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# Report of the Federal Government on Research 2006



RESEARCH

Igniting ideas!

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Responsibility for Part IV, "Research and technology policy of the Länder", lies with the relevant Länder.

The information about German research organisations presented in this report is also provided, and regularly updated, at the Website [www.forschungsportal.net](http://www.forschungsportal.net). The site's integrated search engine supports fast searches for specific research areas and the research organisations working in them.

# Preamble on research policy

"The key factors deciding our future development and ensuring that our social structure is balanced include effective research and the scientific and technical progress founded on such research. Support of scientific research and development thus plays a key role in our state expenditures as an 'investment in our future'".

This fundamental idea – that research and development (R&D) are the forces driving progress and growth – was presented in the first Report of the Federal Government on Research, in 1965, and it is still true today. At the same time, much has changed since 1965. The world has become much more complex. Solutions need to be found to the problems arising from changes in working and production conditions, from shortages of natural resources and from the foreseeable consequences of demographic and global change. At the same time, Germany must compete with other countries for the best ideas, for highly trained specialists, for leading scientists and for excellent companies seeking to establish new locations.

The opportunities and challenges of an increasingly dynamic world call for new policies aimed at strengthening innovation. With its dynamic industrial and business sector, its superbly trained specialists and its scientific resources, Germany can become one of the world's most research-friendly nations, as well as one of the world's most successful

nations in the area of technology transfer. In 2006, the Federal Government enacted the "High-Tech Strategy for Germany", thereby taking key steps toward an effective innovation policy. The basic elements of this strategy include new incentives for application-oriented science and research-friendly industry, as well as for new strategic co-operation between science and industry.

To meet the needs of the new culture of innovation, an independent, internationally composed commission of experts on "Research and Innovation" will soon be advising the Federal Government on scientific aspects of research, innovation and technology policy. From 2008 on, this commission will report every two years on Germany's research, innovation and technological capability. Also at two-year intervals, the Federal Government will submit to the German Bundestag a Federal Report on Research and Innovation that will comprehensively cover the research, technology and innovation policies of the Federal Government, the German Länder and the EU. In each case, the Report of the Federal Government on Research and Innovation will take suitable account of the report of the commission of experts. This "Report of the Federal Government on Research and Innovation" series will supplant the existing "Report of the Federal Government on Research" series.

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## New political emphases and strategies

### Without education, no research

It is now unquestionably accepted that research excellence can be achieved only when young scientists are receiving excellent support. The industry, science and political sectors thus all share the common aim of optimally promoting young scientists, on all levels, and of obtaining outstanding experts and specialists for Germany. Germany needs to be known, both nationally and internationally, for success in educating and promoting talents in its lecture halls, laboratories and workshops. The **Initiative for Excellence** and the **Joint Initiative for Research and Innovation** are important steps toward this goal.

With the **Higher Education Pact**, the Federal Government, in co-operation with the Länder, is responding to the challenge arising in that the numbers of persons eligible for higher education studies are going to increase significantly until 2020. Joint efforts are needed to safeguard the next generation's educational opportunities and, thus, ensure that a broad basis for cutting-edge research is in place.

In fall 2006, the Federal Ministry of Education and Research (BMBF) is introducing the "Young Researchers' Forum" ("Forum Nachwuchs"). This recurring event brings young researchers, from both Germany and abroad, together with specialised policy-makers, science and agency organisations and research institutions.

Outstanding talents are also being promoted in the area of vocational training. The **Vocational Training Programme for the Highly Talented (Begabtenförderung in der beruflichen Bildung)**, for example, is supporting young specialists who wish to acquire further training in their chosen occupations.

At the same time, new forms of training need to be developed and expanded, in co-operation with industry. The **Professionalisation Strategies for Practice** that have developed alongside established training pathways, are one example of such efforts. Such strategies have proven useful in the services sector, for example, in which mid-level, qualified and specialised staff tend to have relatively little formalised training. Employees in this sector commonly acquire their

skills on the job. In the coming years, researchers will search for ways to develop widely applicable qualifications, such as formal training certifications, from such informal training. Additional research will consider the extent to which "lifelong learning" can take place in structures apart from established forms of training and further training.

Research must play a key role in any optimisation of the education system. In the coming years, with a **framework programme for strengthening empirical education research**, the Federal Government will support the Länder in their efforts to reform and modernise the education system. This programme will structurally strengthen and internationalise education research, while also concentrating key resources and enhancing efficiency in their allocation.

### Protecting and using all available resources

A society that depends strongly on innovation must do everything possible to give its young people suitable educational and training opportunities. Germany needs the talents and resources of all its people. For this reason, the Federal Government has long supported efforts to ensure **equal opportunity** – for all people, regardless of background, age or gender.

Germany cannot afford to neglect or ignore any good minds. To enhance its technological capabilities, Germany urgently needs scientists and engineers – of both sexes. It is thus vitally important that young women be encouraged to choose studies and training programmes leading to careers in science and engineering.

In the past, people usually learned and received their education / training only in the first quarter of their lives. They worked decades in occupations with no significant learning phases and then "retired". This approach to learning and working is now completely outdated. To meet the challenges of demographic change, Germany must work in sensible ways to shorten people's initial training and educational phases – in spite of ever-increasing qualification requirements. At the same time, Germany must encourage people to engage regularly in occupationally oriented continuing education and further training, and it must make every effort to integrate older employees more actively in the changing workplace. Demographic change offers opportunities for new approaches to social coexistence – for all ages, and spanning social and cultural differences – aimed at enhancing equal opportunity and better integrating working, learning and family phases of people's lives. The Federal Government plans to commission studies into the necessary bases for implementing such new approaches.

