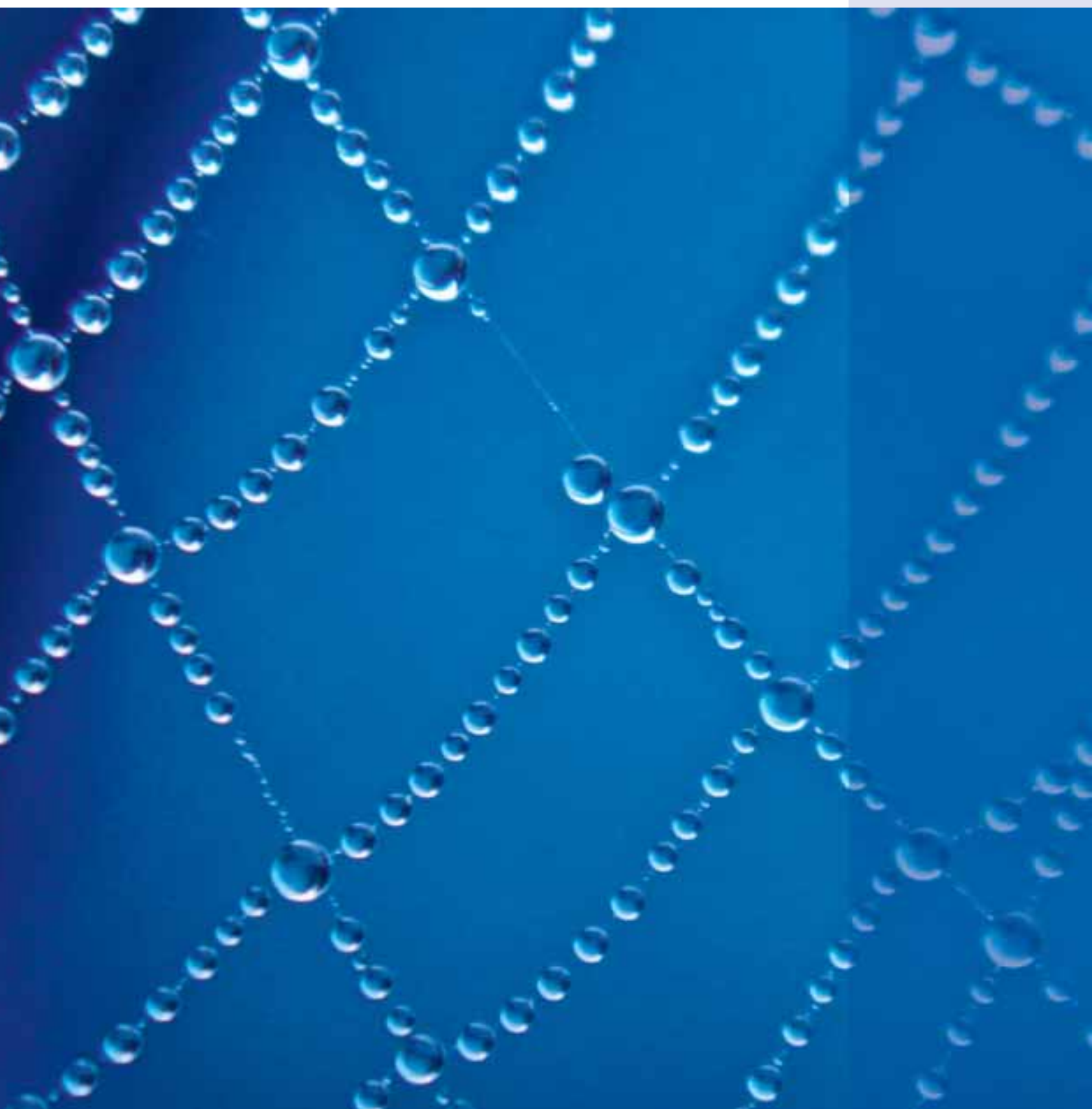




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table of contents

3	executive summary	
9	the agenda	
17	principles and strategy elements	
21	people	
	Status and Challenges	22
	Strategic Guidelines and Recommendations	24
27	society	
	Status and Challenges	28
	Strategic Guidelines and Recommendations	31
33	input/output	
	Status and Challenges	34
	Strategic Guidelines and Recommendations	43
45	key research areas	
	Status and Challenges	46
	Strategic Guidelines and Recommendations	50
53	infrastructure	
	Status and Challenges	54
	Strategic Guidelines and Recommendations	55 >



table of contents



59___ **instruments**

Status and Challenges _____ 60

Strategic Guidelines and Recommendations _____ 62

67___ **governance**

Status and Challenges _____ 68

Strategic Guidelines and Recommendations _____ 69

73___ **internationalisation**

Status and Challenges _____ 74

Strategic Guidelines and Recommendations _____ 75

79___ **literature**

83___ **abbreviations**

84___ **contact**

Vision 2020

Austria is a successful and internationally recognised innovation nation. Excellent research and radical innovation form the basis for Austria's leading position. An integrated approach and successful cooperation between science, industry, society and politics are the core elements of a new culture of openness, flexibility and creativity. This is the foundation for the creation of new knowledge. Framework conditions and structures that foster innovation make Austria an attractive place to carry out research and

development for both Austrian and foreign scientists, and also for business. The efficient use of research results facilitates sustainable social, economic and ecological progress which is supported by a sense of responsibility for the living conditions of future generations. The key policy areas are education, research, technology and innovation. At the heart of this policy is a commitment to people. This makes Austria a dynamic, knowledge-based society at the forefront of global competition..



Strategy 2020

Strategy 2020 sets out a vision of the future for the status that Austria aims to attain by 2020. To turn this vision into reality a comprehensive strategy is needed. In this Strategy 2020 the Austrian Council for Research and Technology Development pre-

sents its proposals and recommendations for realising the vision. The Strategy sets the direction and – especially in the midst of the turbulence created by a global financial and economic crisis – serves as a general orientation aid.

Global Framework Conditions

The global economic and financial crisis has radically changed the framework conditions which had previously been assumed for the development of the RTI system. In terms of the strategic proposals and recommendations, the uncertainty regarding the framework conditions makes it necessary to prioritise those measures which position Austria most effectively as a centre of RTI as it competes in a globalised economy. In particular, measures are needed in the areas of education and raising skills and qualifications, the sys-

tematic definition of key areas and provision of appropriate resources, linked by the instruments of intervention and their governance.

Most countries will have less money at their disposal. Therefore those countries that win the race to the top in 2020 will be those which succeed in using scarce financial resources and the most highly qualified people for the national strengths that give them a competitive edge over other countries. Absolute dedication and a strong focus upon national skills are of the essence.

Starting Point

In recent years Austria has completed a rapid catching-up process in terms of its RTI performance and is now one of the countries in the European Union that is developing most dynamically. In the latest Summary Innovation Index (SII) of the European Innovation Scoreboard 2008 Austria ranks sixth among the 27 EU member states. In an international comparison Austria, together with countries such as France, Ireland, Belgium and the Netherlands, falls into

the category of innovation followers, i.e. the group behind the innovation leaders.

However, Austria is also one of the few countries in the European Union to have a realistic chance of achieving the targets laid down for the member states in the Barcelona and Lisbon processes. With a research quota of 2.73 percent (2009) Austria already clearly exceeds the EU average. However, there is an evident weakness in transforming input into output. Austria in->

executive summary



vests a disproportionately large share of resources in the RTI system and generates only lower than average output in comparison. Other Scoreboard indicators also reveal deficits, especially the below-average percentage of the population

with a tertiary education qualification and the number of science and engineering graduates. The situation in this regard is acutely problematic as there is already a shortage of highly qualified workers.

Challenges

Both these weaknesses point to the greatest challenge that Austria will have to overcome in the next few years: To take the step from being an innovation follower to an innovation leader, i.e. from a country that is catching up to one that produces at the cutting edge of technology. This development step is needed as the returns from an adaptive innovation strategy have now largely been exhausted. Furthermore, on globalised markets there is growing competition from nations that are able to produce in the medium technology segment at substantially lower cost.

An increasing number of countries – including our immediate neighbours – are themselves engaged in a catching up process and are advancing into those positions that Austria had carved out for itself in the past. Austria therefore has no alternative but to take a leap forward and move into the fast lane occupied by the innovation leaders with production structures at the cutting edge of technology and highly developed productivity. However, this move requires a fundamental change in the focus of research, technology, innovation and educational policy.



Strategy Elements

Strategy 2020 structures the reforms that are necessary for this fundamental change in eight strategy elements:

- | | |
|----------------|------------------------|
| ■ People | ■ Infrastructure |
| ■ Society | ■ Instruments |
| ■ Input/Output | ■ Governance |
| ■ Key Areas | ■ Internationalisation |

People

Joining the innovation leaders means increased demand for higher qualifications. Austria needs more and better educated workers. The importance of higher education rises disproportionately with the rising level of development.

The Austrian Council recommends

Improving access to education:

- Starting education earlier
- Later segmentation and modular structure

Improving the attractiveness of tertiary education:

- Balanced teacher-pupil ratios
- More attractive curricula, particularly in the technical-science branches

Positioning science as a career:

- Additional funding for enhanced doctoral training schemes
- Improving contracts to match international standards

- New career models for women

Using and promoting immigration:

- Austria-wide recognition of qualifications acquired abroad
- Facilitating immigration of top researchers
- Starting an awareness campaign.

Society

The growing importance of science, research, technology and innovation for our society requires new forms of dialogue between science and society. It is important to create sustainable access to and opportunities for social participation which strengthen “social robustness”, i.e. social acceptance of technological advances.

The Austrian Council recommends

- Developing a strategy to shape the dialogue by the ministries, Austrian Council, scientific and research community and stakeholders
- Institutionalising this dialogue, ideally in the form of an independent institution
- Regular, ideally annual, realisation of the Long Night of Research
- Developing an incentive system for scientists to participate in the dialogue
- Expanding the Parliamentary Research Service to obtain and edit impartial expertise
- Ethics discourses at universities, Fachhochschulen and other research facilities.

Input/Output

In recent years Austria has been particularly successful in mobilising financial resources for RTI and is in a good position to close the gap to the innovation leaders in Europe. In the current volatile economic climate, however, new targets need to be developed in order to achieve steady growth in R&D spending. The present structure of the various types of research should be balanced and developed further with a stronger focus on output. The public sector should therefore create incentives to expand the proportion of research carried out by business. A need has been identified to put more emphasis on the transformation of resource input to result output and this necessitates a better understanding of the entire RTI system both in quantitative terms and with regard to internal linkages. This requires substantial improvements to the information and data pool for RTI policy and the further development of methods of data analysis and impact research.

