



Bundesministerium  
für Bildung  
und Forschung

# **Education, Research, Innovation – Shaping our Future**

*Education and Research Policy Priorities of the  
Federal Ministry of Education and Research (BMBWF)  
in the 15th Legislative Period*

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## ***Education, Research, Innovation – Shaping our Future***

*Education and Research Policy Priorities of the Federal Ministry of Education and Research (BMBF) in the 15th Legislative Period*

### ***Making Germany strong - economically, socially and ecologically***

The Federal Government wants Germany to be strong – economically, socially and ecologically. Our guiding principles are: renewal – justice – sustainability. We are facing two central challenges: firstly, we want to strengthen our country's position in the global competition, create new jobs and protect and enhance our standard of living. Secondly, we must orient all of our actions to the goal of keeping our planet healthy, so that coming generations will have lives worth living.

Education and research policy plays a key role in meeting such challenges. We are relying on the knowledge, ability and creativity of the people in our country. We want the best-possible education for all, an education system that supports each person's capabilities, regardless of ethnic or social background. This is an area in which the Länder are called on to act; the Federal Government will continue to support them as they make their own necessary efforts in these areas.

We need a powerful, innovative research system. Research produces ideas and concepts for new products, processes and services. At the same time, research must produce results that benefit people and society and that contribute to sustainable development. Strong basic research lays the foundation for the innovations of tomorrow.

Education and research continue to be priorities for us. Since 1998, we have increased future-oriented investments in education and research by more than 25%, and we have implemented many structural reforms. We plan to continue on this course.

We plan to pursue five central aims in this legislative period:

1. Promoting and challenging talent – achieving equal opportunity;
2. Modernising education and research structures – promoting quality for international competition;
3. Promoting technologies for new markets – creating jobs with a future;
4. Research for people and the environment – shaping a future truly worth living;
5. Strengthening centres of growth – moving eastern Germany ahead through education, research and innovation.

More and more, our country's present and future are closely tied up with events in neighbouring European countries and with global developments. Increasingly, this relationship is affecting the everyday lives of each person, just as it affects actions in the areas of education, science, research and the economy. For this reason, all players must develop strategies for active partnership in Europe and with the world. Excellence and a real future perspective can no longer be achieved without internationalisation.

## Promoting and challenging talent – achieving equal opportunity

*If we stopped training young scientists, we would soon have no top-quality research. If we stopped training skilled employees, we would soon have poorly performing companies. We need well-educated and well-trained people in Germany, on all levels and in all areas. Well-educated and well-trained people are our most important resource for the future. They are the basis for our social, economic and cultural development.*

*Education and training have a central impact on personal life opportunities. Education is the key to the employment market. Education enables people to participate constructively in society. And: education imparts values and orientation in an increasingly complex world. This is why we want the best education, training and further training for all people – regardless of where they live and how much they earn.*

*We want*

- *individual education of children to begin as early as possible,*
- *all young people to train for an occupation,*
- *more young people to go on to higher education,*
- *our young scientists to be internationally competitive,*
- *women to have equal opportunities in science and industry,*
- *the ideal of lifelong learning to be within everyone's reach.*

It is never too early – and never too late – to begin promoting and encouraging talent. And education for the gifted and education for the masses must go hand-in-hand, if our future needs for qualified persons are to be met. Our guiding principles are: achieving equal opportunity, and promoting and challenging talent.

In the past legislative period, we agreed on central principles within the "Education Forum" ("Forum Bildung") and the "Alliance for Jobs, Training and Competitiveness" ("Bündnis für Arbeit, Ausbildung und Wettbewerbsfähigkeit"). The Länder are called on to invest more in the future of our children, young people and students. But improving quality is not simply a matter of providing additional resources; resources must be applied efficiently, as the most recent edition of the OECD's "Education at a Glance" has again underscored. The Federal Government plans to continue supporting the Länder in this matter. Business and industry must fulfil the commitments they have made within the national consensus on training and they must considerably increase the numbers of available company training places. Here as well, we stand ready to support such efforts by means of projects and programmes.

### 1. We want to promote all talent as early as possible

#### **Why?**

The first few years of a person's life play a central role in the development of his or her individual talents. And existing talents can grow only if they are detected and promoted on time.

In the early phase of a person's life, his or her parents must take primary responsibility for promoting his or her interests and willingness to learn. We do not want to leave parents alone with this task; parents must be able to balance families and careers. Those who would make parents choose between family and career overlook economic and social realities. Our society is charged with ensuring that we give the next generation the best

possible opportunities to be prepared for a world in which knowledge is becoming ever more important.

The PISA study showed us very clearly that we have been investing too little, in comparison with other countries, in our children's early education. The results of this neglect manifest themselves as poor reading, writing and mathematics skills, and as poor problem-solving abilities in later years of life. Both individual citizens and society as a whole suffer from this development. It is thus especially important to improve kindergarten and primary school education.

### **How?**

- ◆ We plan to improve, significantly, programmes for children younger than 3, as well as day-care-centre education for children older than 3, in cooperation with the Länder and municipalities. In cooperation with the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ), we plan to invite all players in the area of children's education – including the Länder, municipalities, non-state providers, companies and parents' representatives – to a **summit on education and child care**. At this summit, we plan to reach agreements on appropriate, high-quality education and care for children before they enter primary school. In the process, we will explore whether demand-oriented financing instruments (such as child-care vouchers) can better meet parents' and children's interests with respect to children's education and care.
- ◆ We plan to improve school learning environments and instruction quality by considerably expanding the **availability of all-day schools**. All-day schools with clear instructional profiles permit effective, individual support and assistance. They provide more time for learning, as well as space for a new culture of teaching and learning and more intensive participation by parents.

With the **"Future of education and all-day school"** ("Zukunft Bildung und Betreuung") investment programme, we are thus supporting the establishment of additional all-day schools in the primary and secondary I sectors, with total investments of €4 billion from 2003 to 2007. With this effort, we are providing the initiative for a suitable range of all-day schools in all of Germany's regions.

- ◆ Within the framework of a Federal Government / Länder action programme for improving instruction, we plan to provide special support for development of both **language, reading and writing skills** and **mathematics and science skills**. Another emphasis of this effort is on supporting and assisting migrants.
- ◆ The lead vision **"Understanding Thought Processes"** will focus on brain research and integrate central issues of learning research and pedagogy. In this funding priority, we plan to have scientists work together with humanities and education specialists. The very rapid development of brain research is already yielding findings that must go into learning research.
- ◆ In the area of **support for the gifted**, we plan to maintain the high level of support achieved in the past legislative period. National competitions such as "Jugend forscht" awaken young people's interest in education and research. They thus provide incentives to young people with an interest in science and encourage them to excel at an early age.

## 2. We want to give all young people the opportunity to train for an occupation

### *Why?*

Solid training is a foundation for a successful, responsible life and for participation in society. A qualification earned through formal training provides the best protection against unemployment. In comparison with people with qualifications, people who fail to complete their training face nearly three times the risk of becoming unemployed.

As a result of demographic trends, the situation in the market for training places will vary widely by region in the next few years. Whereas in some regions companies are facing shortages of trainees and skilled employees, many other regions still have shortages of training places.

### *How?*

- ◆ In a continuation of our national consensus on training, we continue to believe that industry has the primary responsibility for providing an adequate number of training places, and we will increasingly insist that this responsibility be fulfilled. At the same time, we will use **programmes and projects** to support development of company training places oriented to regional qualification requirements. **Publicly financed training-place programmes** will be designed more closely in line with companies' needs and oriented more strongly to regional economic and employment structures and to companies' demand for qualifications. This effort will include such important elements as supporting training networks and convincing companies that have not yet offered training to begin doing so.
- ◆ We plan to enhance school pupils' training readiness by means of **early career orientation** and thereby to facilitate transitions from school to vocational training. The **"career-choice passport"** (Berufswahlpass) developed in the "School-Economy /Working Life" programme, in cooperation with the Länder (Federal Government / Länder pilot project for documentation of all career-orientation measures of school pupils) is to be introduced on the broadest possible basis in this legislative period.
- ◆ At present, some 15% of all young people and young adults fail to earn a training qualification. In keeping with the European Employment Guidelines, we want to cut this percentage in half by the year 2010. With the programme **"Promoting competencies – vocational qualification for target groups with special support requirements"** (BQF programme), we plan to improve support structures in training preparation, expand support measures for migrants, convince more companies to offer training for the disadvantaged and strengthen schools' own precautionary measures for guarding against failure to complete training and thus against unemployment.
- ◆ By means of a new **system of qualification modules** for linking and crediting training preparation and vocational training, we want to give disadvantaged young people a real perspective for training and employment. The aim is to enable such people to earn a full-fledged vocational training qualification.