### New value creation via science

#### Dialog between science and society

Hardly a day passes without bringing news of scientific breakthroughs. Many of these breakthroughs foster hope – for new treatments or cures for life-threatening diseases, for example, or simply for new ways of making everyday life simpler or more convenient. At the same time, many people have fears, uncertainties and inadequate information about scientific breakthroughs. The Federal Government plans to continue promoting dialog between science, industry and society, as a central task of its research and education policy. People will accept and welcome scientific research and technological development only in the degree to which they understand that the pressing problems of humankind cannot be solved without science.

For this reason, the Federal Government supports efforts to introduce more young people to science and technology, to awaken interest in natural and social sciences and to encourage young people to choose scientific and technical careers.

At the same time, scientists today are more mindful than ever of the context in which their work takes place: society. They understand that they must respond to the challenges of explaining their theories and actions to non-experts and of justifying their work and fostering societal acceptance of it.

In recent years, Germany has achieved a great deal in the area of science communication. Today, numerous successful initiatives and event formats for such communication are in place. The country's "science years" and "science summers" have met with a lively response – both nationally and internationally. The Science Year 2007 will be devoted to the humanities. It will highlight their research and findings, and it will showcase the humanities' role in a vital, innovation-friendly society.

Interaction between the science, industry and policy-making sectors is helping to promote development toward a knowledge society in which a well-informed public considers the scientific issues that affect all of us.

#### Excellence of the science system

Germany's research sector is one of the world's finest. Its strengths include its close links between research and teaching, its freedoms for researchers and its diverse range of higher education institutions, research establishments and companies. If Germany's research sector is to remain internationally competitive in the future, however, its research must

be seen more clearly in terms of its importance for the German economy. Germany needs an excellent research sector that can attract leading researchers and investments from throughout the world.

In their **Initiative for Excellence**, the Federal Government and the Länder have launched a competition aimed at promoting top-quality universities. As part of this effort, universities are developing into internationally recognised knowledge centres that benefit entire regions. Through 2011, the Federal Government and the Länder will invest a total of € 1.9 billion under this initiative, with the Federal Government's share amounting to 75 %. In its first round, the competition has already generated a great deal of excitement and energy at the country's universities. The competition is providing decisive impetus for links and co-operation between universities, research establishments and industry. It is strengthening cutting-edge research at universities, while also furthering efforts to promote young scientists and researchers.

At the same time, the Federal Government is aiming to enhance the competitiveness of the entire science system. Via a "**Joint Initiative for Research and Innovation**", the result of an agreement between the Federal Government and the Länder, major research organisations, including the Max Planck Society, the Helmholtz Association of German Research Centres (HGF), the Fraunhofer-Gesellschaft, the Gottfried Wilhelm Leibniz Science Association (WGL) and the German Research Foundation (DFG), will receive at least 3 % more annual funding through 2010. This budget growth, to be applied to enhancing competition, co-operation and networking, will help to develop additional resources in the German research sector. The effort's emphases include promoting young scientists – especially women – intensifying support for unconventional, open-ended research approaches, improving links between research organisations and universities and industry and implementing new instruments for promoting start-ups from within the research sector. All in all, the effort's uppermost aim is to promote excellence in research and development.

The Federal Government ensures that quality assurance for the research sector also extends to its own federal institutions with R&D tasks. In 2004, it requested the Science Council (Wissenschaftsrat) to evaluate the country's system of **departmental research (Ressortforschung)** and, in the process, to focus especially on 13 selected institutions that typify the system. The Science Council is expected to issue its recommendations in January 2007. Evaluations of an additional 26 federal institutions will follow. The Federal Government is preparing a concept for modern departmental research in the 21st century that will identify necessary standards and

developmental paths for high-quality, efficient departmental research.

A key aim is to ensure that Germany's research sector remains among the world's finest. Large state-of-the-art **research apparatus** and equipment, which are part of the infrastructure for the entire research sector, play a key role in this effort. The success of today's scientific research often depends on the availability of large research apparatus. In addition, use of such resources directly links sophisticated scientific research with scientific education. As a result, such resources are a factor in attracting the world's best researchers. In Germany, young scientists have the opportunity to work on complex questions and problems, in interdisciplinary teams, with state-of-the-art research tools.

### International aspects

The Federal Government is taking an active role in building a European Research and Education Area. It has played a decisive role in shaping the EU's **Seventh Research Framework Programme (FP7)**, and it will launch that programme during the **German Council Presidency** in 2007. The FP7 is the first such framework programme to provide extensive support for basic research from all fields of the natural sciences, engineering, social sciences and humanities. It also features an intensified focus on emerging technologies.

Supporting top researchers will be one of the key topics during the German Council Presidency. The newly established European Research Council (ERC) will facilitate competition between Europe's leading researchers. Europe's cultural dimension, along with that dimension's links to education and science, will be a second key focus. In addition, the presidency agenda will give generous consideration to energy and climate-protection issues.