The Austrian Council recommends

- 3 percent research quota as an interim goal
- Developing the long-term goal for 2020 in the light of the economic situation
- Current structure of R&D funding must be enhanced with a focus on output
- Funding of basic research must be in balance with the other sectors



executive summary



- Strengthening the innovative capability of businesses and the framework conditions for RTI investments
- Improving support for the transfer of technology
- Improving the data pool by means of a coordinated collection and analysis process

Key Areas

Identifying key areas and emerging thematic areas in the Austrian research landscape will become increasingly important. Overarching priorities should be defined across all ministries and appropriate public RTI instruments should be developed for selected key thematic areas and key technologies that are of societal or strategic importance for Austria. This applies only to that area of the RTI system that is not defined by a process that is of necessity thematically open and bottom-up. The aim of the strategy element “Key Areas” is to point out methods and paths for arriving at a holistic definition of key areas and laying the basis for future priorities in the RTI system.

The Austrian Council recommends

- Inter-departmental definition of priorities and RTI instruments (inter-departmental overall project management)
- Elaborating additional strategies for key areas, most urgently in the fields of sustainability, environment, energy, mobility and transport
- Pursuit of niche strategies in the sense of focusing on specific markets and fields of knowledge when establishing thematic key areas
- Focusing thematic programmes on a small number of broadly based key areas
- Limiting the proportion of the funding budget that is available for thematic programmes
- Defining priorities that will empower Austrian researchers to increase their participation in European Framework Programmes
- A systematic approach to foresight activities and technology forecasts

Infrastructure

RTI infrastructure is an indispensable base for world-class research. Due to its unique nature it

represents a good means of strategically positioning the research location. An appropriate infrastructure, especially basic research infrastructure, not only drives employment, it also acts as a magnet that draws Austrian and international researchers.

The Austrian Council recommends

- Establishing links with international RTI infrastructures with a view to thematic key areas
- Creating a platform for the strategic planning of RTI infrastructure in consultation with ESFRI
- Greater joint (supra-regional) use of large-scale infrastructure
- Expanding programmes to promote cooperation to include infrastructure
- Multi-year budgets for infrastructure
- Funding basic university infrastructure through the global budget, but preserving competitive tendering processes for additional research infrastructure.

Instruments

The extensive portfolio of potential instruments for intervention in the RTI system with their numerous forms and sponsors must be used in a targeted and coordinated manner if the overarching goal of strengthening the Austrian innovation system and positioning it among the front runners is to be achieved by 2020. A key element of the Austrian Council’s RTI strategy is therefore to draw up and present the way in which instruments need to be used with the aim of streamlining the multitude of programmes that do not achieve a critical mass and concentrating the use of resources on a small number of broadly-based key research areas that are of strategic, economic and/or social relevance for Austria. Instruments for the corporate sector should be differentiated according to the specific problem. In order to increase R&D intensity in the business sector a special effort should be made to address small and medium-sized enterprises, as their potential is still far from exhausted in Austria.

The Austrian Council recommends

Independent of sector:

executive summary

- Simplifying and increasing indirect funding
- Streamlining the multitude of thematic programmes

Instruments for the corporate sector:

- Increasing the proportion of companies engaged in research and innovation in particular among SMEs and LCUs
- Expanding risk and growth-oriented financing opportunities for young, innovative, technology-oriented companies
- Improving the availability of and access to equity capital and venture capital

Instruments for the collaborative sector:

- Optimising and continuing programmes that promote cooperation between science and industry
- Greater concentration of collaborative institutions

Instruments for universities:

- Developing a long-term strategy for the tertiary

education as a complete portfolio to be implemented through performance agreements

- Increasing the proportion of funding awarded using competitive procedures.

Governance

In the area of governance the main objective is to optimise the steering and interaction of the institutions that are responsible for the implementation and management of public interventions in the RTI system. It is therefore essential to develop a model for the target state of the RTI system in 2020. Changes to the structures and processes can only be successful if they are based on clear objectives.

The Austrian Council recommends

- Concentrating research agendas at the ministries responsible for applied and industry-oriented research – BMVIT and BMWFJ. >



executive summary



- Merging the supervisory and steering structures of the agencies, also with a view to being able to allocate funding to the key areas flexibly and as needed

- Autonomy of the agencies in the sense of agencification in terms of jury and guideline decisions on the basis of the strategic specifications of the ministries

- Increasing the flexibility of employment contract structures at the ministries

- Advisory services provided by the Austrian Council for Research and Technology Development should be directly addressed to members of the government and should encompass the definition of strategic directions, key areas and the necessary funding and monitoring of the implementation of the federal government's RTI strategy.

Internationalisation

Changed global conditions require decentralised, flexible yet sufficiently coherent approaches to international cooperation. Communication which in the past was handled by state bodies will in future take on a more immediate and direct form

and will be carried out by funding agencies and research institutions. The establishment of the European Research Area in particular will lead to a further strengthening of this trend. In contrast it will become harder for state institutions to ensure coherent approaches at the national level.

The Austrian Council recommends

- Realigning responsibilities at the ministries: Coordination function replaces management function

- New methods of coordination between the ministries, research institutions and agencies

- Joint development of participation strategies for European approaches to internationalisation (e.g. ERA-NET)

- Strengthening neighbourhood policy by intensifying scientific collaboration and cooperation in education, research and development in the Central, Eastern, and South East European Research Areas

- Promote Austria as a research and university location in Central, Eastern, and South East Europe, in selected non-European countries and in selected collaborative networks in which third countries participate ■



the agenda



Austria Faces the Challenges of the 21st Century

Vision 2020: Austria is a successful and internationally recognised innovation nation. Excellent research and radical innovation form the basis for Austria's leading position. An integrated approach and successful cooperation between science, industry, society and politics are the core elements of a new culture of openness, flexibility and creativity. This is the foundation for the creation of new knowledge. Framework conditions and structures that foster innovation make Austria an attractive place to carry out

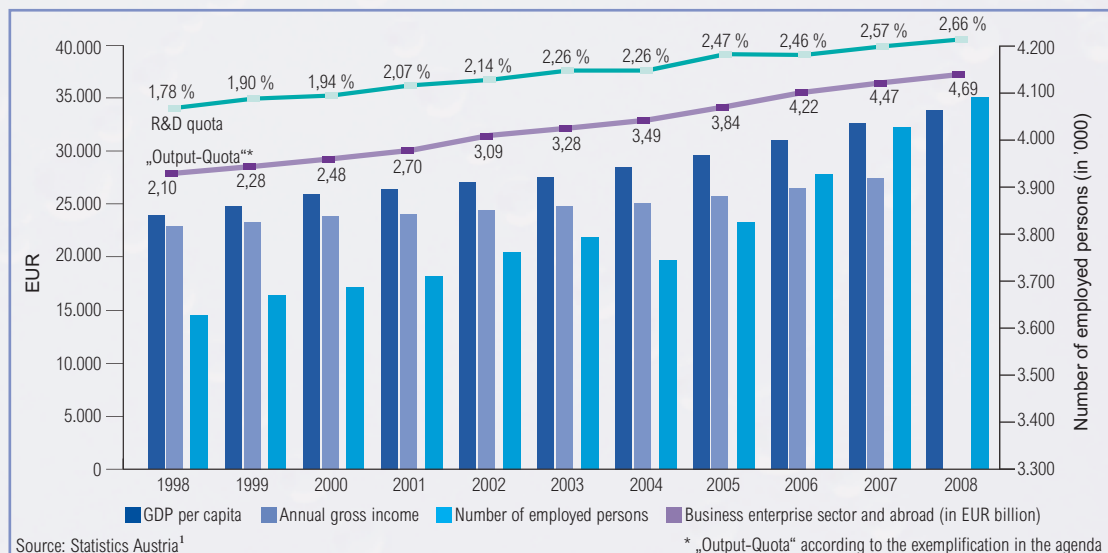
research and development for both Austrian and foreign scientists, and also for business. The efficient use of research results facilitates sustainable social, economic and ecological progress which is supported by a sense of responsibility for the living conditions of future generations. The key policy areas are education, research, technology and innovation. At the heart of this policy is a commitment to people. This makes Austria a dynamic, knowledge-based society at the forefront of global competition.

Research, technology and innovation (RTI) are the prerequisites for achieving scientific, economic, technological, social, ecological and cultural progress in future and thus for creating high-quality jobs and safeguarding competitiveness, sustainability and prosperity. The ambition to join the ranks of the innovation leaders is not therefore an end in itself, but is designed to achieve societal objectives. In the Lisbon strategy

the European heads of state and government stated that research, technology and innovation are the prerequisites for growth and employment in Europe. Research not only increases a country's competitiveness, it also safeguards national prosperity, promotes social inclusion and helps solve societal problems.

The goal of any comprehensive strategic RTI policy must therefore be to support economic

Figure 1:
Development of
GDP per capita,
employment, aver-
age annual gross
income, R&D fund-
ing by companies
including funding
from abroad and
the R&D quota



¹ Gross annual income is the average (arithmetical mean) of the gross annual income of all employed persons (excluding apprentices) based on income tax records, December 2009; GDP per capita is at current prices from the National Accounts, July 2009, the number of employed persons (15 years and older) according to the Labour Force Concept from the Labour Market Statistics, June 2009, the R&D quota from the global estimate of R&D expenditure, May 2009.

competitiveness and sustainable economic development. This provides the basis upon which economic development, employment and prosperity can be advanced. At the same time, the links between input and output are complex and it is necessary to include both input and, to a greater extent than has been the case in the past, output quantities in economic policy considerations. An adequate input of resources and an efficient system for research, technology and innovation are both essential prerequisites for turning the ambitious vision into reality. When looking for an auxiliary quantity against which output can be measured, the results of corporate development activities can serve as important indicators. In turn, these development results are a function of research expenditures in the corporate sector. At the same time, allowance must be made for the time lag between spending and measurable results. This time lag depends on the particular structure of the economy and in the medium term can be regarded as stable. To deepen knowledge of the broader connection, the Austrian Council calls upon the scientific community and Statistik Austria in cooperation with the Austrian Council to prove the links between expenditure on the one hand and

- the development of sales, results and employment
- the development of per capita GDP
- the percentage of sales generated with pro-

ducts that are new to the market²

- the percentage of sales generated with products that are new for the company² and
- the percentage of high-tech exports² on the other.

Successful industrial research is based upon outstanding basic research carried out at adequately funded research institutions and applied research supported by suitable research and funding structures. Within this research structure the efficient transfer of knowledge is called for. The provision of financing for the aforementioned research sectors is of crucial importance in Austria given that it is a high-wage country with few natural resources.

Nevertheless, a policy focusing exclusively on research, technology and innovation has fails to adequately exploit existing potential. The areas of research, innovation, education and training must therefore be developed jointly with a view to improving the development potential of the economy. In December 2008 the European Union adopted the European Research Area Vision 2020³ as part of the Ljubljana Process. This vision explicitly recommended that the modernisation of research, education and innovation systems must proceed hand-in-hand and called for strong interaction within the “knowledge triangle” (education, research and innovation) to be promoted at all levels supported by appropriate European mechanisms.



Increasing Competitiveness and Solving Social Challenges

While research, technology and innovation change all our lives, knowledge of the processes and developments, repercussions and risks in these areas have not spread with the same vehemence.