### 3. We want to encourage more people to go on to higher education

#### *Why?*

The future of our economy and society depends decisively on the qualification level of our population. Growing requirements in the employment market call for intensified efforts to encourage young people to go on to higher education. By the year 2015, Germany will need 2.4 million more qualified employees than it now does. Nearly one million of these people will have to have completed higher education. To meet this requirement, we must encourage more young adults to begin university studies and to complete them successfully. On the average in all OECD member states, 44% of all persons in an age group begin university studies. In Germany, the corresponding figure grew from 27.7% in 1998 to 35.6% (OECD data) for the 2002 academic year. We want this figure to reach at least 40% within the coming years. At the same time, we want to reduce the numbers of people who discontinue their studies and we want to shorten university study periods.

#### *How?*

- ◆ Young people justifiably expect our universities to offer them an education that is of high quality, has a practical orientation and includes an international perspective. For this reason, we plan to offer the Länder a **"Pact for Universities"**. We plan for this pact to include an agreement on the following four aims:
  - Comprehensive improvement of conditions for studies (two-tier degree structure, higher-quality study programmes and better support for students) to reduce the percentage of students who discontinue their studies and to shorten university study periods;
  - A consistent system for promoting and supporting young scientists;
  - Further internationalisation of our higher education institutions;
  - Strengthening of universities' autonomy and profile development.
- ◆ We also plan to make further progress in **expanding access to higher education** for vocationally qualified persons, as agreed on by the Federal Government and the Länder, and in crediting relevant qualifications toward studies (see also page 13).
- ◆ By improving individual support of students, via **reform of the Federal Training Assistance Act** (BAföG), the Federal Government and the Länder have already taken measures to reduce obstacles to university studies. For example, figures on training support in 2000/2001 show that the number of supported students increased by nearly 60,000. We plan to build on this positive development in numbers of people receiving support and in the average amounts of support provided.

The **training loan programme** introduced in 2001 has proven to be a flexible, unbureaucratic instrument that is being used effectively and efficiently to overcome temporary financing shortages. We thus plan to consider additional possibilities for flexibilisation – for example, with respect to age limits as well as periods and maximum amounts of support.

#### 4. We want to offer young scientists attractive perspectives

##### *Why?*

Germany will be able to maintain its position as a leading nation in science and industry only if a great many of its young people receive the opportunity for high-quality academic education. Talented young scientists must be prepared, via efficient support, for later leadership in science, industry, culture and society. Germany needs top-quality people in all areas. For this reason, we increased our funding for doctoral and post-doctoral training by over 40%, to nearly €990 million, between 1998 und 2001.

Young scientists' decisions in favour of German research establishments are influenced by many factors. If Germany is to become more attractive for excellent young scientists, from both Germany and abroad, we must give young scientists early opportunities to move from dependent research to independent research projects. By introducing "junior professorships", we have given young scientists the opportunity to begin independent research and teaching at age 30 – i.e. ten years earlier that was formerly the case. We have provided a total of €180 million for the junior-professor programme. This year, it will be possible to support over 620 young scientists, at over 50 German universities. Transitions from junior professorships to academic chairs must be made more reliable. Qualification pathways for doctoral students and post-docs must be redesigned to produce a coordinated system of support for young scientists. We must offer perspectives for longer-term career planning.

##### *How?*

- ◆ High-quality, structured **doctoral training** plays a central role in ensuring that we have adequate numbers of young scientists. For this reason, in the coming years we will give high priority to improving the organisation of the doctoral-studies phase. This effort will include provision of particularly attractive grants, intended to attract more doctoral students in shortage subjects, and establishment of postgraduate research groups (Graduiererkollegs).
- ◆ Within the framework of the BMBF's **specialised programmes**, we will continue to provide funding for cooperation projects involving industry, higher education institutions and non-university institutions, for qualification of young scientists, so that we will be able to respond quickly to shortages of young scientists.
- ◆ The **Emmy Noether programme** has been a success. It is an attractive way for young scientists to gain research experience abroad and then to work in Germany.
- ◆ To ensure our success in the competition for the world's top scientists, we will give our established and new **top prizes** an international orientation and ensure that these prizes have long-term funding.

## 5. We want equal opportunity for women in science and industry

### *Why?*

Today, more young women than young men obtain a higher education entrance qualification (Abitur). More women than men begin higher education studies. And in recent years women have also caught up with men in the later stages of the educational path, the entryway into science. One out of every three doctoral theses is now written by a woman. On the other hand, only one out of every five habilitation theses is written by a woman, and women hold only one out of every nine professorships. Only 20% of students in technical subject areas and in physics are women. The current discussion about the shortage of skilled people highlights the necessity of developing the promise that women hold for our country. Equal opportunity for women is not only a dictate of social justice, it is also an important factor in the success of science and research and thus in our country's economy. For this reason, we are making every effort to ensure that necessary measures to enable women to balance families and careers are expanded – in universities and research establishments and in continuing vocational training.

### *How?*

- ◆ The **percentage of professors who are women** has increased from 9% in 1998 to 11% at present. We plan to continue increasing this percentage significantly. In the Centre of Excellence Women and Science (CEWS), which we are supporting, we have provided a national coordination, information and advising agency for this purpose.
- ◆ Via the programme **"Impetus for advancement – career strategies for women scientists"**, we offer a specifically targeted mentor programme that helps young women scientists at universities and research institutions apply successfully for management positions.
- ◆ We plan to significantly increase the **percentages of women in technical and natural scientific studies and training programmes**. The competence centre "Women in the information society and technology" is coordinating and linking relevant measures. We plan to expand the availability of innovative study courses for women in the natural sciences and engineering and in information technology. The same applies to women's and gender studies. In addition, we are promoting the development of special course offerings for women in technical professions.
- ◆ In the interest of equal opportunity for women and men in the workplace, the availability of **continuing vocational training** must be improved – especially by companies themselves – and also for women in phases of family-related career interruption or part-time employment. The aim is to open up more opportunities for career development, also in order to increase the percentages of women in management positions.
- ◆ By supporting an **information and service centre devoted to women's start-ups**, we plan to create the necessary structures for effective support of women who start their own companies.

## 6. We want to give all people opportunities and incentives for lifelong learning

### *Why?*

The knowledge society is changing people's living conditions. New structures are appearing in almost all areas of life, because working life, economic activities and social interactions are depending more and more on use of knowledge. The importance of education is changing. Initial training no longer provides an adequate basis for an entire working life. On the other hand, this means that those for whom lifelong learning is an everyday reality can continually improve their educational levels and opportunities for career advancement. And a modularised educational system, with seamless transitions between different learning phases, can help people to overcome initial disadvantages.

### *How?*

- ◆ We plan to prepare proposals for **financing lifelong learning**. The results of the experts' commission appointed in October 2001 will provide the necessary basis for this. The commission will present financing models by the end of 2003.
- ◆ In the area of **further training**, we want to develop and implement more modular concepts. Further-training modules, which can also be used to earn additional qualifications during initial training, will improve links between initial and further training. They will also help open up flexible, diverse pathways for development to higher qualifications and gradual achievement of further-training qualifications. In addition, we plan to review whether this approach can be used to create improved second-chance programmes for adults – for example, for migrants.
- ◆ Self-guided, independent learning, as well as institutionalised learning, require users to make choices that can be sensibly made only when **educational programmes are transparent**. With our initiative to ensure transparency and quality in **further training**, we plan to expand development of relevant quality assurance management. This is also the context for the **"Department for testing educational programmes"**, which we are supporting, in the "Stiftung Warentest".
- ◆ Further-training programmes must meet minimum **quality** standards. For this reason, we need **accreditation and certification systems** for providers and products and for individually acquired skills. By March 2003, we plan to implement the recommendations of the Hartz Commission for further training supported pursuant to Vol. III of the Social Code (SGB) – by means of a legally enshrined, graduated certification system.