In the interest of enhancing networking throughout the research sector, and of enhancing application of the world's knowledge to innovation in Germany, the Federal Government plans to launch an **internationalisation initiative** for German science. In this effort, strategic partnerships with the world's leading scientists will help create centres of competence, in Germany and Europe, with international reputations. The initiative, a concerted effort involving the Federal Government, the Länder, industry and science, is designed to internationally attract top researchers, outstanding young scientists and R&D investments, while enhancing the attractiveness of German research and education services abroad.

## High-Tech Strategy for Germany

### The High-Tech Strategy – new ideas for a new era

In August 2006, the Federal Government approved a High-Tech Strategy, a clear and comprehensive set of policies for strengthening innovation in Germany. For the first time, Germany has developed a cohesive national strategy, applying to all relevant ministries and departments, for making Germany a leader in the world's most important emerging markets. As part of this effort, state and industry R&D expenditures combined are to reach 3% of the country's domestic product by 2010. Today, the corresponding R&D percentage figure for Germany is 2.5%, placing Germany in 9th place in this category – behind OECD member countries such as the U.S. and Japan, but ahead of China. In Europe, Germany ranks 3rd in this category, behind Sweden and Finland. As the Federal Government emphasises, active innovation policies are important for science and industry. The Federal Government plans to invest some € 14.6 billion in the High-Tech Strategy by 2009, thereby increasing the state's R&D expenditures by € 6 billion by that year. Never before, in its entire history, has the Federal Republic of Germany ever had a sharper increase in state R&D expenditures.

Germany's High-Tech Strategy is expected to help provide the first systematic links between research funding and the overall relevant framework conditions. New research priorities are being established in the areas of energy, health care, nanotechnology, information and communications technologies and security.

With its High-Tech Strategy, the Federal Government also wants to encourage researchers to apply their ideas to founding start-ups. In the process, the Federal Government wishes to assist companies in rapidly assimilating new research findings in ways that lead to tomorrow's products. To a greater extent than in the past, good ideas should be leading to good products.

The Federal Government expects the High-Tech Strategy to generate up to 1.8 million new jobs if it is implemented systematically, and if all participants make the necessary commitments, including not only financial commitments. Small and medium-sized enterprises (SMEs) have traditionally played a leading role in Germany in creating jobs, in introducing new technologies and in serving as partners for innovation. And the potential inherent in innovative companies is far from exhausted. With both new and proven instruments, the High-Tech Strategy will effectively support small and medium-sized enterprises in strengthening their

innovation competence and in further expanding their co-operation with the science sector. Technology-oriented and services-oriented start-ups will receive assistance for market entry. To this end, funding in support of R&D at small and medium-sized enterprises is to be increased by 40% by the year 2009.

Implementing the High-Tech Strategy – and, especially, shaping responses to issues that affect a broad spectrum of technologies and designing specific innovation strategies – will be one focus of the **"Industry-Science Research Alliance on technology perspectives for future markets"** ("Forschungsunion Wirtschaft-Wissenschaft zu Technologieperspektiven für Zukunftsmärkte"), which has been founded at the BMBF's initiative. This research alliance currently comprises 16 members, and it has an even balance of representatives of industry and industry associations, on the one hand, and of the science sector and of public-sector research institutions, on the other.

### Promoting technologies and applications

The Federal Government is working to strengthen Germany's research and technology sectors. It is actively promoting promising, emerging technology and research fields, and it is supporting science and industrial enterprises in efficiently applying their know-how leadership to developing products and services. With innovation strategies for a range of various high-tech sectors, the Federal Government is creating links between research and emerging markets. For example, nanotechnology, biotechnology, optical technologies and information and communications technologies are seen worldwide as "driver" technologies that are spawning a broad range of applications and profoundly changing many different industrial sectors. As an export-oriented, high-tech country, Germany depends centrally on mastery of such technologies. And Germany relies even more strongly on being able to use and integrate such basic technologies in economically central applications such as automotive and machine-tool technologies, as well as in environmental and energy technologies and increasingly, construction technology, all of which are needed in efforts to solve the pressing problems of the future. The Federal Government thus plans to build on Germany's strength as a provider of systems technologies.

### Health research and medical technology

One of the Federal Government's major priorities is to further improve health care for patients, while also enhancing pertinent cost efficiency. The Federal Government supports use of research findings in development of new diagnostic and

therapeutic tools. Plans call for building on Germany's leadership in the field of regenerative medicine, for enhancing the attractiveness of Germany's pharmaceutical sector, by improving conditions for clinical studies, and for ensuring that Germany remains a lead market for medical technology. At the same time, intensified use is to be made of the potential of information and communications technologies for benefiting health care.

### Information and communications technology (ICT)

In an effort being led by the Federal Ministry of Economics and Technology (BMWi), the Federal Government is preparing the action programme "Information Society Germany 2010" ("Informationsgesellschaft Deutschland 2010" (iD2010)). The programme's main elements including modernising the relevant legal and technological framework, enhancing integration of the state, of industry and of private persons in the information society, improving security in information and communications technologies and efficiently promoting pertinent research and market-oriented developments.

The Federal Government's iD2010 action programme will link ICT-relevant aspects of innovation and competition policies with administrative-modernisation and social-participation elements to form a unified strategy. The programme is Germany's contribution to reorientation of the Lisbon Strategy and to implementation of the joint EU Strategy "i2010 – A European Information Society for growth and employment". The action programme will be presented at the end of 2006, in connection with the Federal Chancellor's "IT Summit".