For large sections of the population these areas remain “black boxes” and it is by no means clear to all members of the public why massive investments should be made here. >

² See EIS (European Innovation Scoreboard) 2007

³ European Council (2008), European Research Area Vision 2020: “Research, education and innovation policies and programmes are jointly designed among public authorities at all levels with appropriate involvement of relevant stakeholders, whenever this is necessary to optimise their effectiveness, efficiency and value to society and the economy”. See European Commission (2006), Communication from the Commission to the Council and the European Parliament delivering on the modernisation agenda for universities: education, research and innovation. Brussels, 10.5.2006, COM (2006) 208 final.

the agenda



The Austrian Council and most well-known experts are convinced that research, technology and innovation have fundamentally positive impacts provided they are developed, publicly discussed and employed with the necessary ethos and critical reflection (see also Strategy Element Society). In particular, the effects on competitiveness (and thus on growth and employment) and the contribution that can be made to solving major social challenges (climate change, scarcity of natural resources, biodiversity, problems concerning waste, an ageing population etc.) are regarded as

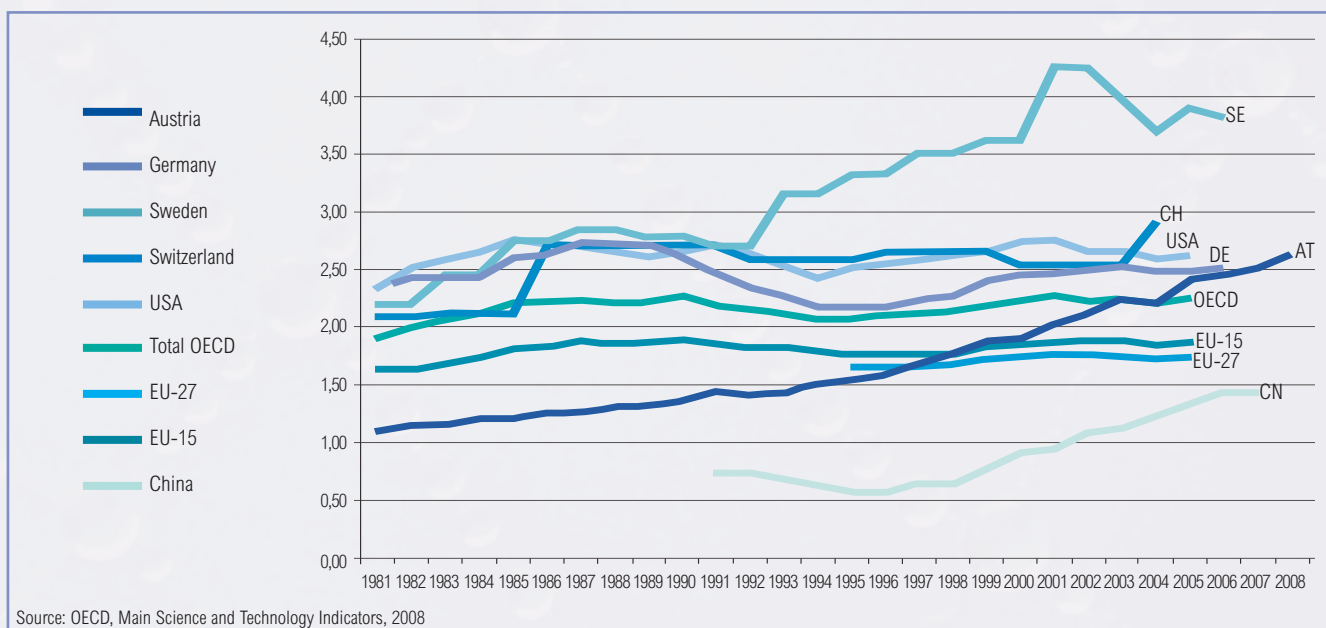
important. While the first point is one of the standard arguments used to advocate investments in this area (see Strategy Element RTI Funding Input/Output) the contribution that research and innovation can make to solving social problems has not really been systematically exploited. There is still a great deal of potential here, which can however, only be developed with a holistic policy approach (see Strategy Element Governance). Technological innovations alone cannot solve the problems we face. There also has to be a stronger focus on social innovations.

Improvements on a Broad Front / Long-Term Weaknesses

In terms of R&D spending Austria is one of those countries in the European Union that is developing most dynamically. The exemplary catching-up process that the Austrian RTI system has undergone in recent years is confirmed by

numerous international comparisons. Thus the latest Summary Innovation Index (SII) of the European Innovation Scoreboard 2008 (EIS)⁴ puts Austria in sixth place among the 27 EU member states. In an international comparison

Figure 2:
Growth of the
R&D quota in
an international
comparison



⁴ European Commission (2009): European Innovation Scoreboard 2008: Comparative Analysis of Innovation Performance. PRO INNO Europe Paper No. 10; Brussels.

EIS provides an indicator-based scoreboard for evaluating performance in the area of research, technology development and innovation. The EIS analyses 25 individual indicators which are grouped together in five categories and cover "innovation input" and "innovation output".

Austria, together with countries such as France, Ireland, Belgium and the Netherlands, falls into the category of innovation followers, i.e. the group behind the innovation leaders. In 13 of the 25 SII indicators Austria even lies above the EU average.

In particular, Austria boasts a better than average innovation performance compared to its competitors among the innovation followers and the innovation leaders: Today, Austria is the country with the most dynamic pace of development after Ireland⁵ and is now one of the countries in the European Union to have a realistic chance of achieving the targets laid down for the member states in the Barcelona and Lisbon processes. In terms of the research quota, Austria has also significantly exceeded the EU average in recent

years. In 2009 this amounted to 2.73 % of GDP,⁶ putting Austria in fifth place behind Sweden, Finland, Germany and Denmark in an EU comparison (see Fig. 2).

Austria's main weaknesses are in the categories human resources, the availability of risk capital and radical innovation (percentage of turnover due to product innovations). These deficiencies have been known for some time; however, there are as yet no signs of any significant catching up in a European comparison. This trend indicates that it is precisely those factors which are so important for putting the country at the top of the technological league tables (risk capital (see above), human resources, radical innovation) that are not yet sufficiently well established in Austria.⁷



Innovation Follower oder Innovation Leader?

An imbalance between innovation input and output is only one indication of the greatest challenge that Austria will have to overcome: To take the step from being an innovation follower to an innovation leader, or from being a country that is engaged in a catching up process to one that produces at the cutting edge of technology, i.e. is a front-runner. This development step is long overdue: As early as 1996 the draft outline of a government technology policy concept noted that the returns from an imitative strategy – of the kind pursued by an innovation follower or a catching up country – had largely been exhausted. The changes that have been made since then as well as the vigorous efforts to achieve the 3% target have not sufficiently changed structures in Austria. As a result, the task of achieving a fundamental change in the orientation of research, technology, innovation and policy still remains to be carried out (see Strategy Element Governance). The step toward innovation leadership and the

adoption of the necessary measures (e.g. in the educational, funding and political system) would significantly broaden Austria's options both in terms of maintaining competitiveness and the achievement of societal goals. The top position that Austria already holds in some areas relating to ecological, social and economic sustainability could form the basis for a role as an international leader.

The closer one gets to the top (i.e. to the frontiers of technological, economic and social innovation), the less effective the measures and instruments used in the past become. While these were suitable for closing the gap, they fail when it comes to overtaking or implementing a visionary research policy. This empirically well-established link – that economic policy measures deliver differing returns depending on the level of a country's development – creates a difficult situation for economic policy decision-makers, as it raises the question as to why the existing instru- ➤

⁵ See Cunningham, P. (2009): Science Policy and Evaluation: the Irish perspective. Presentation on the 2 Evaluation Day on 23 March 2009, Vienna.

⁶ See Statistik Austria, Global Estimate 2009.

⁷ European Commission (2009): European Innovation Scoreboard 2008: Comparative Analysis of Innovation Performance; PRO INNO Europe Paper No. 10; p. 25f.

the agenda



ment should be modified given that on the whole it has worked in the past and apparently still does.

A reorientation might be facilitated by growing social (national and global) problems and competition from neighbouring countries as well rising global competitive pressure even for sophisticated products and services. Given such developments it seems obvious that Austria needs to develop further and develop increasingly radical innovations of its own if it is to take its place

among the drivers and not the driven. This goes hand in hand with the need to make some of the resources used for research, technology and innovation available as “gambling money” with which high-risk bottom-up approaches can be pursued that would not otherwise receive support in the current funding system due to their novelty. This would not only (in the case of success) permit the development of innovative solutions; it would also break open old moulds (see Strategy Element Instruments).

Necessary Policy Approaches for Working Successfully at the Frontier of Technological, Economic and Social Innovation

The closer a country operates to the frontier of technological, economic and social innovation, the more resources it has to invest in research and well developed scientific infrastructure (see

Strategy Element Infrastructure). Research supports and strengthens innovation, especially at companies wishing to spawn innovations of their own. In the context of financing basic research,



the public sector plays a central role. In Austria, as in most of the other OECD countries, this is mainly financed by public funds.

The importance of higher education rises disproportionately with the rising level of development. More and better educated workers are the backbone of an economy that wishes to close the gap on the innovation leaders. This concerns both the capacities within the educational system and the development of the potential of all those who live in Austria. Austria's position, especially in this latter area, (measured in terms of the conspicuously small percentage of the population with a tertiary education qualification) is troubling (see Strategy Element People).

Structuring the scientific and educational system is, as Austria has had ample opportunity to learn, a challenging process. However, a strategy that envisages joining the ranks of the innovation leaders must also integrate the planning and development of education, research and innovation (triangle policies). But what looks like a bold demand can in fact put back some momentum into a number of discussions that have ground to a standstill. If these policy areas are seen together, it becomes clear that there can be no real and lasting progress without more and better educated workers embedded in a stable social context and that those stakeholders who are interested in long-term economic competitiveness, creating new jobs, safeguarding the social systems and solving society's problems against the back-

ground of sustainable development can hardly reach any other conclusion. A front running strategy also involves other policy areas (regulation, macro-economic steering, public procurement, standardisation, competition policy etc.) which require highly complex management and steering (eventuell: guidance) (see the Strategy Elements Key Research Areas, Governance, Instruments). Here it is vital to significantly improve strategic and implementation competence.

Supporting enterprises and scientific institutions also requires significantly broadening the range of instruments that are used. Policymaking in the past usually exhausted itself in the introduction of new programmes, which, furthermore, were inadequately coordinated with one another. If the efficiency of the system is to be improved, a balance has to be achieved in the funding sector between key research areas and thematically open programmes (see Strategy Element Key Research Areas, Governance, Instruments) and horizontal coordination with other policy areas. This should make it possible to draw up all-embracing packages of measures and abandon the fixation upon programmes. However, this policy approach should not stop at the federal level; instead relationships with the EU, neighbouring countries and less developed countries should be intensified (see Strategy Element Internationalisation). Last but not least, it is also important that activities be coordinated with those of the federal states.