In a further step, we are seeking to establish, in this legislative period, a nation-wide certification system for quality assurance in **all further training**.

- ◆ In the area of **continuing education**, we are working with the Länder to develop accreditation models, oriented specifically to the learning process, for quality assurance purposes. This project is also to be implemented, on a broad basis, in this legislative period.

- ◆ Suitable procedures should be in place to record and credit **informally acquired skills** – for example, skills acquired through learning on the job. With such procedures, relevant skills will improve employability and can be credited within the system of formal further training. We plan to support the development of the necessary bases for this with the programme "Learning culture for skill development" ("Lernkultur Kompetenzentwicklung"). At the same time, we are working with the Länder to develop a nationally applicable concept for a so-called "Lifelong learning passport" (documenting all acquired skills) that will include results of informal learning.
- ◆ In our era, knowledge is becoming obsolete at shorter and shorter intervals. New media are changing the possibilities and requirements for learning. With the **lead vision "Tomorrow's Worlds of Learning"**, we want to act early to set the right course to strengthen learners' own self-guidance and independent responsibility.

## Modernising education and research structures – promoting quality for international competition

*Without a highly capable education and research system, we will lack people with quality training. Unless we are able to change and adapt, we will make no real progress. Only those who are willing to compare themselves to the world's best have a chance to keep on developing and to stay competitive. We want Germany to be an international leader in education and research.*

*In light of relevant international developments, not only does Germany urgently need a cross-Länder education/research system architecture, its education and research systems must also be compatible with international structures. There can be no excellence and future perspective without internationalisation.*

*We want*

- *Germany to be among the five leading nations in the area of education, within 10 years,*
- *Our education and research systems to become more modern, capable and transparent,*
- *To intensify the links between our education and research systems,*
- *The European Education and Research Area to become a reality,*
- *Our universities and research establishments to be seen, internationally, as beacons in education and research.*

We must have a coherent system in which general education, vocational training, higher education and continuing education can be acquired and individually structured. This system must be designed to give each person a second and even third chance when necessary.

And the basically successful structures of the German research system must remain adaptable, in light of the global competition in science. Within the system, we must create the basis for more competition – and for more cooperation and networking.

High-quality basic research is an important part of any innovative research sector. Basic research is what produces truly new things and develops the real innovations of tomorrow. Our universities are still one of the pillars of our basic research sector. Via the Deutsche

Forschungsgemeinschaft, we plan to strengthen this area further. Important contributions to this effort will also be made by non-university research establishments – especially the Max Planck Society, the Helmholtz Association of National Research Centres and the institutes of the Fraunhofer Gesellschaft and of the "Blue List".

We plan to make full use of the OECD's international performance comparisons, of agreements on international standards within the UNESCO framework and of the EU's benchmarking processes in order to optimise education and research in Germany. University studies and research, and vocational training and continuing training, in our country must again establish international standards of quality. We will succeed in this effort only if we define quality through objective standards and ensure compliance with such standards via evaluations.

Science and research require an innovation-friendly framework. International standards and agreements are having an increasing impact on our research and education system. We need to integrate our ideas and concepts within co-ordination processes taking place at the EU and global levels, and we must take an active role in shaping such processes.

## 1. We want to work with the Länder to develop a high-quality school system with national standards

### *Why?*

PISA, and the internal comparative study for Germany, PISA E, clearly showed us the weaknesses of the German school system: pupils at German schools perform below average, in central areas, when compared internationally. And in no other country does social background play such an important role in deciding children's school pathways and educational success as it does in Germany. None of our Länder has any reason to be satisfied.

### *How?*

- ◆ To develop our educational system systematically and efficiently, we must introduce ***national education and performance standards***. We have commissioned a study to this end, and we plan to discuss its results with the Länder, with regard to what the next steps should be. Implementation of national education and performance standards will be reviewed regularly by an independent ***evaluation agency*** that we plan to develop in cooperation with the Länder. Only in this way can we safeguard the quality of our educational sector in the long term.
- ◆ Evaluation results also provide the basis for regular, ***national reporting on education***, which Germany still lacks – in contrast to all the countries that were successful in the PISA study. In keeping with a formal request of the German Bundestag, we plan to appoint an independent Council of Educational Advisors ("Rat der Bildungsweisen") in cooperation with the Länder. This Council will regularly publish reports with recommendations for development of Germany's education sector.

## 2. We want to modernise our vocational training system

### *Why?*

Some 66% of our young people begin in-company training within the dual system, and some 10% begin fully qualifying vocational training at full-time vocational schools or health-care-system schools. These highly practically oriented forms of vocational training have retained their importance, in spite of the growing numbers of people who begin university studies.

The high standards of our vocational training system are recognised internationally. In particular, the dual system of vocational training prepares young people for their transition from training to employment in a manner that is seen as exemplary, world-wide. Nonetheless, in the interest of our young people, we must carefully and critically review whether our vocational training system structures are still in line with the requirements of modern educational pathways and occupational careers. The main points to consider are: lifelong learning; the need for acquisition of broad, specialised skills and of key and additional qualifications; and increasing mobility in Europe. We need increased flexibility and transparency within our training and further training system.

And we do not want to ignore the problems we have long been facing in our vocational training system: many of our vocational schools lack modern equipment; coordination and cooperation between training companies, part-time vocational schools, inter-company training centres and extra-company training institutions are often inadequate; regional development of training places is often poorly linked with regional economic structural development; there is no transparent, constant review of the quality of training and examinations; the difficult market for training places tends to force out weaker achievers; we lack an integrated funding approach – numerous, often uncoordinated support efforts are made in general schools, via assistance programmes for youth, in vocational preparation and vocational training, in employment promotion and via return-to-learn programmes.

### *How?*

- ◆ We plan to move ahead with the vocational training reform we began in the past legislative period, as well as with modernisation and flexibilisation of vocational training and enhancement of its transparency. To accomplish this, we need comprehensive **amendment of vocational training law** (Vocational Training Act, Vocational Training Promotion Act and, possibly, the Upgrading Training Assistance Act). We are aiming to have the necessary measures and amendments underway by early 2004.
- ◆ We plan to implement those improvements rapidly that lend themselves to short-term implementation. Such improvements include broad-based testing of the new **two-layer examinations** (i.e. early taking of parts of final examinations). In addition, we plan to urge the Länder and the social partners to credit relevant vocational schoolwork toward final examinations.
- ◆ We also plan to adapt existing **training occupations** to new requirements and to create new occupations. Together with the concerned parties, we will look for ways of further shortening preparation of reorganisation procedures and final deliberations with the social partners and the Länder, in order to streamline the modernisation procedures still further. Together with the social partners, we will explore other areas in which additional training occupations for qualified skilled employees are becoming necessary. To this end, we will make use of possibilities, as provided for in the Vocational Training

Act, for two-year and three-year training programmes and for graduated training. We will continue working to make training structures more flexible – for example, through addition of elective components.

- ◆ With our initiative "**Early recognition of qualification requirements**", we plan to support the modernisation process in the area of training and further training. Emerging changes in qualification requirements, in the employment market, will be studied with the aim of developing policy options, early on, for training and further training.
- ◆ Toward the end of the 1990s, a shortage of highly qualified skilled employees proved to be a central barrier to innovation, especially for small and medium-sized enterprises. We must develop instruments with which we can recognise requirements for skilled employees, in early phases, and respond accordingly. We will support relevant efforts of the Bund-Länder Commission for Educational Planning and Research Promotion (BLK). We will continue to support **expansion of training capacities in information technology and engineering** occupations.

### 3. We want to make our universities internationally attractive

#### **Why?**

Universities are the foundation of Germany's research system. They provide the basis for scientific, technological, social and economic innovation. At the same time, by training highly qualified people, universities contribute significantly to our country's economic stability and future perspectives.

As we continue to develop our universities, we are emphasising a maximum degree of autonomy, competition and independent profile formation, instead of state control. The state has stopped micro-managing universities. On the other hand, universities must document the quality of their work. For this reason, regular evaluations of research and teaching, and comparative rankings, must become routine.

