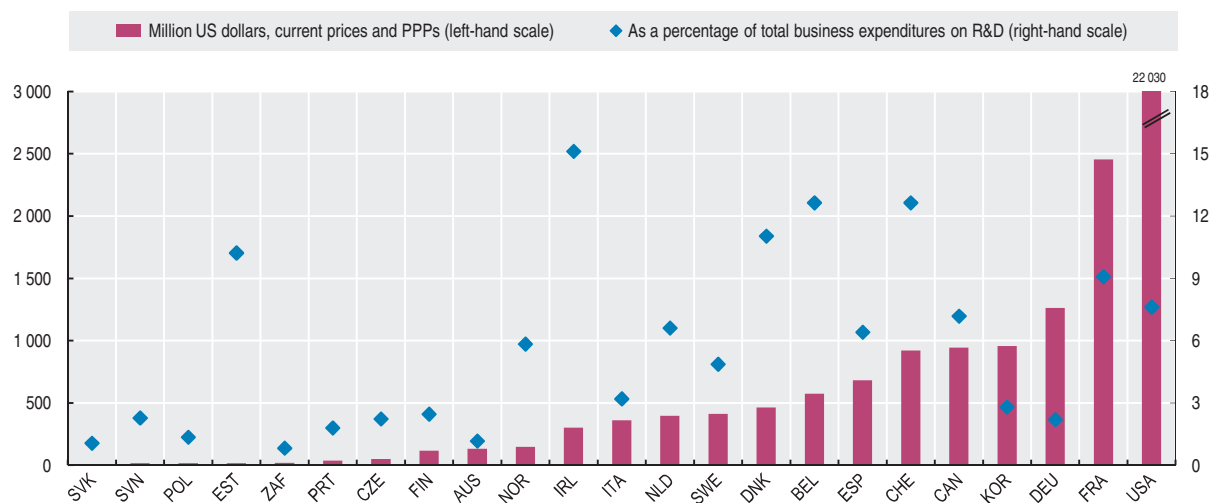

**Biotechnology R&D expenditures in the business sector**

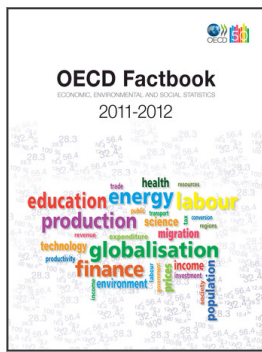
2009 or latest available year

	Million US dollars, current prices and PPPs	As a percentage of total business enterprise R&D	As a percentage of industry value added
Australia	133.4	1.2	0.023
Belgium	574.0	12.6	0.264
Canada	944.5	7.2	0.110
Czech Republic	50.7	2.2	0.027
Denmark	463.7	11.0	0.389
Estonia	17.1	10.2	0.097
Finland	115.6	2.5	0.098
France	2 454.9	9.1	0.200
Germany	1 262.6	2.2	0.067
Ireland	301.6	15.1	0.263
Italy	360.1	3.2	0.031
Korea	957.5	2.8	0.106
Netherlands	395.7	6.6	0.093
Norway	148.7	5.8	0.084
Poland	16.8	1.4	0.004
Portugal	37.1	1.8	0.024
Slovak Republic	2.4	1.1	0.003
Slovenia	15.4	2.3	0.042
Spain	682.4	6.4	0.068
Sweden	411.3	4.9	0.196
Switzerland	922.3	12.6	0.384
United States	22 030.0	7.6	0.252
South Africa	19.0	0.8	0.006

 StatLink <http://dx.doi.org/10.1787/888932505963>
**Total biotechnology R&D expenditures in the business sector**

2009 or latest available year


 StatLink <http://dx.doi.org/10.1787/888932505982>



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