From Efficient Institutions to an Efficient System

For a long time Austria was not really certain about how research, technology and innovation should be dealt with. In the late 1960s the OECD country background report identified an under-developed awareness of research, an almost complete lack of coordination of RTI activities, the lack of a research concept and a blatant lack of budget funds for RTI. Even in 1970 the Aus-

trian research quota amounted to only 0.6 % of GDP.⁸ In 1967, and in response to the criticism from the OECD, the Ministry of Science and Research (BMWF), the Austrian Science Fund (Austrian Science Fund (FWF)), the Austrian Industrial Research Promotion Fund (Forschungsförderungsfonds für die gewerbliche > Wirtschaft - FFF) were established.⁹

⁸ OECD (1971): Wissenschaftspolitik in Österreich, Paris.

⁹ See also the detailed account by Pichler, R. /Stampfer, M. /Hofer, R. (2007): Forschung, Geld und Politik: Die staatliche Forschungsförderung in Österreich 1945-2005; Innsbruck-Wien-Bozen.

the agenda



In the decades to come the funds were to form the backbone of the Austrian science and technology funding system. Their almost exclusive focus on their core business areas and the new challenges which nevertheless arose led to the establishment of further institutions, but not to steering and coordination structures that would have been able to accommodate the increasing complexity. The repeated attempts to develop strategies remained piecemeal efforts and none of these concepts managed to enter the political sphere and none of them were implemented.

With the establishment of the Austrian Council for Research and Technology Development in 2000 a new strategic policy body was created and efforts focusing on long-term, strategic visions for the national RTI system were intensified. The main task of the Austrian Council for Research and Technology Development is to provide the Austrian government with systematic, independent and sound advice on all strate-

gic aspects of research, technology and innovation with the aim of contributing to a forward-looking research, technology and innovation policy that will promote sustainable social and economic development. In pursuit of these tasks it has in the past issued the National Research and Innovation Plan (NAFIP) and Strategy 2010. Although approximately three quarters of the proposals contained in the latter have been implemented, this process has been anything but “linear” so that a series of tasks pertaining to the improvement of governance remain to be completed (see Strategy Element Governance). The present Strategy 2020, the recently completed system evaluation and the research dialogue provide an adequate basis for the development of strategies at the governmental level. For this to actually happen, political leadership is now called for. Otherwise, the implementation process will remain erratic and the effects suboptimal. ■



principles and strategy elements



The global economic and financial crisis has radically changed the framework conditions which had previously been assumed for the development of the RTI system. As the current crisis is not a cyclical but a global structural crisis, it can be assumed that once it has passed very little will be as it was before. There will be a perceptible impact on the supply, production and demand structures of most sectors of the economy. In terms of the strategic proposals and recommendations, the uncertainty regarding the framework conditions makes it necessary to prioritise those measures which position Austria most effectively as a centre of RTI as it competes in a globalised economy. In particular, measures are needed in respect of education and improving skills and qualifications, the systematic definition of key research areas and the provision of appropriate resources, linked by the instruments of intervention and their governance.

The need inherent in the crisis to make fundamental directional adjustments is exacerbated by the need for shorter response times. For this reason, the authors have throughout the entire Strategy document differentiated between short-term (2010), medium-term (2013) and long-term (2020) recommendations and have denoted them accordingly. It follows from this that the respective parts of the RTI Strategy 2020 must be checked against the framework conditions at regular intervals and if necessary continuously revised.

The timescale is not linked to forecasts regarding the duration of the crisis as these cannot be made with any degree of seriosity. Both the time frame until 2020 and the global economic crisis forbid long-term forecasts as to which countries will be among the leading innovation nations in ten years time, as this does not depend on their past strategy but on the strategy they choose to adopt now and for the future. Hence the need for continuous monitoring of the strategy, continuous communication and thus maximum flexibility to shape the framework conditions, the design of research funding programmes and the use of resources.

Political decision-makers have a duty to give clear priority to education, research, technology

and innovation policy and to ensure medium-term planning security by making the necessary budgetary resources available.

In formulating Strategy 2020 the Austrian Council has proceeded from the following principles that should guide action:

- Sustainability and social relevance are overriding motives for research, technology and innovation.
- The education, training and higher education of the population are the key asset in a knowledge-based society.
- Education, research and innovation are an inseparable whole. High political priority must be given to pursuing and organising this “knowledge triangle”.
- Wherever possible funding should be awarded on the basis of competition.
- It is essential to focus on potential and strengths, areas that are developing poorly should be critically evaluated and reconsidered.
- New structures and topics should only be opened up if in the medium term a “leading position” (excellence) can be achieved, they can be expected to offer above-average market potential and/or there is an important social need.
- A globally networked world demands nationally defined strategies for internationalisation.
- Structures must be made more flexible in order to respond rapidly and efficiently in a globalised world.
- Transparency and participation are policy-making maxims that reflect the responsibility toward society of those in decision-making positions.

Strategy 2020 is based on these fundamental ideas and guiding principles. However, it is also based on a solid foundation of thorough analyses of the status quo. The choice of strategy elements serves to structure the discussion. The following nine strategy elements were identified on the basis of a large number of studies and analyses:

1. People
2. Research, Technology, Innovation and Society
3. Input/Output
4. Key Research Areas

principles and strategy elements

- 5. Infrastructure
- 6. Instruments
- 7. Governance
- 8. Internationalisation

Each element of the strategy was developed on the basis of a thorough gathering of facts, the identification of an additional need for information and action, and the resulting decisions regarding necessary further steps such as further analysis, studies or workshops etc. Accordingly various study presentations, workshops and discussions were organised which then provided key input for strategic guidelines and recommendations. Finally, existing strategy documents and the results of the research dialogue and system evaluation were taken into account when drawing up proposals and recommendations for the strategic focus in the period up to 2020.

People are at the heart of all activities in the RTI system. Depending on the subject of the research, the nature and scope of the resources that are required vary. Strategic goals are pursued by defining key structural and thematic areas. The adequate deployment of resources based on efficient steering by governance ensures the successful interaction of people, resources and key research areas. The third dimension differentiates between the regional, national and international levels. The first two levels are dealt with jointly in the individual strategy elements, due to its increasing importance the international level is dealt with in a separate element of its own.

People & Society

Research in Austria is defined by the people who carry it out. Every monetary target defined as part of strategic policymaking must have as its focus the availability of qualified human capital, i.e. creative and committed men and women. Measures in the area of human resources and the relationship between science and society are therefore of crucial importance for the Austrian RTI system. The two strategy elements "People" and "RTI and Society" deal with the strategic planning of human resources development and the requisite framework conditions, also in relation to the dialogue between science and the public.

Input/Output

Austria is one of the few EU countries to have a realistic chance of achieving the 3 % target laid down in the Lisbon strategy. However, in the current economic climate this could take a few years longer than previously assumed. The framework conditions for future development should be subjected to a thorough analysis. The collection and analysis of R&D financial data is the prerequisite and starting point for the strategic recommendations in this regard. An assessment of the impact of spending on economic growth and productivity and how it can be increased are also of relevance in this context.

Key Research Areas

Greater importance must be given to systematically identifying key areas and emerging thematic areas in the Austrian research landscape. The aim of this strategy element is to point out methods and paths for arriving at a holistic definition of key research areas in order to further reinforce Austrian scientific and technological strengths and position them at the top of the international competition tables. Furthermore, RTI activities in areas that are of major importance for society should be systematically stimulated with a view to developing sustainable solutions.

Infrastructure

If it is to function effectively and efficiently the Austrian innovation system must be provided both quantitatively and qualitatively with adequate research infrastructures, both at home and in terms of proper access to international facilities. Based on a comprehensive survey of the current situation and an appraisal of demand in the period up to 2020, the strategy element Infrastructure sets out the requirements for satisfying this essential prerequisite for outstanding, internationally respected research work in Austria.

Instruments & Governance

Further structural development and optimisation are basic requirements for improving the attractiveness and efficiency of the Austrian RTI sys->



principles and strategy elements



tem. Structural deficits must be systematically eliminated, if Austria is to continue to hold its own in the competition between research nations. Taking into account the results of the system evaluation, the strategy elements Governance and Instruments focus on the structural requirements pertaining to organisational structures and process organisation in the RTI system as well as upon the measures and adjustments that are needed with regard to the funding instruments for the year 2020.

Internationalisation

In addition to the development of human resources, monetary support for research and suitable framework conditions, internationalisation is one of the strategic cornerstones that will constitute the terms of reference for Austrian RTI policy in the next few years. Priority should be given to increasing international mobility, integration in international networks and developing strategies for closer collaboration with neighbouring countries. ■





Status and Challenges

In knowledge-based economies the future of a location depends on the qualifications, commitment, creativity and motivation of the people. To maintain and increase its prosperity, Austria therefore requires better qualified and at the same time committed, creative workers who can think for themselves – both university graduates and highly qualified skilled workers. Demands are rising: On globalised markets there is growing competition from nations that are able to produce in the medium technology segment at substantially lower cost. This is especially true of those countries in Austria's immediate neighbourhood. Austria's strategic response must therefore be to leave behind the group of technology followers and move into the fast lane to join the innovation leaders and front-runners with cutting-edge production structures and highly developed productivity. This strategy implies a steadily rising demand for higher

qualifications and lifelong learning. This is even truer given that the democratic trend is increasingly altering the numerical balance between those who are actively employed and those who are in retirement.¹⁰ Continuously raising productivity will enable this gap to be closed again.¹¹

Austria has the prerequisites to overcome the challenges that this creates:

- Only modest use is made of the skills potential in Austria. Substantial opportunities for development can be opened up here by improving access to education and gearing educational systems more closely to individual needs.
- A more open attitude to immigration can broaden the skills base and help alleviate the future shortage of qualified workers.
- Increased research and innovation activities raise productivity, create jobs and contribute to maintaining prosperity.

Rising Demand for Skilled Workers

The rising demand for better qualified workers has been clearly evident since the 1990s. Between 1995 and 2006 the number of university graduates as a percentage of the Austrian workforce rose from 8.8 % to 13.2 %. In the same period, the percentage of those in employment with only compulsory schooling fell from 22.7 % to 16.7 %.¹² However, studies confirm an imbalance in the development of human resources in Europe compared to the USA and Japan. While in 2005 there

were 5.8 scientists for every 1,000 persons in gainful employment in the European Union, the figure in the USA was 9.3 and in Japan 10.3.¹³ With a figure of 7.4, Austria is not among the leaders compared to the other countries of the European Union, but it could expand its capacity to 8 scientists per 1,000 persons in gainful employment. This goal is consistent with the budget trajectory for achieving the research quota of 3 % of GDP.¹⁴

¹⁰ Biffl, G., (2006): Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation, Teilstudie 6: Bevölkerungsentwicklung und Migration, WIFO.

¹¹ Fassmann, H. (2007): Wann kommt der "Knick" des Arbeitskräfteangebots? Prognose der erwerbsfähigen Bevölkerung. In: Fassmann, H. (ed): 2. Österreichischer Migrations- und Integrationsbericht 2001-2006. Rechtliche Rahmenbedingungen, demographische Entwicklungen, sozioökonomische Strukturen; Klagenfurt, p. 283-284.