If our universities are to become internationally attractive, they must offer students and professors alike modern facilities with excellent equipment for learning and research. Since 1998, we have increased funding for university construction by more than 19%. We have given enormous impetus to development of multimedia, virtual instruction via our programme for investment in the future (Zukunftsinvestitionsprogramm). With the establishment of the G-Win gigabit science network and the Dante European consortium, in which Germany has a key role, our universities are now linked within a scientific communication network that is equivalent to that of the U.S..

#### **How?**

- ◆ To further improve the quality of university studies, we are offering the Länder a **Pact for Universities** (see also page 5). The university and science programme (HWP) will be continued, in cooperation with the Länder, until 2006. With this programme, in conjunction with measures under the programme for investment in the future of universities (new media in higher education, notebook universities, university marketing, research centres and patent-exploitation agencies (PVA), a structurally effective innovation package for our universities is taking shape.

In return, we expect universities to subject themselves to comparative **ranking**. By this we mean evaluation of research and teaching performance, in the various subjects, in accordance with measurable criteria. The aim is to develop a meaningful, differentiated

ranking system that will make it possible to rank subjects at the various universities, with respect to both teaching and research, in a standardised nation-wide system.

- ◆ With their orientation to application and actual practice, universities of applied sciences (Fachhochschulen) fulfil an important function in the higher education system. We want to promote this type of university. The programme for **support of applied research and development at universities of applied sciences** will be continued, in cooperation with the Länder.
- ◆ We want to enhance the international orientation of our quality assurance and recognition of study periods and qualifications, especially within the framework of the **Bologna process**.
- ◆ Within the framework of **international negotiations on trade in services (GATS)**, we plan to work to ensure that the structure of Germany's publicly financed higher education system can be maintained, in principle, and that private educational programmes also have to comply with quality standards.

#### 4. We want to enhance the transparency of the education system

##### **Why?**

In improving our education system – vocational training, university studies, continuing education – we must overcome the existing strict separation between different sectors and keep opportunities open at all times. The answers to the challenges and requirements of lifelong learning include orientation to users, promotion of individual responsibility and enhancement of transparency and equivalence of educational pathways. We want to create more flexible pathways for career development, with transfer opportunities at the interfaces between training preparation, vocational training, continuing education and higher education. In the long term, we want to lead more people, via transparency and transfer opportunities, to higher qualifications.

##### **How?**

- ◆ The Bund-Länder Commission (BLK) and the Education Forum agreed to **expand access to higher education** for vocationally qualified people and to credit relevant vocational qualifications toward studies – for example, within the framework of credit systems. We plan to call for and work toward such broader access to higher education.
- ◆ International comparative studies in the education sector have also shown that we in Germany know too little about our educational system and, especially, about its performance. For this reason, we plan to strengthen empirical **education research**. To this end, we must effectively encourage and promote young scientists, since at present we do not have enough scientists working in this area. Research must begin giving greater attention to issues that are important with regard to steering the education system: what characterises the transfers within the education system and between the education and employment systems? How do educational careers normally proceed? What impact does the environment have on design of successful teaching and learning processes?

## 5. We want to make the non-university research landscape more competitive and transparent

### *Why?*

Evaluation of research organisations in recent years has clearly shown that our research sector, when compared internationally, is highly differentiated and complex. If this multi-layered system is to remain vital, research institutions must be adaptable, and individual research organisations must remain transparent. Performance must be documented in competitively oriented procedures that are transparent and oriented to international quality standards. This is the only way for our research institutions to survive and be attractive within intensifying international competition.

### *How?*

- ◆ We want to build on the success of **programme-oriented support**, as introduced by the Helmholtz Association of National Research Centres, in operative implementation. This applies to the process of prioritisation and external evaluation of competitive programme proposals, a process which has had impressive initial success, and to scientifically adequate controlling processes that provide the basis for enterprise-like flexibilisation. If this reform is successful, it will serve as an international model for development of new concepts in research financing.
- ◆ To continue developing our strengths, we need **a more strongly networked, joint strategic approach** taken by all research organisations in Germany. This must involve several elements:
  - The various involved players must have a **joint basis for strategic planning**. This means that they must consult with each other regarding their relevant priorities and priority-derived programmes. **Consultation processes** must continue to be strengthened; the Science Council is currently developing concepts for relevant procedures.
  - Existing efforts to achieve work-sharing and joint approaches to programme implementation must be fundamentally intensified and given new concepts. Concepts for programme-related **virtual institutes and joint, temporary research units**, especially involving cooperation between universities and Helmholtz Centres, must be refined. With its **"Impetus and networking fund"** ("Impuls- und Vernetzungsfonds") for cooperation with universities and other research institutions, the Helmholtz Association of National Research Centres has developed innovative concepts that should be pursued further.
  - Ultimately, networking and work-sharing also necessitate comparable **procedures for evaluating** work undertaken and financed jointly. The Helmholtz Association of National Research Centres, the Fraunhofer Gesellschaft, the Max Planck Society and the Gottfried Wilhelm Leibniz Science Association have all developed their own specific procedures, which have proven successful, for planning and evaluation; on this basis, we must develop comparative, overarching evaluation criteria, with the assistance of the Science Council.

- ◆ We plan to design the **framework conditions for staff** in a way that is **adequate to the needs of science**. The new, more performance-oriented elements of compensation for professors must be transferred to compensation of senior scientists and science managers at non-university research institutions. For staff of universities and research institutions, who currently fall under the Federal Collective Agreement for Public Employees (BAT), we wish to create a modern, standardised system of hiring and working conditions, by means of a **collective agreement for the science sector**. With this approach, we want to meet the needs of universities as well as those of research institutions, which function as innovative research companies. The need for action arises from the increasing difficulties of research institutions and universities in obtaining and retaining highly qualified staff and from the obstacles to mobility between science and industry. Our aim is to create, rapidly, conditions that reflect the realities of the highly dynamic employment market in the science and research sectors.
- ◆ One important instrument for improving links between university and non-university research is personnel-based cooperation in the form of **joint appointments**. In keeping with recommendations made in the DFG/MPG system evaluation, such cooperation on the personnel level must be expanded and adapted to newly designed qualification pathways – for example, through joint appointment of junior professors.
- ◆ A high-quality research sector requires a **modern research infrastructure**. We plan to expand and modernise our research infrastructure.

In many scientific and technical disciplines – and, increasingly, also in the life sciences – high-quality **large-scale facilities** are the key to successful research. All researchers, especially those in the higher education sector, must have access to the best and most powerful research equipment, in keeping with the scientific quality and originality of their research projects.

In light of the high costs involved, particularly complex **large-scale experimental facilities** can be planned only in a European (or even global) framework. We want to ensure that, in site selection, Germany is appropriately considered, in keeping with its scientific and economic importance. Use should be made of the possibilities provided by the European Union's Sixth Framework Programme for Research. We must develop reliable, use-oriented financing concepts for such infrastructures.

## 6. We want to intensify the links between our education and research systems

### **Why?**

To have a successful innovation process, we must have well-trained, motivated specialists who are able to apply their experience and to develop their expertise in step with accelerated innovation and product life cycles. Fast, unhindered access to relevant knowledge is becoming a determining factor, and successful knowledge management and creative knowledge networking are becoming strategic pillars of the innovation process.

At the same time, education and qualifications determine the extent to which people accept new technological developments – in both their private and workplace environments. Diffusion of technologies can be accelerated by this relationship – or slowed and blocked.

### **How?**

- ◆ We must **promote interest in education and research**, by making the public, and especially our youth, aware of the fascination of research. The "Years of Science", which have begun with the Year of Physics and the Year of Life Sciences, should thus be continued (see also page 29).
- ◆ We plan to present a **"Knowledge Society 2006" framework concept**. With this concept, we aim to provide easier access to information (for example, through establishment of specific knowledge platforms, and through contributions to the establishment of the digital library) and to improve relevant networking (for example, by developing the science network into an open infrastructure for education and research, by supporting the work of competence networks linking science and industry and by refining methods and services for distribution and processing of scientific data).
- ◆ Where necessary, we plan to integrate **measures for training and further training**, and for **attracting young scientists**, in our specialised programmes.

## **7. We want to make the European Education and Research Area a reality**

### **Why?**

At their meeting in Lisbon, the heads of government of EC member states established the goal of making Europe the world's most competitive and dynamic knowledge-based economic area by the year 2010. Only by pursuing this goal can we compete with countries such as the U.S. or Japan. The European Education and Research Area will play a central role in achieving this aim. We want to take an active role in making the European Education and Research Area a reality, in refining its design and, in the process, in promoting integration of central, eastern and south-eastern European countries.