### Nanotechnology

In the "Nano-Initiative – Action Plan 2010", an effort that is being managed by the BMBF and that was presented in November 2006, the Federal Government has created a unified, interdepartmental framework for aims and approaches in nanotechnology. In the main, the initiative is focussed on pertinent new fields, on enhancing conditions for relevant research, on responsible use of the new technology and on comprehensive public dialog. The effort is also designed to introduce additional sectors and companies to nanotechnology and to eliminate barriers to investment.

The Federal Government plans to engage in intensive dialog with the public regarding the opportunities and risks inherent in this new cross-cutting technology.

### Biotechnology

The Federal Government wants Germany to be a European leader in biotechnology, in terms of numbers of companies, numbers of jobs and revenue. To this end, the Federal Government plans to identify and eliminate barriers to relevant growth, to develop new key fields such as "white" biotechnology and nanobiotechnology and to orient its support strategy to the links in the sector's innovation chain.

### Security technologies

Via a national security-research programme, the Federal Government plans to promote the establishment of joint science-industry research platforms. The planned measures in this area will help develop the economic potential of security technology, while also enabling industry to make early use of relevant emerging opportunities in the world market. At the same time, they will provide a technical basis for protecting Germany's citizens and for safeguarding the freedom of Germany's society.

### Energy technologies

The Federal Government plans to push forward with Germany's transition to a sustainable energy supply. In a balanced way, this effort will fulfil the criteria of reliability, cost-effectiveness and climate/environmental protection. A balanced energy mix, without one-sided dependencies, is of decisive importance with regard to innovation in Germany. At the same time, a central priority must be placed on careful use of fossil resources. Plans call for doubling the German economy's energy productivity by 2020, with respect to 1990; for increasing renewable energies' contribution to Germany's primary-energy needs from its current level of nearly 5% to at least 10%, by 2020; and for reducing emissions of greenhouse gases such as carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) as cost-effectively as possible.

### Transport technology

Germany is to become Europe's logistics hub. This process will require enhancing the efficiency of Germany's entire transport system, improving the competitiveness of Germany's automotive and transport industries, reducing the stresses that transports create for people and the environment and ensuring, throughout the long term, that the country's entire population has access to modern, suitable and safe means of mobility. The Federal Government's fuels strategy of 2004 is being updated. With the help of new technologies, the average

CO<sub>2</sub> emissions of newly registered automobiles, taking into account a certain percentage of biofuels in the overall fuels mix, are to be reduced to 120g CO<sub>2</sub>/km by the year 2012. By 2015, biofuels are expected to account for 8 % of all fuel consumed in the country's transport sector.

### Aerospace

The Federal Government plans to help implement the European aerospace industry's "Vision 2020" strategic research agenda. This agenda calls for strengthening the German aviation industry's core competences, for reducing environmental pollution from air transports, for enhancing safety and passenger convenience and for building on Germany's competence in satellite navigation and remote earth sensing. These efforts will further enhance Germany's leadership in aerospace research and technology, as well as helping to ensure that German companies have good opportunities in the European and global competition ensuing in relevant emerging markets.

### Humanities and social sciences

The humanities and social sciences are also receiving systematic consideration in the High-Tech Strategy. The humanities and social sciences make important contributions to our critical perspective of the present in which we live and of our future options. In its 2007 budget, the BMBF is increasing its funding for research in the humanities and social sciences by nearly 22 percent, to € 44.3 million. At the same time, the support initiative "Space for the Humanities" ("Freiraum für die Geisteswissenschaften") is being launched. It is aimed at strengthening the European role of German humanities, via international research groups in the humanities, via thematically oriented support measures aimed at the interfaces between the humanities and natural sciences and via establishment and expansion of projects involving young scholars and researchers.

The High-Tech Strategy's technology-specific strategies and measures will complement the Federal Government's non-technology-specific relevant activities, such as technology-overarching research-support programmes for small and medium-sized enterprises, the environmental innovation programme and the High-Tech Start-ups Fund (Hightech-Gründerfonds).