¹² Fritz, O. / Huemer, U. / Kratena, K. / Mahringer, H. / Prean, N. / Streicher, G. (2008): Mittelfristige Beschäftigungsprognose für Österreich und die Bundesländer, Berufliche und sektorale Veränderungen 2006-2012, WIFO.

¹³ OECD (Febr. 2007), Main Science and Technology Indicators or The "Human Factor" in the field of innovation, Federation of Austrian Industry.

¹⁴ See also European Commission (2004): Science and Technology: The Key to Europe's Future – Guidelines for Future European Union Policy to Support Research; Brussels.

Interrupted Education

The skills potential that is available in Austria does not appear to have been exploited to anywhere near a satisfactory degree. This is above all due to the interrupted education chain. It is harder for those social strata with both lower and medium levels of education to obtain higher qualifications through education. This exacerbates the shortage of skilled workers and also reduces the number of people who reach the level of education required for university admission which in turn is one of the causes of the notoriously small percentage of graduates from institutions of higher education.

One major reason for this situation is the selective and segmented educational system in which educational opportunities for children are generally determined by the level of education attained by their parents. Children from families with poor educational opportunities choose other forms of education than do the children of more highly qualified parents. Only 52 % of Austrian children attain the same level of education as their parents. Only 26 % attain a higher level, while 22 % actually fail to reach the level achieved by their parents. The choice of school type is influenced by the educational background but also the professional and social status of the parents. Changes in this area must therefore start by raising parental awareness.¹⁵ The introduction of one year of compulsory kindergarten education is a first step toward greater educational justice and to making better use of the potential for development.

Movement between educational pathways – and thus adjustment to the needs of the employment

market – is prevented by the lack of modularity in the highly segmented educational system. This situation is characterised by a lack of encouragement for newcomers and lateral entrants to education as well as difficult conditions for those wishing to obtain qualifications at a later stage in life and in other areas of lifelong learning. This is also true with regard to immigrants who, although they tend to be better educated than the Austrians, are usually employed in jobs for which they are overqualified.¹⁶ Absolutely no use at all is made of the skills of well-qualified asylum-seekers whose applications are being processed.

Overall, this reveals a picture of difficult and therefore inadequate access to higher education in Austria. While in Poland, Sweden or Norway 78 % of the population start higher education,¹⁷ in Austria the figure is only half as high.¹⁸ The flow of entrants to institutions of higher education is growing too slowly to close the gap to the leading nations in accordance with the front-runner or innovation leader strategy. Furthermore, compared to the other countries in the OECD, the tertiary education section in Austria is still characterised by high drop-out rates that are explained more by social background or course-specific selection criteria than by actual achievement criteria.

While generally better qualified people are needed to achieve employment and economic growth, and also to overcome the major challenges facing society, special efforts are required with regard to scientific and technical training.¹⁹ The situation with regard to access to education >

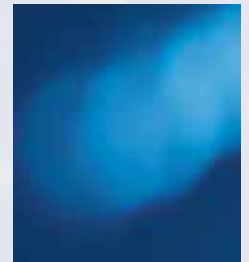
¹⁵ OECD (Febr. 2007), Main Science and Technology Indicators or The “Human Factor” in the field of innovation, Federation of Austrian Industry.

¹⁶ See also European Commission (2004): Science and Technology: The Key to Europe's Future – Guidelines for Future European Union Policy to Support Research; Brussels.

¹⁷ Haas, M. (2008): Humanressourcen in Österreich (A comparative study carried out on behalf of the Council for Research and Technology Development), University of Vienna, Faculty of Economic Sciences; Vienna.

¹⁸ Gächter, A. / Stadler, B. (2007): Qualifizierung, Dequalifizierung und berufliche Weiterbildung in Österreich 2001 und 2005. Arbeitspapiere Migration und soziale Mobilität No. 3, <http://www.zsi.at/attach/p306ihaus.pdf>.

¹⁹ OECD (2007): Education at a Glance, OECD Indicators; Paris.



people



and graduate numbers is especially poor in these disciplines. Young men, who choose these subjects more frequently, study less frequently in Austria than on average in the OECD and women

who start to study tend not to consider these subjects. Satisfying the demand for qualified workers in this area is already the biggest challenge facing Austria as an economic location.²⁰

Obstacles to Careers in Science

Compared to other countries the situation in Austria is characterised by the small percentage of graduates and the lack of attractiveness of scientific careers.²¹ Agreement regarding a collective bargaining agreement for scientific personnel within the university system marks an important step on the way to making careers in science more attractive.

Adequately funded and extremely well-equipped universities are a vital prerequisite for attractive scientific careers in Austria. It is they that determine how attractive the Austrian science sector is to world-class researchers, to Austrian scientists working abroad and to talented students.

Strategic Guidelines and Recommendations

Based on this analysis and the current challenges in relation to the development of human resources, the Austrian Council has identified the following strategic guidelines. What is crucial in this respect is an all-embracing approach: Education, research and innovation have a mutual impact on one another and – if decisions in these areas are made in isolation from one another – lead to a very inefficient system. It is therefore necessary to plan these areas together and implement the measures in a concerted manner.

Strategic Guideline 1: Improve Access To Education

To fully exploit peoples' skills and creative potential it is essential that a concerted effort is made to include everybody living in Austria in an all-embracing further development of human resources. To this end, it is necessary to actively address those sections of society with poor educational opportunities in an effort to counteract the social selectivity of the system. In order to attract more people to higher education, the universities and universities of applied sciences (Fachhochschulen) must be given the appropriate financial resources and structures. The percentage of graduates must be increased by achieving a balanced

ratio of staff to students, and by making all disciplines more attractive, especially in the sciences and engineering sector.

The Austrian Council recommends

■ Recommendation 1.1

New school concepts – also based on well-established and proven international models – should be put in place to eliminate early segmentation at the age of 9 or 10 and increase the number of students leaving school with certificates of secondary education. In this connection, innovative school models must be developed ►2020

■ Recommendation 1.2

Language training in German and English should be increased at both kindergarten and school and additional targeted measures introduced to improve German-language skills among immigrants and better exploit their potential in terms of tertiary education. Furthermore, an effort should be made to specifically promote maths and science skills. ►2013

■ Recommendation 1.3

The financial resources of the autonomous universities should be increased. The commitment to an

²⁰ See also Federation of Austrian Industry (2008): *Menschen schaffen Zukunft*; Vienna.

²¹ See Biffl, G. (2007): *Forschungsstandort Wien: Zur Rolle der Humanressourcen*, WIFO; Vienna.

investment quota of 2 % of GDP in higher education and training should be reaffirmed. This also includes adequate funding for a collective bargaining agreement and attractive career models for scientists working at universities. ►2020

■ Recommendation 1.4

To lower drop-out rates the quality of teaching must be enhanced by massively improving the ratio of staff to students. Programmes to clarify student motivation as well as the improved communication of degree course content at schools should be institutionalised. Induction phases during the initial period at university or tests – provided they are actually aimed at measuring aptitude for a course – should be introduced as selection procedures.²² ►2020

■ Recommendation 1.5

A coordinated programme of action should be implemented to advertise science and engineering-based courses with the aim of increasing the number of students starting and completing such degree programmes. As part of these efforts, the continuation of programmes designed to generate an early interest in technology (especially among girls) should be intensified. ►2013

■ Recommendation 1.6

Special programmes should be developed to motivate and encourage individuals to enter higher education whose social or linguistic background might at first sight appear to present an obstacle. ►2013

Strategic Guideline 2: Raise the Profile of Science as a Career

As stated in the current Government Programme,²³ it is essential to motivate more people in both

science and industry to take up a career in research, technology and innovation in order to ensure the sustained generation of new knowledge – both in basic and applied research. To this end, the profile of science as a career must be raised and scientific careers made more attractive.

The Austrian Council recommends

■ Recommendation 2.1

In addition to the one thousand extra post-doc positions already envisaged in the 2006 Government Programme, additional financial resources should be invested to improve educational opportunities in the doctoral and entire post-doctoral phase. In order to attract scientists to Austria and keep them here, contracts must be brought into line with international standards (tenure track system, collective bargaining agreement for scientists) ►2013

■ Recommendation 2.2

New career models must be developed for women in research to improve work-life balance.²⁴ Above all, it is necessary to recognise career interruptions. In particular, assessment criteria for grants and other subsidies should be revised and university careers made more attractive for women and those wishing to start or switch careers at a later date. ►2013

■ Recommendation 2.3

Better services should be offered to researchers with the threefold aim of a) keeping highly qualified Austrian scientists in the country and persuading them to return after periods spent abroad, b) attracting foreign scientists to Austria and c) networking all those concerned with one another. The EURAXESS initiative of the European Commission should serve as the model here. ►2013 >



²² See also Spiel, C. / Schober, B. / Litzenberger, M. (2008): Evaluation der Eignungstests für das Medizinstudium. Evaluierungsprojekt im Auftrag des BMWF; Vienna. http://www.bmwf.gv.at/uploads/tx_bmwfcontent/Spiel_Studie.pdf

²³ Government Programme for the XXIV Legislative Period (2008), <http://www.spoe.at/bilder/d268/Regierungsprogramm.pdf>, p. 42

²⁴ Government Programme for the XXIV Legislative Period (2008), <http://www.spoe.at/bilder/d268/Regierungsprogramm.pdf>, p. 210



■ Recommendation 2.4

Industry and science should be strengthened in the educational sector and should work together at an institutionalised level. To this end, existing initiatives should be continued and a doctoral programme established as a private-public-partnership under the academic supervision of the universities to bring questions from business and society into the domain of higher education. Business, industry and society will thus provide an impetus for science. The emphasis should be upon the collaborative aspect. ►2013

■ Recommendation 2.5

Universities of applied sciences where the number of degree programmes has reached a critical mass and which owing to the economic structure of their home region have a greater need for research should be put in a position where they can become long-term stable research partners for local industry. ►2013

Strategic Guideline 3: Use and Promote Immigration

Irrespective of their country of origin, highly qualified individuals help improve the potential for growth and employment of the region in which they live. In this context, it is essential to specifically include all those who are resident in Austria in the further development of human resources in order to reap the benefits of this additional potential.