### **How?**

- ◆ We are seeking strong German participation in the **Sixth Framework Programme for Research**. To this end, we have established a nation-wide network of national contact points that will assist German applicants, in the early stages of their applications, in optimally using the possibilities afforded by the Sixth Framework Programme. Germany's science and industry sectors are called on to take an active role in integrated projects and networks of excellence, and to assume consortial leadership as often as possible.
- ◆ In the pending review of the **EU's Framework for State Aid**, we are supporting generous, unbureaucratic treatment of research grants, so that state and industry investments in research and development can move forward.
- ◆ The large **multilateral research institutions** in Europe, such as CERN, ESA, ESO, EMBL, EMBC, ILL, ESRF, are excellent examples of research cooperation in Europe. The Large Hadron Collider (LHC) at CERN, and ESO's Atacama Large Millimeter Array (ALMA), can even be considered global projects, since countries from other parts of the world are involved in their construction and financing. We must safeguard and strengthen the quality of the research infrastructures of these institutions. These

research infrastructures are open to users from all research institutions, and they contribute to the high standard of scientific training.

- ◆ We continue to support intensified cooperation between the **European Space Agency (ESA)** and the European Union. We must ensure success of the two pilot projects in this cooperation, the **GALILEO** satellite navigation project and the Global Monitoring for Environment and Security project (**GMES**).

With regard to the **ARIANE** European launcher, we are working closely with France to find a solution that gives Europe access to outer space under economically acceptable conditions. We also consider it important for the involved space companies to carry out development, construction and operation of space transportation systems under their own responsibility, to the greatest possible extent, and to make use of all potential for efficiency and cost reduction.

According to current planning, the **COLUMBUS** European research module is to dock with the International Space Station at the end of 2004. In negotiations with our partners, we will insist that the station provide an adequate basis for use of the research laboratory.

- ◆ Within the framework of the European "**Brügge Initiative**", we plan to carry out new measures in the areas of crediting and transparency of qualifications. We plan to spur development of transborder vocational training programmes, promotion of lifelong learning and occupation-related foreign-language learning. With regard to the new generation of EU education programmes (SOCRATES, LEONARDO), we are seeking a considerable increase in funding for mobility measures, so that more trainees can be qualified internationally.

## 8. We want to strengthen internationalisation in education and research

### Why?

Science and industry depend on being able to work closely with international partners. Internationalisation must thus be a standard guiding principle for all. Our science and research sectors must be supported in expanding their cooperation within Europe and world-wide. We are aiming to be a driving force in the international "brain circle". We want our talented people to be able to gather experience abroad, and we want foreign experts and specialists to come to our country with their knowledge and experience.

By no later than the end of this decade, we want to increase the percentage of German university graduates who have international experience from its current level of 13% to 20%, and we want to increase the percentage of foreign students in our student bodies from its current level of about 7.5% to 10%.

More Germans should gain experience in international institutions and contribute experience to such institutions. Conversely, we want to attract more foreign doctoral students and university teachers in particular.

We must begin early to lay the foundation for internationalisation: foreign language learning and openness to other cultures are now requirements for all young people in education and training.

### **How?**

- ◆ We are supporting **educational programmes** that are internationally attractive and compatible, as well as close networks with international research partners. We will encourage the Länder and the universities to offer more international courses of studies, especially master's programmes for foreign students with bachelor's degrees – and this must include programmes taught in foreign languages. Support for German study programmes abroad, which was initiated in 1998, is to be continued, and experience gained in these measures is to be transferred, where possible, to continuing education programmes.
- ◆ We will continue to support expansion of International Graduate Schools (Internationale Graduiertenkollegs) and the Max Planck Society's International Research Schools.
- ◆ We plan to continue the **marketing campaign** for Germany's education and research sectors.
- ◆ Cooperation with western European countries and with the U.S. and Canada remains the basis of our international activities. We plan to intensify **bilateral and multilateral cooperation** with central, eastern and south-eastern European countries and with Israel – including Palestinian researchers and scientists. We plan to orient our cooperation with Asia, South America and Africa to strategic measures.

## **Promoting technologies for new markets – creating jobs with a future**

*Research produces ideas and concepts for new products, processes and services. Without innovation, we can neither protect existing jobs nor create new ones. As a wealth of examples shows: we can achieve the Federal Government's central aim – reducing unemployment in Germany – only if we mobilise new forces for growth via research, new technologies and innovation.*

*Innovative technological developments, for example, significantly reduce costs in manufacturing of microprocessors, reduce automobile weights, enhance lighting efficiency and reduce oil consumption in car engines. Biotechnology and genetic engineering are revolutionising the pharmaceutical industry. Optical technologies will enable us to observe metabolic processes in living cells and thus to adopt new approaches in the development of medicines and vaccines.*

*Germany's economic future – and our ability to make our economy sustainable – depend on our determination to seize the opportunities provided by new technologies and innovative services.*

*For this reason, we want*

- *to unleash new forces for innovation, via strong, high-quality research,*
- *to strengthen small and medium-sized enterprises, as catalysts for innovation,*
- *to develop the possibilities of knowledge and technology transfer,*
- *to increase the numbers of innovative start-ups.*

In the past few years, Germany has maintained its position as one of the world's most important locations for innovation: since the mid-1990s, German industrial companies' revenue percentages with new products on the market have doubled. In recent years, research-intensive and knowledge-intensive economic sectors, including information technology, pharmaceuticals and automaking, have grown nearly five times faster in our country than our economy as a whole.

Today, more than 50% of gross value added and of jobs in manufacturing, as well as a total of nearly three million employees and more than half of all German exports, are directly tied to development of new technologies and relevant innovations. And knowledge-intensive services, a sector of constantly growing economic importance, is also having significant impacts on growth and employment. Between 1998 and 2000, this sector alone created over 400,000 new jobs. By the end of the 1990s, one-fourth to one-fifth of all economic growth in Germany was tied to use of information technologies.

The Federal Government's research and innovation policies have contributed substantially to this development. A high level of state commitment to research and development (R&D) has gone hand-in-hand with sharp increases in industry's own research expenditures. As a result, in 2001 research and development again accounted for over 2.5% of Germany's gross domestic product.

We want to accelerate our movement toward an economy whose most important resources are knowledge and competence. For this reason, we have embraced the aim outlined by European heads of government that calls for increasing R&D's share of gross domestic product to 3% by 2010. We call on business and industry to contribute to this aim by increasing its own R&D expenditures.

## **1. We want to unleash new forces for innovation, via strong, high-quality research**

### ***Why?***

The challenges in the innovation competition are growing. Innovation and product cycles have been shortening very rapidly. National innovation leadership is being undermined more and more quickly by the appearance of new products and processes and by cheap imitations. Knowledge does not stop at national borders. Today's large companies are global players that orient both their production and their research and innovation internationally, to key markets and technologically leading regions.

Increasingly, the market success of products depends on supporting services such as customer service, maintenance and software. Clusters of knowledge-intensive services tend to form around new technologies. Changing environmental awareness, and the need to promote closed-loop systems, are necessitating closer links between innovation processes and sustainability criteria.

Product sellers are evolving into providers of product systems, and such systems are becoming more intelligent, smaller, more complex and more highly networked. Increasingly, they are produced via mastery of multiple, integrated technologies. Hardly any one company now possesses, in-house, all of the skills and competencies needed to succeed in the innovation competition, and thus cooperation is growing more and more important. As data shows, more and more know-how is being purchased "off the shelf", developed through contract research and produced in cooperation networks with a long-term perspective. At the same time, companies are tending to reduce their own longer-term research activities. In light of these trends, public research is growing in importance as a strategic partner for industry. Our innovation policy is in line with this insight.