# Contents

	Page
<b>Preamble on Research Policy</b>	<b>I</b>
<b>Part I: The German Research Landscape – Structures and Financing</b>	<b>1</b>
Introduction	2
1    Framework and work structures	2
1.1    The legal framework	2
1.2    Work structures	3
1.2.1    Bund-Länder Commission for Educational Planning and Research Promotion (BLK)	3
1.2.2    Science Council	3
2    State support instruments	4
2.1    Project support	4
2.2    Institutional support	5
2.3    Commercialisation of project results	5
3    Quality assurance	6
3.1    "easy", the electronic application/offer system of the BMBF, BMWi and BMU; "profi", the project-support information system for internal electronic processing; and "profi online"	6
4    Research support – structure and stakeholders	7
4.1    Structure of German research support	7
4.1.1    Federal Government and the Länder	7
4.1.2    Industry	7
4.1.3    Foundations	8
4.2    European Union	8
5    Funding organisations	9
5.1    Deutsche Forschungsgemeinschaft (DFG)	9
5.2    German Academic Exchange Service (DAAD)	14
5.3    Alexander von Humboldt Foundation (AvH)	15
5.4    Institutions for promoting gifted students in higher education	16
6    German Foundation for Peace Research (DSF)	18
7    Deutsche Bundesstiftung Umwelt (DBU)	19
8    "German Humanities Institutes Abroad" Foundation (DGIA)	19
"Otto von Guericke" Federation of Industrial Co-operative Research Associations (AiF)	20
9    Arbeitsgemeinschaft industrieller Forschungsvereinigungen „Otto von Guericke“ e.V. (AiF)	22
10   Project management agencies and DLR space-programme management	23
10.1   Project management agencies	23
10.1.1   Project management agencies of the Federal Ministry of Education and Research (BMBF)	24
10.1.2   Project management agencies of the Federal Ministry of Economics and Technology (BMWi)	25
10.1.3   Project management agencies of the Federal Ministry for the Environment, Nature Conservation and Reactor Safety (BMU)	27
10.2   DLR space-programme management	27
11   Organisations and institutions that carry out R&D	28
11.1   Universities	28
11.2   Max Planck Society (MPG)	31
11.3   Fraunhofer-Gesellschaft (FhG)	58
11.4   Helmholtz Association of German Research Centres (HGF)	78
11.5   Leibniz Association (WGL)	83
11.6   Federal and Länder institutions that carry out R&D	101
11.6.1   Federal institutions with research tasks	101
11.6.2   Länder institutions with research tasks	114
11.7   Academies and German Academy of Natural Science (Deutsche Akademie der Naturforscher Leopoldina)	146
11.8   caesar Foundation (center of advanced european studies and research)	149
12   Business enterprises	149
13   Extramural industrial research institutions in eastern German Länder	150
14   Specialised central information institutions and specialised central libraries	150

	Page
<b>Part II: Resources for science, research and development in Germany, and state R&amp;D expenditures: description and international comparison</b>	<b>159</b>
Introduction and explanation of terms	160
15 Science expenditure	163
16 Expenditure on research and development	164
17 Staff employed on research and development	168
17.1 Structure and development	168
17.2 Percentage of R&D staff with academic qualifications	168
17.3 Percentage of R&D staff who are women	168
17.4 R&D density (R&D staff per 1,000 inhabitants)	172
18 Federal expenditure on research and development, 1998 to 2006	172
18.1 Structure and development	172
18.2 Federal expenditure on research and development, total and by government ministries	172
18.3 Federal expenditure on research and development, by funding areas and funding priorities	173
18.4 Expenditure of the Federal Government and of the BMBF for research and development – profile presentation	177
18.5 Federal R&D expenditure, by type of funding	180
18.6 Federal R&D expenditure, by recipient groups	180
18.7 Federal expenditure on research and development, by region	181
19 Expenditure of the Länder on science, research and development	181
20 Joint research funding by Federal and Länder governments	184
20.1 Deutsche Forschungsgemeinschaft (DFG; German Research Foundation)	184
20.2 Max Planck Society (MPG)	185
20.3 Fraunhofer-Gesellschaft (FhG)	185
20.4 Helmholtz Association of German Research Centres (HGF)	185
20.5 Leibniz Association (WGL)	185
20.6 Academies Programme	185
20.7 German Academy of Sciences Leopoldina	186
21 Higher education resources for research and development	186
21.1 Importance of the higher education sector for research and development	186
21.2 Higher education expenditure on teaching and research	186
21.3 Higher education expenditure on teaching and research, by areas of science	186
21.4 Higher education expenditure on teaching and research, by type of higher education institution	186
21.5 Total higher education expenditure on R&D	187
21.6 Higher education R&D expenditure, by fields of science	187
21.7 Higher education R&D expenditure, in western German and eastern German Länder and in Berlin	188
21.8 Financing of higher education R&D expenditures	188
21.9 Total R&D staff in higher education	188
21.10 Higher education R&D staff, by field of science	188
21.11 Higher education R&D staff– regional distribution	189
22 Support for research and development in industry	189
22.1 Federal funding of research and development in the business enterprise sector	189
22.2 Structure of Federal R&D funding in the business enterprise sector	191
23 International comparison of government resources for research and development	192
23.1 Government R&D expenditure as a percentage of gross domestic product	192
23.2 Government-financed R&D expenditure in the European Union	192
<b>Part III: The Federal Government's research and technology policy</b>	<b>199</b>
Introduction	201
24 Support organisations, construction in higher education and special programmes oriented primarily to higher education	201
24.1 Basic financing of the Max Planck Society	202
24.2 Basic funding of the Deutsche Forschungsgemeinschaft	203
24.3 Basic financing of the Fraunhofer-Gesellschaft	204
24.4 Expansion and construction of higher education institutions	205