The Austrian Council recommends

■ Recommendation 3.1

A single Austria-wide approach based on international standards should be established for the recognition and crediting of foreign qualifications. The modalities of the nostrification process should be generally improved and simplified. At

the European level, the government should work toward the general recognition of qualifications obtained within the EU. ►2013

■ Recommendation 3.2

The government's commitment to ease access to Austria's RTI system for top international scientists is to be welcomed. To this end, a targeted package of measures to promote the immigration of qualified scientists, students and doctoral candidates should be developed. Legal and administrative hurdles for qualified immigrants and their families should be abolished. ►2013

■ Recommendation 3.3

To ensure public acceptance for the integration of foreigners, an awareness campaign should be developed that transports the positive image of an innovative country of immigration. The campaign should also aim to make Austria more attractive abroad as a destination country for highly qualified immigrants. ►2013

■ Recommendation 3.4

Universities should develop more national joint degree programmes. An incentive system should be developed and consideration should be given to embedding it in performance agreements. ►2013

■ Recommendation 3.5

Traditional mobility programmes should be complemented by research-based mobility programmes. Particular emphasis should be given to a focus on performance. ►2013

■ Recommendation 3.6

Access to Austrian research institutes should be eased for foreign students and post-doctoral candidates from third countries. Legal and internal barriers at universities should be eliminated. ►2013 ■





Status and Challenges

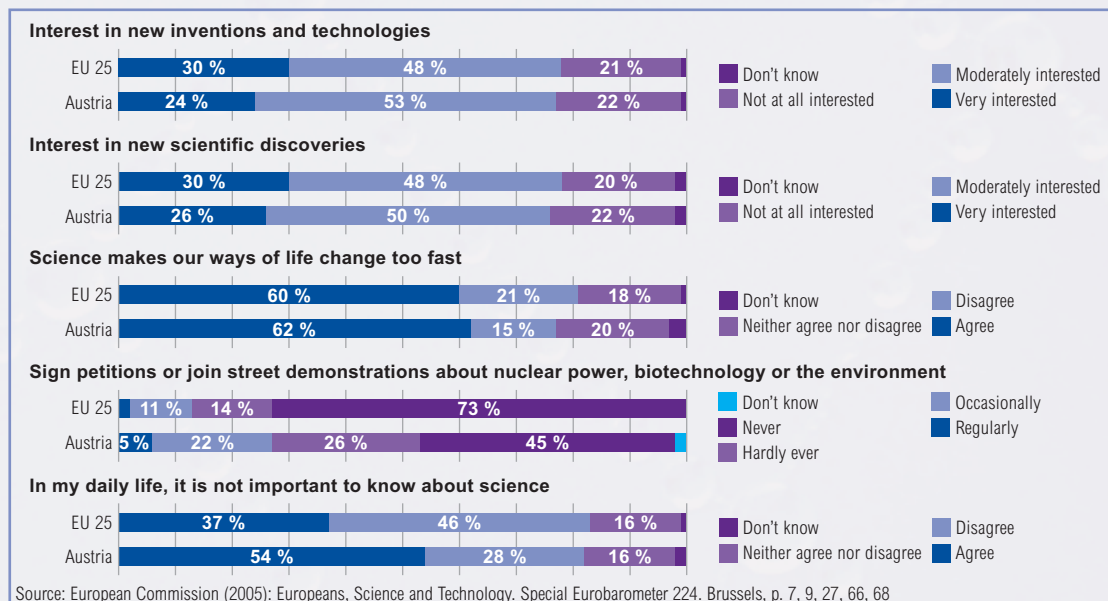
In the concept of the “knowledge-based” society, science, research, technology and innovation are considered to be decisive force fields of societal development. They penetrate all areas of life and activity and are considered essential for improving our quality of life, safeguarding our competitiveness and thus our prosperity. They are entrusted with the task of finding answers and solutions to the questions and problems of our age.

The more research, technology and innovation noticeably change the life of every individual, the more they are called upon to address the potential changes and discuss them in a forward-looking public conversation. However, at present there is almost no area in society about which the public has such a dearth of specific knowledge as science, research, technology and innovation. Thus it is still largely unknown how science actually works, how new knowledge is generated and how it also

constitutes a cultural achievement. However, if there is a lack of knowledge about this topic, it is then hardly surprising that the public discourse is usually dominated by terms such as “risk” and “uncertainty” and that it is extremely difficult to engage in a fact-based discussion. Greater information does not automatically mean greater acceptance and endorsement for science and RTI, but it is conducive to a dialogue in which conflicts can be dealt with in a more transparent, comprehensive and structured fashion even if they cannot be resolved.

Austria has only a weak tradition of consultation and dialogue processes in regard to science, technology and innovation policy.²⁵ “Scientific-technological advances such as genetic engineering and nano-technology were, and still are, mostly carried out as projects by elites who are institutionalised within the funding system. There is a tendency to

Figure 3:
The attitude of
Austrians to
science, research,
technology and
innovation in
an European
comparison



²⁵ See also Felt, U. / Fochler, M. / Müller, A. (2003): Sozial robuste Wissenspolitik. Analyse des Wandels von dialogisch orientierten Interaktionen zwischen Wissenschaft, Politik und Öffentlichkeit; Vienna, p. 40.

²⁶ Gottweis, H. / Latzer, M. (2006): Forschungs- und Technologiepolitik, in: Dachs, H. et al. (eds), Politik in Österreich. Das Handbuch; Vienna, p. 719.

avoid public, and also parliamentary, involvement”.²⁶ However, it is not as if Austrians are fundamentally uninterested in inventions, technology and scientific knowledge. According to comparative surveys, the level of interest in Austria is only slightly below the European average (see Fig. 3). However, the opinion that “one does not require

any knowledge about science in one’s everyday life” is considerably more widespread here than elsewhere in Europe. Willingness to participate in the discussion of these topics in the form of petitions and demonstrations “against nuclear energy, genetic engineering and for environmental protection” is significantly above the European average.

Deficits in the Culture of Communication

In Austria, science and RTI communication as well as participatory discussion and consultation processes are underdeveloped due to discontinuities, the lack of key players (e.g. foundations) and inadequate involvement of other key actors (e.g. universities and museums/science centres) as well as ominously close links to political interests.²⁷ The official rhetoric in relation to the need to communicate science and RTI is dominated by the terms “awareness” and “promotion of acceptance” and “promoting young scientists”. Although a dialogue with the public is always called for, in practice there is a discrepancy between the rhetoric and reality. The emphasis is still very much upon “selling science”.²⁸

It fits this picture that the parliamentary Research Service has still not been effectively expanded. Thus Austria does not have – as is common international practice – an independent institute of technology assessment that is linked in some way to the political system.²⁹ On the contrary, as a result of the individualised consultation of experts, in many cases in accordance with the party line, parliamentary committees and mem-

bers of parliament are exposed to fragmented influences. The so called system of “proporz” (proportional representation election system) also shapes decision-making in questions of scientific and research policy.³⁰

The Austrian Council therefore examined the issue of science and RTI communication early on and took a number of significant steps by initiating the campaigns “Innovatives Österreich I” and “Innovatives Österreich II” and by organising participatory processes.³¹ However, as “Innovatives Österreich” came to an end in 2006 and has not been replaced, there is now a lack of adequate coordination, networking and support for measures in the area of science and RTI communication.

Apart from the lack of structures, efforts to address the general public by means of awareness-raising measures run the risk of trying to target everyone, but reaching no one. Various studies show that there is no such thing as “the public”, but in fact a number of different groups with differing needs, concerns and interests (for examples, questions concerning the environment, food or >



²⁷ Science Communications (2008): “Governing” Wissenschaft und Gesellschaft. Vergleichender Bericht im Auftrag des RFTE, p. 5.

²⁸ Science Communications 2008: “Governing” Wissenschaft und Gesellschaft. Vergleichender Bericht im Auftrag des RFTE, p. 64.

²⁹ While the Institute of Technology Assessment of the Austrian Academy of Sciences (ITA) works for various ministries on a project basis, it is not linked to them in any legal form. To date the Austrian Parliament has only rarely, if at all, been a customer of the ITA. Felt/Fochler/Müller 2003, p. 42.

³⁰ Kozeluh, U. (2008): Wissenschaft und Gesellschaft, Verhältnis – Auswirkungen – Einbindung (Report on behalf of the Council for Research and Technology Development); Vienna, p. 87.

³¹ For example the Citizen’s Conference “Genetische Daten – woher, wohin, wozu?” in June 2003, and the Future Search & Assessment workshops on “Energie und EndverbraucherInnen” in November 2007.



health).³² At the same time, however, it should be remembered that any belief that addressing a target audience involves nothing more than efficiently delivering messages to defined groups to whom the “products” science and RTI should be “sold” is short-sighted.

The relationship between science, research, technology, innovation and society cannot be reduced solely to the appropriate form of communicating information. A productive dialogue needs forms of communication and negotiation that not only satisfy increasing democratic demands, but are also capable of assuming a translation function in

cases where there are conflicting values. This opens up possibilities and space for a critical examination and informed discussion of important issues that are of public interest and in which civil society, interest groups, scientists and researchers as well as policymakers can participate with a view to generating “socially robust knowledge”. The success of such participatory processes for society as a whole, however, depends upon whether the societal input is actually fed back into the political decision-making process and societal participation can be sustained at the political level.

Ethics and Morality

The fact that in addition to “knowledge” science and research also mean “acting” and “shaping”, presents an ethical and moral challenge in these areas. Science gives us the means to change and shape the world and even human beings. It therefore has a responsibility not just to the present generation but also to future generations.

Today the public discussion of the resulting ethically controversial questions pertaining to science and RTI is conducted mostly in the media. Ethical opinion-making among scientists and researchers is currently as limited at universities as at non-university research institutes or within companies – as a consequence of which the social contexts and values within which science and RTI are embedded, and which they in turn influence, are not usually reflected.

Essentially one must distinguish between two ethical dimensions in science and RTI. On the one hand, “scientific integrity” which includes inter alia, the demand for the accurate documentation of sources, the controllability and repeatability of experiments, the careful separation of one's own ideas and those of others and finally, the common ownership of scientific

knowledge. An important first step was taken here with the establishment of the Agency for Scientific Integrity in November 2008. This issue must now be rigorously pursued in future.

Then there is the “ethos of scientific responsibility”³³, which demands ethical reflection from science and RTI where and when rapid scientific and technological progress raises serious moral questions that concern society as a whole in its values and which will also have an impact on future generations. This ethos demands ethical reflection upon both the objectives of science and research – including the world views and images of man underlying them – as well as the means used by science and RTI to realise these objectives.

Where there is unrestricted acceptance of the freedom of science, and in view of the fact that the rapid increase in knowledge multiplies the possibilities we have of changing the world, it becomes increasingly important to examine which of the applications from the knowledge generated we actually need and how we wish to use the knowledge produced by science and RTI. The model of science that still prevails and which strictly separates knowledge from its

³² See also: Felt, U. / Wynne, B. (2007): Taking European Knowledge Society Seriously. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate; Brussels.