### **How?**

- ◆ In our specialised programmes, we are concentrating research support on areas that can have major leverage on growth and employment. Consequently, we are strengthening **information and communications technology**, a basic technology and growth engine in many sectors, as well as its links with other technologies and its integration within applications (automobiles, machines, services). We are promoting **microsystems technology, optical technologies, materials research and clean processes and production technologies**, for further development of existing markets. We are developing new growth sectors through **biotechnology and nanotechnology**. All in all, we are creating a broad basis of scientific and technical resources for our economy.
- ◆ We are linking our support for research and development with long-term technological, economic and social trends, also in keeping with the national sustainability strategy. In the process, we are orienting ourselves to results of innovation research: success in innovative markets seldom depends on the mere technological excellence of the products offered; to find real acceptance, innovations must offer people real solutions to real needs.
  - We plan to present a new **framework concept, "Innovation through new technologies: strengthening research – creating jobs"**. In it, we will concentrate research efforts more strongly on **lead innovations**, i.e. on cross-technology, integrated projects aimed at value creation through potential applications. Projects will be implemented jointly by industry and science.
  - With **lead visions such as "Living in a networked world: individual and secure"**, we will orient our support to society's needs. Our guidelines will include social visions for which the state has special responsibility.

## 2. We want to strengthen small and medium-sized enterprises, as catalysts for innovation

### *Why?*

Germany has over 3.3 million small and medium-sized enterprises (SME), in a spectrum of sectors that includes manufacturing, crafts, commerce and services. As direct sellers, suppliers and services providers, SME produce components for large companies, offer special system solutions and provide services. They employ a total of nearly 20 million people and contribute decisively to tax revenue, prosperity and our economy's performance. SME account for 70% of all employment and 49% of the country's gross value added. SME are thus an important factor in the German economy's innovativeness and competitiveness.

This is why in recent years we have made support of SME a central focus of our education and research policy. We have appropriately simplified funding procedures, oriented calls for programme proposals to the needs of SME and facilitated new cooperation between SME and public research institutions. Over 66% of all companies participating in the BMBF's support measures are now SME with fewer than 500 employees. This percentage translates into an absolute number of 1,700 companies and an increase of 54% over 1998.

We plan to expand our initiatives for SME in the next four years. This effort will be a central contribution to the Federal Government's campaign on behalf of small and medium-sized companies. The need for political action in this area is all the greater in that the economic framework for innovative SME has worsened: sea changes in venture-capital markets, and the debates about BASEL II, are reducing the availability of financing for innovation in this economic sector; in spite of high unemployment, a shortage of skilled personnel continues to obstruct SME innovation, as it has for years; the complexity of new technologies is increasing the challenges for qualified innovation and cooperation management.

### *How?*

- ◆ We plan to enlarge the role of SME in our specialised programmes. SME will receive greater consideration in **development of support strategies**. By means of new support instruments – such as lateral entry into specialised programmes and in ongoing collaborative projects – we hope to increase the numbers of SME in funding projects.
- ◆ Where appropriate, results of specialised programmes will be made available to larger numbers of companies, via **demonstration projects and user support** (transfer centres).
- ◆ We plan to take additional steps to **simplify funding procedures**, in order to facilitate access to funding programmes. In the process, we will review proposals from grant recipients and consider other research funders' support procedures with regard to their potential for adaptation to BMBF support. By building on the existing electronic application procedure (easy), and exploiting the potential of digital signatures, we plan to introduce an online procedure for application and other standard processes involving potential applicants and funders (profi-Online). This is also a pilot project in the framework of the Federal Government's BundOnline 2005 programme.

- ◆ Programmes providing innovation assistance for SME are being supported by the Länder, various federal ministries and by the European Union. The measures on various levels complement one another, but they also require a great deal of coordination. We plan to work with the Federal Ministry of Economics and Labour (BMWA) to enhance the transparency of the funding system, increase the consistency of individual measures and improve communication regarding available support. By developing SME-support advising into a **"first-stop agency"**, we plan to facilitate fast, unbureaucratic participation of SME in R&D-support programmes and to assist them in programme use. In a broad-based information campaign, will ensure that SME from Germany participate to the largest possible extent in the **Sixth European Framework Programme** for research and development. Relevant preparatory work is already being financially supported within a few specialised programmes (see also page 16).
- ◆ Research and innovation policy in Germany, and its range of instruments, have been oriented primarily to strengthening technological competence. By supporting innovation of SME, we plan to complement this approach in the following way:
  - Small companies in particular still have difficulty in gaining access to public research institutions and to assistance for their research and development problems. By establishing an **Internet competence platform**, we will provide the information resources for SME that Germany has been lacking.
  - We plan to improve the research and development programme **"Innovative development of work – the future of work"**, especially in the areas of support of innovation and design of innovative environments and company cultures.
- ◆ We plan to orient our **"Innovative services" support concept** to development of new services (for example, education services, services for senior citizens).

### 3. We want to make full use of the potential for knowledge and technology transfer

#### **Why?**

Over 21,000 companies regularly carry out research and development in Germany. Only 5,000 of these companies report having marketed new products, in recent years, developed on the basis of new scientific findings. This shows that there is considerable potential for increasing use of knowledge and technology transfer.

#### **How?**

- ◆ **Non-university research institutions** have an important task in the innovation process, in providing fundamental knowledge and new instruments for innovation. Such institutions should receive **incentives** for more effective **transfer** of new technologies in the context of product and process innovation.
- ◆ **Strategic alliances and networks** between research institutions and companies should continue to be expanded. Industry must be given a greater voice with regard to the aims and content of public research. In recent years, individual research institutions, universities and universities of applied sciences (Fachhochschulen) have developed excellent models for cooperation with industry; we want to ensure that these "best practices" are held up as good examples.

- ◆ By reforming the basic privilege under which university teachers are the sole proprietors of their inventions resulting from university-funded research, and by establishing patent-exploitation agencies, we have laid the foundations for more professional commercialisation of inventions of research institutions. We plan to continue working to make **patent commercialisation** more efficient.
- ◆ The philosophy of **applying commercialisation obligations in project support** will increasingly be applied to funding of institutions. In financial statutes, the Helmholtz Association of National Research Centres will be required to commercialise research and development results under its own responsibility, to describe its relevant commercialisation activities in its innovation reports and to submit such reports to its supervisory bodies. The Deutsche Forschungsgemeinschaft plans to bring its own regulations on commercialisation of results into line with this basic idea, in the framework of its own objectives. We plan to urge other research organisations to apply this philosophy more strongly.
- ◆ We plan to take the initiative in **networking Germany's many agencies for technology transfer**. Other countries, such as the U.S., have done much more in this regard. Such networking will help focus tasks and contribute to quality assurance.

#### 4. We want to increase the numbers of innovative start-ups

##### **Why?**

New companies create new jobs. This is especially true of spin-offs from the science sector. Start-ups are also one of the most effective ways of translating research findings into marketable innovations.

The Global Entrepreneurship Monitor now considers Germany's support system for start-ups to be exemplary. However, recent trends in stock markets seem to have undermined progress in availability of venture capital, at least to some extent, and this investor-climate shift poses risks for successful new technology-based companies in Germany. Support for start-ups still has deficits in entrepreneurship education, i.e. in education, motivation and advising for new entrepreneurs.

##### **How?**

- ◆ In cooperation with the Federal Ministry of Economics and Labour (BMWA), we plan to increase the range of courses and support measures for new entrepreneurs from universities (**entrepreneurship chairs, EXIST**).
- ◆ Support of spin-offs, within the framework of commercialisation of R&D results, is explicitly a task of research institutions that are jointly supported by the Federal Government and the Länder. A broad range of measures is available to such institutions for this purpose. Via the **EEF Fund** (facilitating start-ups from research institutions - **Erleichterungen von Existenzgründungen aus Forschungseinrichtungen**), we plan to provide additional incentives to encourage research institutions to give new entrepreneurs early, optimal assistance. Successful spin-offs will be taken into account in decisions on funding for research institutions. In connection with knowledge and technology transfer, we will initiate a benchmarking process for supporting "best practice" in research institutions' assistance for start-ups.

- ◆ We are planning to integrate *instruments for support of start-ups* in our specialised programmes.
- ◆ It's never too early to start learning how to be an entrepreneur. That is why we are now preparing a young people's competition for technology-based start-ups, "**Youth start-ups**" ("Jugend gründet"; to start in 2003). On the basis of the relevant software-based platform, we will also provide specific teaching and learning tools in economic education.