	Page	
24.5	Special programmes oriented primarily to higher education institutions	205
25	Large-scale equipment for basic research	206
26	Marine and polar research; marine technology; geosciences	210
26.1	Marine research	211
26.2	Polar research	214
26.3	Geosciences, geotechnologies	215
26.4	European and international co-operation	218
26.5	Shipping and marine technology	220
27	Space research and space technology	224
28	Energy research and energy technology	228
28.1	Efficient energy transformation	228
28.2	Renewable energies	231
28.3	Nuclear energy research	232
28.4	Decommissioning of nuclear pilot and test facilities	233
28.5	Nuclear fusion research	234
29	Research for sustainable development	234
29.1	The earth system – Atmosphere, climate system, large scientific apparatus	235
29.2	Research for sustainability	237
29.2.1	Societal action in the interest of sustainable development	239
29.2.2	Sustainable use concepts for regions	240
29.2.3	Sustainable use of natural resources	240
29.2.4	Concepts for sustainable development in industry and business	244
29.3	Peace and conflict research, humanitarian mine-clearing	246
30	Research and development in the health-care sector	247
31	Research and development to improve working conditions	264
32	Information technology	268
32.1	Software systems	269
32.2	Basic technologies in information technology	271
32.2.1	Communications technologies	272
32.2.2	Nanoelectronics and nanosystems	275
32.3	Microsystem engineering	276
32.4	Production systems and technologies	280
32.5	Multimedia	282
32.6	Internet – basic principles and services	287
32.7	Global network of scientific and technical information	288
32.8	Use of information and communications technologies in education	291
33	Biotechnology	295
34	Materials research; new technologies	302
34.1	New materials, nanomaterials	303
34.2	Optical technologies	307
35	Aeronautical research	310
36	Research and technology for mobility and transport (including transport safety)	312
37	Regional planning and urban development; construction research	316
37.1	Physical planning, city planning, housing	317
37.2	Construction research – construction engineering research	320
38	Research in the food sector	325
39	Research and development in agriculture, forestry and fishery	327
40	Education research	330
40.1	Overview of types of projects and extent of research promotion	330
40.2	Institutional funding, and measures to strengthen empirical education research	336
40.3	Research projects in the context of education reporting covering all education sectors	337
40.4	Research in general education	339
40.5	Research in the area of vocational training	353
40.6	Higher education research	357
40.7	Research on learning and further training	362
41	Innovation and improved basic conditions	368

	Page	
41.1	Innovation financing for technology-oriented companies and start-ups	369
41.2	Improvement of technology and science transfer/ support for research co-operation and innovative networks	372
41.3	Technical-economic infrastructure	375
41.4	Other indirect support measures	376
42	Humanities; economic and social sciences	377
42.1	Humanities	377
42.2	Economic and social sciences	378
43	Other basic conditions not assigned to other sectors	390
44	Defence research and technology	397
44.1	Defence research and technology (R&T)	397
44.2	Defence technology development	398
44.3	Non-technical research and studies of the German Federal Armed Forces	399
44.4	Research in the area of defence medicine and psychology (including veterinary medicine, dentistry and defence pharmacy)	400
44.5	Research in the area of geo-information systems	401
44.6	Research in the area of military history	402
44.7	Research in the social sciences	402
<b>Part IV: Research and technology policy in the Länder</b>	<b>405</b>	
	Introduction	408
45	Baden-Württemberg	408
45.1	Principles and priorities of research and technology policy	409
45.2	Higher education research, and technology policy not oriented to the higher education sector	410
45.3	Technology support and technology transfer	413
45.4	Promotion of young researchers	415
45.5	International co-operation	415
46	Free State of Bavaria	417
46.1	Principles and priorities of research and technology policy	417
46.2	Research within and outside of the higher education sector	417
46.3	Technology support and technology transfer	419
46.4	International activities	421
46.5	Other state programmes and measures	422
47	Berlin	423
47.1	Principles and priorities of research and technology policy	423
47.2	Higher education research	423
47.3	Research outside of the higher education sector	424
47.4	Technology support and technology transfer	425
47.5	International activities	426
48	Brandenburg	427
48.1	Principles and priorities of research and technology policy	427
48.2	Higher education, and research establishments outside of the higher education sector	428
48.3	Technology support and technology transfer	432
48.4	International co-operation	432
48.5	Other state programmes and measures	433
49	Free Hanseatic City of Bremen	434
49.1	Principles and priorities of research and technology policy	434
49.2	Higher education research	434
49.3	Research outside of the higher education sector	438
49.4	Technology support and technology transfer	441
49.5	International activities	442
50	Free and Hanseatic City of Hamburg	442
50.1	Principles and priorities of research and technology policy	442
50.2	Research within and outside of the higher education sector	443

	Page	
50.3	Technology support and technology transfer	446
50.4	International co-operation	447
51	Hesse	447
51.1	Principles and priorities of research and technology policy	447
51.2	Higher education research	449
51.3	Research outside of the higher education sector	451
51.4	Technology support and technology transfer	451
51.5	International activities	454
52	Mecklenburg-Western Pomerania	455
52.1	Principles and priorities of research and technology policy	455
52.2	Research within and outside of the higher education sector	456
52.3	Technology support and technology transfer	458
52.4	International co-operation	460
53	Lower Saxony	461
53.1	Principles and priorities of research and technology policy	461
53.2	Research within and outside of the higher education sector	463
53.3	Technology support and technology transfer	463
53.4	International co-operation	466
54	North Rhine-Westphalia	467
54.1	Principles and priorities of research and technology policy	468
54.2	Research within and outside of the higher education sector	468
54.3	Technology support and technology transfer	475
54.4	International co-operation	476
55	Rhineland-Palatinate	477
55.1	Principles and priorities of research and technology policy	477
55.2	Research within and outside of the higher education sector	477
55.3	Technology support and technology transfer	480
55.4	International co-operation	481
55.5	Other state programmes and measures	482
56	Saarland	483
56.1	Principles and priorities of research and technology policy	483
56.2	Higher education research	485
56.3	Research outside of the higher education sector	486
56.4	Technology support and technology transfer	487
56.5	International activities	487
57	Free State of Saxony	488
57.1	Principles and priorities of research and technology policy	488
57.2	Research within and outside of the higher education sector	489
57.3	Technology support and technology transfer	491
57.4	International co-operation	492
57.5	Other state programmes and measures	492
58	Saxony-Anhalt	493
58.1	Principles and priorities of research and technology policy	493
58.2	Research within and outside of the higher education sector	494
58.3	Technology support and technology transfer	498
58.4	International support measures and co-operation	498
59	Schleswig-Holstein	499
59.1	Principles and priorities of research and technology policy	499
59.2	Research within and outside of the higher education sector	500
59.3	Technology support and technology transfer	503
59.4	International co-operation	505
60	Free State of Thuringia	506
60.1	Principles and priorities of research and technology policy	506
60.2	Research within and outside of the higher education sector	507
60.3	Technology support and technology transfer	511
60.4	International co-operation	512