³³ Nida-Rümelin, J. (1996): Wissenschaftsethik, in: Op.cit. (ed.): Angewandte Ethik. Die Bereichsethiken und ihre theoretische Fundierung, Stuttgart, pp. 778–803.

application must therefore be critically questioned, above all by scientists and researchers. The Austrian Council therefore warmly welcomes an initiative by Joanneum Research, where a working group “Ethics in Science and

Technology” has been set up to develop an Ethics Charter based upon the “classification of the objectives and methods of research and technology in perspectives that focus upon human life in its entirety”.³⁴

Strategic Guidelines and Recommendations

The Austrian Council considers that science and RTI has a duty – especially where it is publicly funded – to fully and broadly inform society about its activities as well as about new knowledge and developments. Among other things, this means that all public research results in Austria (in particular publications, primary research data, etc.) should be freely accessible on the web by the year 2020 – key word: open access. Furthermore, varied, but above all sustainable possibilities for dialogue must be provided in order to offer a wide public or various sections of the public, space for critical reflection.³⁵ This is also consistent with the demand made by the European Commission in 2002 in its action plan Science and Society: “In a knowledge-based society, democratic governance must ensure that citizens are able to make an informed choice from the options made available to them by responsible scientific and technological progress”.³⁶

Strategic Guideline 4: Create Structures for Active Dialogue and Participation

The discontinuation of the dialogue programmes within the “Innovatives Österreich” initiative

and the decision not to replace them has left a gap in the framework and structures for an active dialogue between science/RTI and society. We now have to create space and opportunities for civil society, scientists, researchers and interest groups to jointly subject the acquisition and utilisation of knowledge to a critical discourse.

The Austrian Council recommends

■ Recommendation 4.1

Representatives of the Austrian Council, the ministries, the scientific community, the stakeholders, media and civil society should jointly develop a strategy for shaping the dialogue between science/RTI and society. ►2010

Monitoring: The Austrian Council will support and follow further developments in connection with the preparation of a strategy to shape the relationship between science/RTI and society.

■ Recommendation 4.2

The Long Night of Research („Lange Nacht der Forschung“) should be held regularly as a national festival, ideally each year. At the same time, greater attention should be paid to ensuring that



³⁴ Joanneum Research – Working Group „Ethics in Science and Technology“ (2008): Ethik in der Forschung. Ethik-Konzept des Joanneum Research (Living Paper); Graz, p. 5.

³⁵ This dialogue must take place on several levels with the help of a comprehensive mixture of methods. Firstly, it concerns the initial consent to approach a scientific subject and also participation in specific policymaking. Depending on the topic and objectives, differing methods must therefore be used – from low threshold measures such as Science Centre activities, to institutional procedures, such as parliamentary committees or citizens' conferences. Science Center Netzwerk 2009, p. 2 f.

³⁶ European Commission (2002): Science and Society Action Plan; Brussels. p. 3.



the Long Night and similar science communication activities do not present themselves as “education programmes” or “sales shows”, but endeavour to achieve a dialogue between science and society in a spirit of mutual respect.

■ Recommendation 4.3

A system of incentives should be developed to encourage scientists and researchers to actively engage in a dialogue with the public. ►2013

■ Recommendation 4.4

The “Science/RTI and Society” dialogue should be institutionalised, ideally in the form of an independent institution. As this is only possible if participatory processes and the political decision-making process are sufficiently well integrated, measures should be taken to ensure that while this institution is fully independent, it should be linked to the political system in a way that ensures its results are heard. Coordination with relevant European initiatives should be sought. ►2013

Monitoring: The Austrian Council will set up a working group to follow developments and press for progress.

■ Recommendation 4.5

The Parliamentary Research Service should be expanded and tasked with obtaining, editing and furnishing independent expertise. An Institute for Technology Assessment should be networked more closely with parliament and the Parliamentary Research Service. Subsequently,

supporting scientific research pertaining to the development of new technologies should be expanded ►2013

Strategic Guideline 5: Create Awareness of the Ethical Dimension of Science, Research and Technology Development

As part of the dialogue between science/RTI and society, methods and structures must be established that not only provide scope for examining the effects of scientific and technological progress (key word: technology impact), but also, at an early stage of the scientific work, permit the question as to which points of departure, norms, value systems, views of man and the world, visions and promises for the future actually underlie the research questions. As Austria must be able to form its own judgement about trends in science and RTI there can be no thematic taboos.

The Austrian Council recommends

■ Recommendation 5.1

Research establishments and institutions of higher education should take the establishment of ethical discourses into their own hands. The core task is to develop and establish ethical guidelines and to communicate them externally. The ethical discourse should be conducted in a more inter-disciplinary and trans-disciplinary fashion. Science, research and technology ethics should be anchored at universities and universities of applied sciences. ► 2013, 2020 ■





Status and Challenges

The mobilisation of financial resources was one of the most important *sine qua non* demands made by the European Union in its Lisbon strategy. None of the EU countries that were not already ranked among the leading nations has pursued the Barcelona target of increasing investment in research to three percent of GDP by 2010 as consistently and successfully as Austria. In 2009 a figure of 2.73 % was reached (Global Estimate: Statistics Austria). At the same time, it should be noted that the recent years have also shown that the growth rates necessary for coming closer to the 3% target are also feasible. The Austrian Council remains committed to the 3 % target that has become the politically defined symbol for the positive and dynamic development of the RTI system. However, in 2009 the macro-economic impacts of the global economic and financial crisis have been clearly felt and it will probably not be possible to assess the medium-term development for another one or two years. In this situation, it is especially important to continue working toward the goal of catching up with the front-

runners among researching nations by 2020 by substantially increasing R&D expenditures.

The Government Programme for the XXIV Legislative Period clearly set out a number of key points:

■ The government set itself the goal of increasing the country's research quota to 3 % of GDP by 2010 and to 4 % by 2020. Austria should move from the "followers" league to the league of "innovation leaders", thus making the Republic one of the most innovative countries in the EU. In order to achieve these goals, the government will provide adequate funding while considering that its budgetary policy should trigger as much private investment in research as possible.

■ Measures should be developed that "will help support basic or pure research, providing it with a funding quota in line with that of European leaders".

■ The government states that "it is worth striving for the budgetary value of 2 % GDP public and private expenditure on the tertiary education sector", but without referring to the 2020 time frame specified in November 2008.

1998–2008: Dramatic Rise

In the last ten years research, technology and innovation have moved dramatically up the political agenda. Unlike many other areas of policy, the prioritisation of this area has been accompanied by a significant increase in financial resources. Spending on research as a percentage of GDP rose from 1.78 % in 1998 to 2.14 % in 2002 and then to 2.73 % in 2009 (Table 1).

As shown in Table 2 the biggest increase among all performance sectors in the period 1998–2006 was recorded for the corporate sector, which grew by an average of 9.4 % p.a. With the justification given in the Agenda, this provides the basis for more developmental re-

sults.

In spring 2002 the European Council set itself new targets in Barcelona. The aim was now to increase total spending on R&D and innovation in the EU to 3 % of GDP by 2010 while European business was called upon to provide two thirds of this new investment. It was now that the R&D quota started to appear prominently in Austrian RTI policy: Spending 3 % of GDP on R&D became the central target parameter of Austrian RTI policy. The Austrian Council also based its Strategy 2010 on this input target.

At the same time, there was a decline in public spending as a percentage of total investment in

³⁷ Government Programme for the XXIV Legislative Period (2008), Chapter "Research, Technology, Innovation (TTT)", p. 39 (See footnotes 23 and 24).

³⁸ Government Programme for the XXIV Legislative Period (2008), Chapter "Research, Technology, Innovation (RTT)", p. 45 (See footnotes 23 and 24).

³⁹ Government Programme for the XXIV Legislative Period (2008), Chapter "Science", p. 204. (See footnotes 23 and 24).

Table 1: FUNDING of Research and Experimental Development carried out in Austria 1998–2009

Year	Gross Domestic Expenditure on R&D (in EUR mn.)	of which financed by:					Nominal GDP (in EUR bn.)	Gross Domestic Expenditure on R&D as % of GDP
		Federal Government	Federal States	Business Enterprise Sector	Abroad	Other		
1998	3.399,83	1.097,51	142,41	1.418,43	684,63	56,86	190,85	1,78
2000	4.028,67	1.225,42	248,50	1.684,42	800,10	70,23	207,53	1,94
2002	4.684,31	1.362,37	171,26	2.090,62	1.001,97	58,09	218,85	2,14
2004	5.249,55	1.462,02	207,88	2.475,55	1.016,61	87,49	232,78	2,26
2006	6.318,59	1.772,06	219,98	3.057,00	1.163,35	106,20	257,29	2,46
2008	7.516,58	2.337,04	367,00	3.483,73	1.207,70	121,11	282,20	2,66
2009	7.652,27	2.545,50	401,86	3.439,83	1.132,37	132,71	280,11	2,73

Source: Statistik Austria: Global Estimate 2009 [Excerpt]

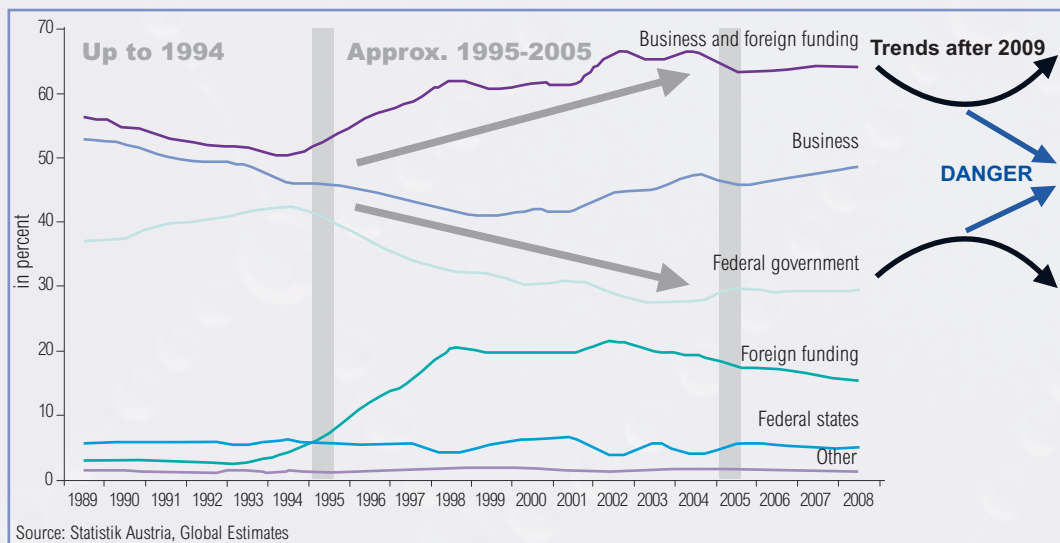
Table 2: R&D PERFORMANCE by Sectors 1998–2006

Year	Business Enterprise Sector		Higher Education Sector		Government		Private Non-Profit Sector	
	EUR mn.	%	EUR mn.	%	EUR mn.	%	EUR mn.	%
1998	2.161		1.010		219		10	
2002	3.131	9,7	1.266	5,8	266	5,0	21	18,8
2004	3.556	6,6	1.402	5,2	270	0,6	22	1,6
2006	4.449	11,8	1.523	4,2	330	10,6	17	-12,5
1998–2006		9,4		5,3		5,3		5,8

Source: Statistik Austria, R&D in all economic sectors

R&D (in the period 1995–2005), which most recently totalled 35 to 37 % (see Fig. 4). In contrast, business enterprises have increased their spending much more significantly than the public sector. As a result, another Barcelona target has almost been met, namely, two thirds

of research to be financed by the business sector and one third by the state. This dynamic development of corporate research has proven to be the main factor behind rising levels of R&D spending and movement toward the 3 % target. This is not only attributable to the increase in >

**Figure 4:**
Development of
the RTI financing
structure in
percent

input/output



R&D promotion schemes, in particular tax incentives, but to a variety of other factors, such as the investment climate or access to scientific results. Given the dynamic development in the corporate sector, it is to be expected that innovation output will also register higher than average growth. WIFO (Austrian Institute of Economic Research) has already empirically demonstrated the positive link in terms of sales and

employment.⁴⁰ The current economic situation harbours the risk of a reduction in corporate research (see Fig. 4). The public sector therefore has a duty to provide suitable incentives for coming years so that the proportion of research carried out by the corporate sector can be increased. This will also enable the innovation output of corporate research to grow in accordance with the reasoning set out in the Agenda section.