## Research for people and the environment – shaping a future truly worth living

*Research should not be an end in itself. Research findings must directly benefit people and society and must contribute to sustainable development. The battle against disease and the struggle to protect our environment have top priority for us.*

*To protect our perspectives, we must try to recognise trends in society, the environment, science, research and technology as early as possible. We must seek to understand the opportunities and risks of new developments early on and to develop alternatives, if necessary, to ensure that the future remains a future worth living. Such needs call for broad-based discussion, and we wish to involve scientists and experts from a wide range of different disciplines, as well as representatives of relevant interest groups and the public, to take part in this discussion.*

*We want*

- *to enable people to benefit from the opportunities provided by modern biomedical research,*
- *to enhance the quality and efficiency of health care via research,*
- *to promote, with concepts for sustainable development, a healthy environment and better quality of life,*
- *to engage in intensive discussion with society, regarding science and research and the opportunities and risks of new developments.*

Science and research have brought us great progress. They can also pose risks for human beings and the environment, however. The challenge is to integrate research and knowledge – about living things, the environment, society, culture, the economy and technology – within a productive context, so that they will be available for society's strategies for sustainable action.

Scientists and the public must communicate with each other. Under a concept known as "public understanding of science", English-speaking countries began years ago to develop highly differentiated, stable structures in this area. We are working toward similar aims with the concept "Science in Dialogue". Orientation of research priorities to social and economic development is being studied internationally within the framework of foresight processes. In the FUTUR process, we have already refined and implemented the available instruments.

## 1. We want research to develop new possibilities for therapy and to help improve the quality of our health-care system

### **Why?**

Life sciences are now producing new knowledge and findings at an unprecedented rate of speed. Genome research will deepen our understanding of the causes of disease, thereby opening up new possibilities for more effective therapies and prevention. In the National Genome Research Network, we have combined biomedical expertise and technological resources to take a decisive step toward interdisciplinary research oriented to the fight against disease. We plan to continue these efforts energetically.

Progress in other areas of life science is opening up other new possibilities – for example, for making nutrition healthier or combating diseases that primarily afflict older people. Biotechnology also provides new opportunities to establish resources-conserving industrial production.

Our health-care system is facing major challenges. For example, the current demographic development will create heavy future demands for care for chronically ill people. With the help of research, we want to promote a high-quality, affordable health-care system.

### **How?**

- ◆ With the **"Integrated general concept for life sciences"** (IGEL), we want to help genome research in Germany make decisive progress. The concept is combining the next phase of the **National Genome Research Network** with innovation and technology from related scientific disciplines such as bioinformatics, proteome research and systems biology.

With the research priority **"Development of new medicines and therapy approaches"**, we plan to follow up on research findings from basic biomedical research and translate these findings into new therapeutic and diagnostic procedures.

With the help of sustainable biotechnology, we plan to lay a long-term foundation for development of healthy foods. Within the framework of the research initiative "Food, Environment, Health", we are establishing a new funding priority, **"Genome analysis in animal organisms"** (FUGATO). Findings from functional genome analysis are to be applied in the interest of safe, successful, conventional animal husbandry.

The purpose of the new measure **"Biotechnological production"** is to establish resources-conserving, energy-efficient and sustainable industrial production through the use of modern biotechnology.

- ◆ We plan to prepare a comprehensive concept for **"Research on ageing"** and, by establishing a relevant research priority, intensify molecular research into ageing, along with age-specific clinical research and research on health care for the elderly.
- ◆ We plan to intensify the research priority **"Care research"**, for which financing is being shared equally with the central organisations of statutory health insurance.
- ◆ With the help of carefully targeted support of **clinical studies**, we plan to improve the scientific basis for doctors' work. To this end, we plan to provide joint support in cooperation with the Deutsche Forschungsgemeinschaft.

- ◆ With the lead vision "**Healthy and vital throughout life by prevention**", we plan to help people stay healthy. The focus of this effort will be on developing evaluation procedures for measuring the effectiveness and cost-benefits relationships of prevention. In addition, we wish to create product ideas for an innovative "prevention market", to help citizens do more for their own health, under their own responsibility.

## 2. We want to respect ethical boundaries

### *Why?*

Research for people and the environment must respect society's moral and ethical boundaries. For this reason, development of research and technology must take place in the context of dialogue – between natural sciences and humanities, and between science, industry and the general public. Without adequate social acceptance, new developments have little or no chance for success. This is particularly obvious in the area of the life sciences, in which rapid scientific progress fuels hopes for improved medical care and yet remains burdened with risks. In this area, both public discussion and continuing supportive research are indispensable.

### *How?*

- ◆ We plan to continue the UN process begun with the **Franco-German initiative against reproductive cloning**. The long-term aim is to bring about a UN Convention on ethical issues in biomedicine.
- ◆ We are working to harmonise bioethical standards within the **European Union**. In this area as well, we plan to take the position that high ethical standards must be combined with research-friendly provisions.
- ◆ We plan to continue dialogue on the aims, possibilities and impacts of life sciences research and its applications. For this reason,
  - We plan to discuss central issues in a broad public forum and to support the work of the **National Ethics Council**;
  - We plan to provide a broader basis for research into the social, ethical and legal consequences of the application of modern biotechnological processes (**ELSA**). To this end, we plan to expand **ELSA** projects, which thus far have been oriented to human genome research and molecular medicine, to include so-called "green genetic engineering".

## 3. We want to use education, research and technology to promote sustainable development

### *Why?*

In recent years, science has shown convincingly that human beings are in the process of endangering their natural environment. The growing world population's continually increasing energy consumption will have dramatic impacts unless climate protection policies are energetically applied. In addition, it is equally important to be able to manage extreme climate events, such as floods, storms and drought, i.e. development of early warning systems and optimal adaptation options must be intensified.

Policies for sustainable development must include new concepts for all areas that use finite resources. The aim must be to protect the world in which we live – to protect an intact environment, maintain a healthy food supply and preserve a high quality of life.

### **How?**

- ◆ We plan to develop a new framework programme for "**Development of sustainability concepts and prevention and management strategies**", with the following focuses: research into sustainable system solutions in business and industry, including agriculture and forestry; sustainable safeguarding of drinking water resources; preventive flood protection; soil conservation, including reintegration of contaminated areas; sustainable use of coastal zones; development of regional sustainability concepts.
- ◆ With the framework programme "**Research into Earth's vulnerability – Earth system analysis and risk assessment**", we plan to promote research into global change, including the areas of climate, land use, biodiversity, global cycles, peace research, natural disasters and risk management.
- ◆ The work of the **German Foundation for Peace Research** (Deutsche Stiftung Friedensforschung) will be supported. At the European level, we plan to promote integration of peace and conflict research in the Framework Programme for Research.
- ◆ In cooperation with the Länder, and in the framework of the Federal Government / Länder programme "**Education for sustainable development**", we plan to continue using cooperation and partnerships to integrate schools within regional and cross-Länder networks, with the aim of expanding school education to include sustainable development.

## **4. We want to design mobility and urban development in harmony with the environment**

### **Why?**

A decisive aspect with regard to sustainable development of our society and environment is the way our city regions develop in the future. Environmental protection, mobility and urban development do not have to be mutually exclusive. By means of integrated transport concepts, we can link road and rail transport with air and waterway transport in intelligent ways. This improves opportunities for environmentally compatible mobility and it creates jobs.

### **How?**

- ◆ We plan to develop new, strategic solutions for transports, with the aim of providing safe, healthy mobility for people. Within the framework of a lead vision, we are developing intelligent concepts for **advanced traffic management** in large cities, aimed at making it easier for people to use public transportation instead of their private automobiles. Another focus is on **reducing noise**, a growing burden on many people.
- ◆ We also plan to spur development of innovative solutions for **goods transports**. One lead vision we are pursuing, in cooperation with Deutsche Bahn (German Railways) and our European neighbours, calls for moving goods by rail instead of by trucks on motorways.

## 5. We want broad-based dialogue about the development of science and research

### *Why?*

In the knowledge society, real communication between science and the public, and development of standards for responsible approaches to scientific disciplines and technologies, are of central importance. Research must provide orientation within rapid social change, and it must enable people to reach their own judgements regarding the opportunities and risks of scientific findings and technical developments. We want to involve people in identifying topics and setting priorities in research policy. In this way, we can enhance the research sector's orientation to the needs of individuals and society.