	Page
<b>Part V: International Co-operation in Research and Technology</b>	<b>513</b>
The BMBF's Internationalisation Strategy	515
61    Bilateral co-operation with European countries	516
61.1    Bilateral co-operation with countries of western, northern and southern Europe	516
61.1.1    Stiftung Deutsch-Niederländische Windkanäle (DNW – German-Dutch Wind Tunnel Foundation)	517
61.1.2    Franco-German University	518
61.1.3    Centre Marc Bloch	519
61.1.4    Villa Vigoni	519
61.1.5    Deutsch-Französisches Forschungsinstitut (Franco-German research Institute)	520
61.2    Bilateral co-operation with countries of central, meastern and south-eastern Europe	521
61.3    Bilateral co-operation with countries of the Commonwealth of Independent States (CIS)	523
61.3.1    Strategic partnership with Russia	523
61.3.2    Current emphases of programme-oriented and project-oriented co-operation with Russia	523
61.3.3    Current emphases of bilateral co-operation with Ukraine	525
61.3.4    Academic exchanges	526
61.3.5    Co-operation involving innovative small and medium-sized enterprises (SMEs)	526
61.3.6    Multilateral and European co-operation	526
62    Co-operation in the framework of the European Union	527
62.1    Basis of research support in the European Union	527
62.2    The "Lisbon Strategy"	528
62.3    The 6 <sup>th</sup> European Framework Programme for Research and Technological Development	529
62.4    The 7 <sup>th</sup> European Framework Programme for Research and Technological Development	530
62.5    The Federal Government's advising centres relative to the European Framework Programme	533
63    European initiatives, organisations and research institutions	544
63.1    The ERA-NET funding instrument	544
63.2    EUREKA	544
63.3    COST – European co-operation in the field of scientific and technical research	546
63.4    European Strategy Forum on Research Infrastructures (ESFRI)	548
63.5    European Space Agency (ESA)	548
63.6    European Organisation for Nuclear Research – European Laboratory for Particle Physics (CERN)	550
63.7    European Southern Observatory (ESO)	551
63.8    European Molecular Biology Conference (EMBC)	552
63.9    European Molecular Biology Laboratory (EMBL)	552
63.10    European Synchrotron Radiation Facility (ESRF)	553
63.11    Institut Max von Laue – Paul Langevin (ILL)	554
63.12    European Centre for Medium-Range Weather Forecasts	555
63.13    European University Institute (EUI)	555
63.14    European Transonic Wind Tunnel (ETW)	556
63.15    Council of Europe	557
64    Co-operation with non-European countries and regions	558
64.1    Co-operation with the U.S. and Canada	558
64.2    Co-operation with Latin America	561
64.3    Co-operation with Mediterranean and African countries	563
64.4    Co-operation with the Asian-Pacific region	565
64.5    Co-operation with developing countries	570
65    Multilateral organisations	571
65.1    Organisation for Economic Co-operation and Development (OECD)	571
65.2    International Energy Agency (IEA)	573
65.3    International Atomic Energy Agency (IAEA)	573
65.4    United Nations Educational, Scientific and Cultural Organisation (UNESCO)	574
65.5    Intergovernmental Oceanographic Commission of UNESCO (IOC)	575
65.6    University of the United Nations	575
65.7    UN Commission on Sustainable Development (CSD)	576
65.8    United Nations Framework Convention on Climate Change	576
65.9    Intergovernmental Panel on Climate Change (IPCC)	577
65.10    World Meteorological Organisation (WMO) – A UN specialised agency	577

65.11	North Atlantic Treaty Organisation (NATO)	578
65.12	Human Frontier Science Program Organisation (HFSP)	579
65.13	United Nations Convention on Biological Diversity	579
65.14	Global Biodiversity Information Facility (GBIF)	580
65.15	Consultative Group on International Agricultural Research (CGIAR)	581
66	List of international scientific and technical agreements	582