### *How?*

- ◆ We plan to develop a new support concept for the **humanities and social sciences**, aimed at promoting interdisciplinary research and strengthening its contribution to discussions about important issues concerning society. This effort includes expanding socio-ecological research with its specific priorities "Sustainable development of the economy" (also on a global scale) and "Social inequality and ecological modernisation". An especially important topic has to do with solidarity with various social groups and society's future perspectives.
- ◆ We plan to strengthen the initiative **"Science in Dialogue"**. We want to improve the organisational and financial framework for this initiative in cooperation with the science organisations, for whom dialogue with the interested public must become a standard responsibility – as it is in many other countries.

For years, we have supported numerous relevant projects and initiatives, including the **"Years of Science"** and the "science summer". The year 2003 will be the "Year of Chemistry". In the new legislative period, a year will also be devoted to humanities and cultural sciences.

- ◆ In the **FUTUR** process, we plan to continue our dialogue with science, industry and society about shaping our future. The aim of this effort is to identify especially innovative lead visions for research policy, in keeping with society's needs, and to combine previously isolated support approaches strategically. These lead visions will then be translated into specific research-support measures. In this way, experts from industry, associations and non-governmental organisations, creative thinkers, researchers and young scientists will all have an intensified role in the setting of priorities in research policy.
- ◆ We plan to improve methods of **innovation and technology analysis**, in order to enhance participation and critical review of research priorities.

## Strengthening centres of growth – moving eastern Germany ahead through education, research and innovation

*Eastern Germany is already deep into the competition for the best minds and concepts. Within just a few short years, a modern, highly capable education and research landscape has been created there. Now, we must work to translate the qualifications, creativity and commitment of eastern Germany's people into innovations and economic growth. If we are to eliminate persisting disadvantages and barriers in the economic structure of the new Länder, we must take new approaches. Education and research policy is relying more and more strongly on cooperation between local players.*

Creating regional and inter-regional networks; managing innovation processes efficiently; compensating for lacking capital; and dealing with growing international competition for the best specialists: these are just some of the challenges that we – and not just the new Länder – are facing. But the urgency of these issues in eastern Germany makes the new Länder leaders in dealing with them. The answers found there could serve as a model for Germany and Europe.

In eastern Germany we want to

- *develop more regions with competitive profiles in industry and science ,*
- *promote successful, innovative start-ups,*
- *enable all young people to receive quality training,*
- *stop the exodus of young specialists,*
- *create attractive perspectives for talented young scientists.*

The new Länder now have a state-of-the-art public research infrastructure that compares with the best in Europe. Research institutions such as the GeoForschungsZentrum Potsdam, the Max Delbrück Centre for Molecular Medicine in Berlin, the Institute for Neurobiology in Magdeburg and the UFZ Centre for Environmental Research Leipzig-Halle are recognised centres of excellence that conduct top-level research that is acclaimed world-wide. Eastern Germany's universities are among Germany's best – also for the reason that they provide good support for their students. Eastern Germany's universities and inter-company training centres have state-of-the-art equipment and laboratories, and its general and vocational schools also stand up well to comparison.

Many regions have specific qualifications and expertise that are making them centres of growth. For example, some 26% of the BMBF's funding for biotechnology goes to the new Länder. The Jena BioRegion is producing new biotechnology companies at an enormous rate. And Dresden, Berlin and Potsdam are already excellent biotechnology centres. The Leipzig-Halle-Bitterfeld region is one of the world's new leading centres for environmental protection technology. The Thuringia-Saxony region has earned a world-wide reputation in electronics. In Saxony-Anhalt and Saxony, competitive clusters are emerging in the automobile-supplier industry; in Mecklenburg-Western Pomerania, an alliance of innovative maritime technology companies is forming.

And yet eastern Germany's economic and research sector still has structural deficits, even significant ones. One of the area's main structural particularities is a lack of large companies, including a lack of headquarters and research departments of such companies. In contrast to the situation in western Germany, most industrial research in eastern Germany takes place in small and medium-sized companies. A pronounced shortage of capital resources hampers urgently required process and product innovation and clouds perspectives for competitive

management. Most importantly, however, it hinders the establishment of knowledge-based, research-intensive and development-intensive start-up companies.

With support concepts such as "InnoRegio" and "Innovative regional growth centres", we have developed a new approach to innovation policy. This approach supports networks of different local players and strengthens their innovative capability. With joint research and development projects and forward-looking entrepreneurial management, local players gain competitive advantages in the market. As a result, regions develop their own economic and scientific profiles, profiles that include new companies and provision of suitable training programmes.

## 1. We want to develop more regions with competitive profiles in industry and science

### *Why?*

The future of the new Länder depends on their industry's long-term ability to innovate. Innovation is the key basis for creation of viable, high-quality jobs and for companies' success in international competition. An optimal climate for innovation is one in which different players, from sectors such as education, research, industry and politics, work together confidently and rapidly translate their findings into developments. This is why, in the last legislative period, we began placing innovation-policy aims and their regional focus at the centre of our research and education policy for the new Länder. The already emerging trend toward more independent initiatives and cooperation between science, industry and politics must now be assisted so that it produces viable developments in eastern Germany's regions.

### *How?*

- ◆ We plan to refine the new support approach we have chosen for **InnoRegio** and the **regional growth-centres initiative**. We are doing this by creating a tailored combination of different support instruments, especially in the areas of research and development, training and further training and innovation and network management.
  - **Innovation forums** prepare the way for cooperation between partners in regional and supra-regional innovation processes. By promoting such forums, we want especially to support initiatives to establish market-oriented cooperation involving the areas of education, research, industry, politics and administration. In addition, we want to assist regions in developing strategies of their own for sustainable regional innovation processes. This effort necessitates close cooperation and consultation with the Länder and with the EU Commission.
  - With the **InnoRegio Programme – Innovative Impetus for the Region**, we are supporting cooperation, in a diverse range of projects, between industry, politics, education and research, in a total of 23 regional innovation networks. A particularly important aspect of this effort is its focus on professionalising network management and creation of self-sustaining structures, especially through intensified commitment of private capital.
  - By supporting **innovative regional growth centres**, we will focus the aims and instruments of InnoRegio on market-oriented alliances of research and industry with high growth potential. With special support for efficient innovation management, cooperation in growth centres is being oriented closely to the market; in the process, company start-ups are being prepared and implemented.

## 2. We want to promote innovative start-ups

### *Why?*

Start-ups are the best way to transfer research findings and qualifications into economic value creation. Knowledge-based innovative companies develop new markets and create high-quality jobs. Their influence throughout regions enlivens education and research, attracts additional companies and creates competitiveness, even in an international context. New companies are a key basis for regional attractiveness and prosperity.

### *How?*

- ◆ Increasing the number of knowledge-based spin-offs in eastern Germany is a special focus of measures such as EXIST and EEF Fund (see also page 23). By supporting **innovation and start-up laboratories** in universities and research institutions, we are also efficiently supporting improvement of facilities and equipment for spin-offs in the high-technology sector.

## 3. We want to improve training opportunities

### *Why?*

In addition to top qualifications, in the new Länder we need a solid vocational training base. The new Länder have a particularly severe shortage of training places, a shortage that is causing young people to leave the region. A vicious circle results: without training places and jobs, young people leave; without a good supply of trained specialists, companies leave and no new companies come into the region.

### *How?*

- ◆ We are continuing **our training place programmes** for the new Länder, especially in cases where industry's own efforts, as agreed with industry in the national consensus on training, do not suffice to increase the number of available training places. In the process, we are focussing especially on improving the capabilities and willingness of SME to provide training and on linking regional industrial and structural development.

## 4. We want to offer attractive perspectives for talented young scientists

### *Why?*

Eastern Germany's Länder are not receiving any special bonuses in the international competition for the best people. If they are to attract and keep talented young scientists, we must ensure that the framework for scientific research meets international standards. Top-quality research takes place in well-equipped laboratories, at universities and research institutions with leading scientists and researchers and in academic environments that take young scientists' professional and personal interests seriously. We want to help improve the attractiveness and competitiveness of eastern German scientific centres by efficiently promoting outstanding research talent. We are working closely with the Länder in this effort.

### **How?**

- ◆ Under the motto "Creating excellence – keeping talent", we are promoting the establishment and development of **centres for innovation competence** in which excellent research and promising ideas are prepared for international competition. The initial emphasis is on developing suitable research and organisational strategies and on supporting particularly talented young, international research teams.