**Part VI: Tables/Statistics 599**

67	Tables	601
	Table 1: Science expenditure of the Federal Republic of Germany	601
	Table 2: German R&D expenditure and financing sectors	602
	Table 3: Gross domestic expenditure on R&D (GERD) in Germany, by performing sectors	603
	Table 4: Government science expenditure, by functions and funding sources	606
	Table 5: Government science expenditure, by functions and funding sources	608
	Table 6: Joint research funding by Federal and Länder governments (institutional funding)	610
	Table 7a: Federal expenditure on science, research and development, by government ministries	612
	Table 7b: Expenditures of the BMBF for education, science, research and development	615
	Table 8a: Federal expenditure on science, research and development, by funding areas and funding priorities	616
	Table 8b: Federal expenditure on science, research and development, by funding areas and funding priorities	626
	Table 9: Federal expenditure on science, research and development, by type of funding	635
	Table 10: Federal expenditure on science, research and development, by recipient groups	639
	Table 11: Federal Government payments to business enterprises for science, research and development, by economic activity	645
	Table 12: Expenditure of the Federal Government on international science organisations and intergovernmental research institutions, for science, research and development	649
	Table 13: R&D expenditure of the Federal Government and the Länder, by research objectives	653
	Table 14: Basic funds provided by the Länder and by local governments for science, by functions and Länder	655
	Table 15: open	
	Table 16: Intramural R&D expenditure by the business enterprise sector, and proportion of self-financed intramural R&D expenditure, by economic activity	662
	Table 17: R&D expenditure of the business enterprise sector, by economic activities (intramural and total R&D expenditure)	664
	Table 18: Work force, revenue and intramural R&D expenditure of business enterprises, by economic activities and company-workforce size	667
	Table 19: open	
	Table 20a: Higher education expenditure on teaching and research, by type of higher education institution	676
	Table 20b: Expenditures of higher education institutions on research and development	679
	Table 21a: Expenditure of non-university science institutions, by types of expenditure	680
	Table 21b: Expenditure of non-university science institutions, by areas of science	685
	Table 22: Receipts from, and expenditure on, patents, inventions and processes (excluding copyrights) in the Federal Republic of Germany, by economic activities	690
	Table 23: Receipts from, and expenditure on, patents, inventions and processes (excluding copyrights) in the Federal Republic of Germany, by major partner countries	692
	Table 24: Germany's receipts from, and expenditure on, technical research and development, in foreign trade, by economic activities and groups of countries	696
	Table 25: Gross domestic expenditure on research and development in selected OECD countries, by financing and performing sectors	700
	Table 26: Government expenditure on research and development in selected European Union countries, in 2003, by research objectives	703
	Table 27: Government expenditure on research and development in selected European Union countries, by various criteria	705
	Table 28: Patents and licenses in the balances of payments of elected countries	709

	Page	
Table 29a:	R&D personnel, by groups of persons and by sectors	711
Table 29b:	R&D personnel by sex, by sectors and by personnel groups	713
Table 30:	R&D personnel in the business enterprise sector, by economic activities	714
Table 31:	R&D personnel in the business enterprise sector, by occupations and economic activities	716
Table 32:	R&D personnel in institutions for co-operative industrial research and experimental development, by occupations and economic activities	720
Table 33:	Higher education personnel, by occupations and fields of science	723
Table 34:	Personnel of non-university science institutions, by institutions and	729
Table 35:	Personnel of non-university science institutions, by institutions and fields of science	737
Table 36:	open	
Table 37:	open	
Table 38:	R&D personnel in selected OECD countries, by occupations and sectors of employment	742
Table 39:	Federal R&D expenditure – regional breakdown	744
Table 40:	Länder R&D expenditure – regional breakdown	745
Table 41:	R&D expenditure for all of the Federal Republic of Germany – regional breakdown	746
Table 42:	Intramural R&D expenditures of the business enterprise sector – regional breakdown by host countries of research locations	747
Table 43:	R&D expenditure of higher education institutions – regional breakdown	748
Table 44:	Regional breakdown of R&D expenditure of non-university science institutions	749
Table 45:	Total R&D personnel of the Federal Republic of Germany – regional breakdown	750
Table 46:	Regional breakdown of R&D personnel in the business enterprise sector, by economic activities	751
Table 47:	R&D personnel of higher education institutions – regional breakdown	760
Table 48:	Regional breakdown of R&D personnel of non-university science institutions	761
Table 49:	World market shares of selected OECD countries for R&D-intensive goods	762
Table 50a:	Basic data for the education sector	766
Table 50b:	Budget of the Federal Republic of Germany for education, research and science, by performing institutions	767
Table 50c:	2003 budget of the Federal Republic of Germany for education, research and science, by financing institutions	768
Table 51a:	Indices for population, employment and economic activity	769
Table 51b:	Population, employment and gross domestic product	770
Table 52a:	Number of new students as a percentage of the relevant age group (ISCED 5A) – an international comparison	773
Table 52b:	Numbers of new students in Germany – absolute and as a percentage of the relevant age group (ISCED 5A), by subject groups and areas of studies	774
Table 53a:	Number of university graduates as a percentage of the relevant age group (ISCED 5A) – an international comparison	776
Table 53b:	Numbers of university graduates in Germany – absolute and as a percentage of the relevant age group (ISCED 5A), by subject groups and areas of studies	777
Table 54:	Employment of highly qualified people in knowledge-intensive industry sectors in Germany	779
Table 55:	Number of scientific publications per million inhabitants	780
Table 56:	Patents relevant to the global market – an international comparison	781
Table 57a:	Indices for innovation in the mining and manufacturing sectors	782
Table 57b:	Indices relative to innovation in the business-to-business services sector, 1998 – 2004	784
Table 58:	Start-ups in research-intensive and knowledge-intensive industry sectors in Germany	786
Table 59:	The research-intensive sector's contribution to the foreign trade balance, in selected industrialised countries	787
Table 60:	Production and employment in Germany's research-intensive industrial sector	788

## List of figures

## List of abbreviations

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