High Percentage of Foreign Funding

The strong performance of the private sector has been boosted by the R&D investments made by international corporations at their subsidiaries in Austria. For research in Austria is characterised by a high level of foreign funding: This accounts for roughly 16 % of total R&D expenditure (2008), a figure only equalled by a small number of other European countries.

A survey commissioned by the Austrian Council also examined the influence of foreign funded R&D activities in Austria above and beyond this.⁴¹ Taking into account internal coordination processes (budget and topic planning) within international corporations, roughly 36 % (approx. EUR 1,450 bn.) of corporate R&D spending in Austria is co-determined from abroad.

Although in absolute terms foreign funding has increased in recent years, it has more recently registered a decline in percentage terms and, in 2009, also in terms of actual amounts. Due to the relatively high level of dependence upon foreign funding, and given the desire to achieve a higher

R&D quota for Austria, this development must be regarded as critical. For fulfilling the long-term aim of intensifying R&D activities the share of funding originating abroad is just as important as that generated domestically. Foreign funding is a particular mark of Austria's quality as a location for research and if possible appropriate measures should be taken to increase it once more. (See Strategy Element "Instruments").⁴²

Since 2005/06 funding by Austrian and foreign business enterprises has started to level out. However, since 2009 there appears to have been a structural break as a result of which both the volume of corporate funding and the 2:1 ratio of private to public financing are shifting in an undesirable direction. Greater public sector funding is therefore required to counter this trend and stabilise the situation. There are a number of direct and indirect instruments available to the public sector that could be implemented in part with a greater degree of emphasis (see Strategy Element Instruments).⁴²

Financing and Performance of R&D in Austria

Key data for the public funding of R&D of business enterprise include:⁴³ In 2006, 1,121 companies received public R&D funding. At EUR 428 million

public sector funding accounted for 9.6 % of total internal R&D spending by the corporate sector. The largest share, at EUR 156 million, was the

⁴⁰ See Falk M. /Hake M. (2008): Produktivitätseffekte und Bestimmungsfaktoren der steigenden F&E-Ausgaben in Österreich (Study carried out on behalf of the Austrian Council), WIFO; Vienna.

⁴¹ AMC 2008: Special survey "F&E bei österreichischen Unternehmen im ausländischen Konzernverbund", in cooperation with Statistics Austria; Vienna.

⁴² See also WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 4: Tax Incentive Schemes for Research and Development; and Report 5: Das Angebot der direkten FTI-Förderung in Österreich; Vienna.

⁴³ Statistics Austria (2008): Forschung und experimentelle Entwicklung (F&E) im Unternehmenssektor 2006; Vienna.

research premium, followed by Austrian Research Promotion Agency (FFG) funding amounting to EUR 116 million, federal funding (mainly for the collaborative sector) of EUR 98 million and funding from the federal states amounting to EUR 38 million. The research premium was included in the survey for the first time in 2006 and is the main reason for the sharp increase in funding between 2004 and 2006 (from EUR 229 million to EUR 428 million).

There has been one change with regard to the types of research (classified according to Frasca-

ti), which while presumably unplanned, is due to the increasing importance of corporate research (see Fig. 5). Although between 2002 and 2006 expenditure on all types of research rose in absolute terms, basic research still accounted for 18 % of research in 1998. This share subsequently declined to 17.8 % in 2002 and 17 % in 2006.

In an international comparison the percentage of Austrian basic research is slightly below average (see Fig. 6).⁴⁴

The relative decline in basic research is the result of the higher than average growth of the corpor->

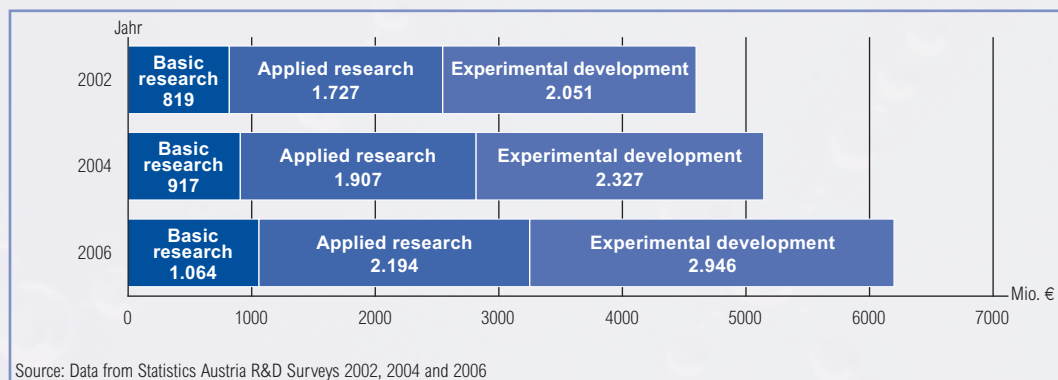


Figure 5:
Development of
R&D according to
type of research

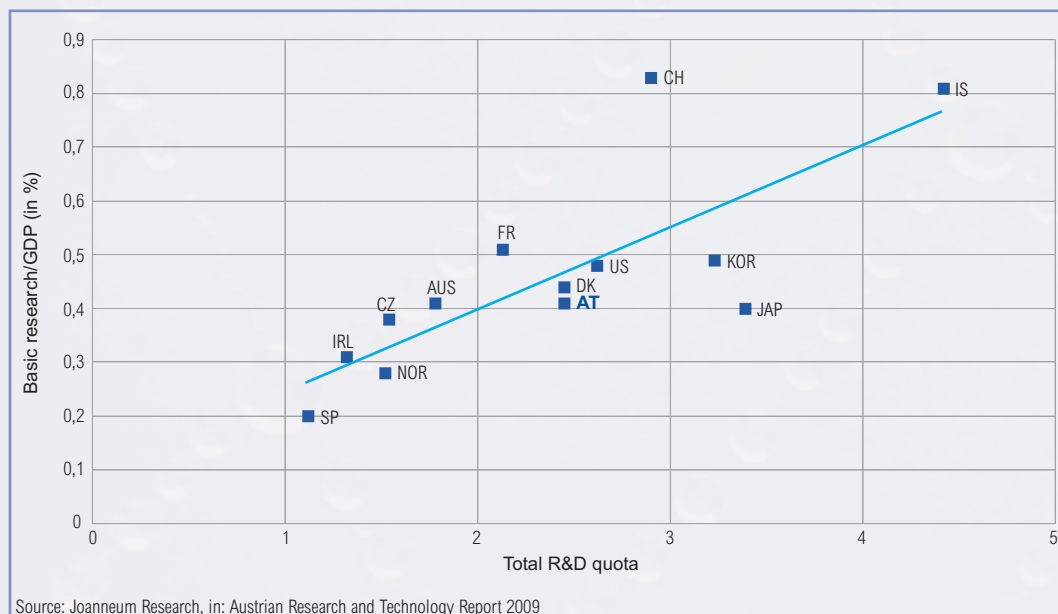


Figure 6:
R&D quota and
basic research quota
in international
comparison

⁴⁴ See Austrian Research and Technology Report 2009, p. 88.

input/output



ate sector. The percentage of experimental development funded mainly by industry has risen from 43.3 % (1998) to 44.6 % (2002) and now stands at 47.4 % (2006). This process will probably be reinforced by the focus of public funding on the collaborative sector and the corporate sector.

From the data shown in Fig. 5 it can be seen that spending on all types of research has grown in absolute terms over the years. In relative terms, the percentage of basic research is declining while applied research is also losing ground. The statistics show that the share of the latter has fallen from 38.7 % (1998) to 37.6 % (2002) and 35.4 % in 2006, demonstrating a shift in favour of experimental development. The collaborative sector is particularly affected as more than 50 % of its work is conducted in the field of applied research. In the context of an expansion of total expenditure, there should be a balanced further development of the structure of the research types, pushing forward knowledge transfer from basic research into the corporate sector (see Recommendation 6.2).

In Fig. 7 the arrows show the flow of funding from one financing sector to another performance sector⁴⁵, whereas the boxes⁴⁶ show R&D expenditures for implementation in the respective sector. The trends referred to above permitted the conclusion (before the crisis of 2008) that Austria was well on the way to achieving important global targets on the strategy path for 2010. Thus R&D financing was moving toward the 3 % quota and the country was coming closer to achieving the political aim of a funding structure in which the

private sector provided two thirds of R&D investment and the public sector one third.

Notwithstanding the current difficult economic environment, it is necessary to continue pursuing the goals that have been laid down in order to position Austria among the leading research nations. Further analysis is required to determine which financial target figures or budget trajectories can be laid down for this.

The Austrian Council has raised the definition of key thematic areas and the corresponding use of resources in the Austrian research system as new issues in this debate. Too little has been known about this in the past, although the same is also true in other countries. At any rate, a knowledge of how funding is distributed between research topics would certainly provide a broader basis for strategy development. In the past R&D data in Austria has been collected in conformity with the international requirements of the EU and OECD, namely by branch of industry and branch of science. However, the data calculated in this manner is of only limited value for identifying R&D priorities in terms of topics or types of research. This aspect of the Austrian R&D landscape is analysed by the Austrian Council in collaboration with the organisations that collect the data.

Special enquiries by the Austrian Council made to funding agencies, research institutes and business enterprises (the process is still in the early stages at universities) provided an approximate picture of the distribution of R&D funding between the key areas defined by the Austrian Council (see Strategy

⁴⁵ The statistics distinguish between four performance areas (the higher education sector, state sector, private non-profit sector and corporate sector – details in the boxes) and four sources of funding (public sector, corporate sector, private non-profit sector and foreign funding – details by the arrows). It should be noted that the higher education sector is not a source of funding, while in line with the domestic concept “abroad” cannot be a performance sector. For the purpose of this analysis, the “corporate sector” was broken down still further: On the one hand, the business segment (essentially comprises companies from the manufacturing sector engaged in production for the market with aim of generating revenue or other economic advantages and the service sector), on the other, the institutes sub-sector (these are service facilities that carry out research and experimental development for business enterprises; in most cases not with the intention of generating revenue or other economic advantages, such as ARC, Joanneum Research or the competence centres). Regarding the interests of clarity and due to its insignificance for the current figure, the private non-profit sector was not included.

⁴⁶ The size of the shown boxes does not reflect the financial volume of the specific sectors.

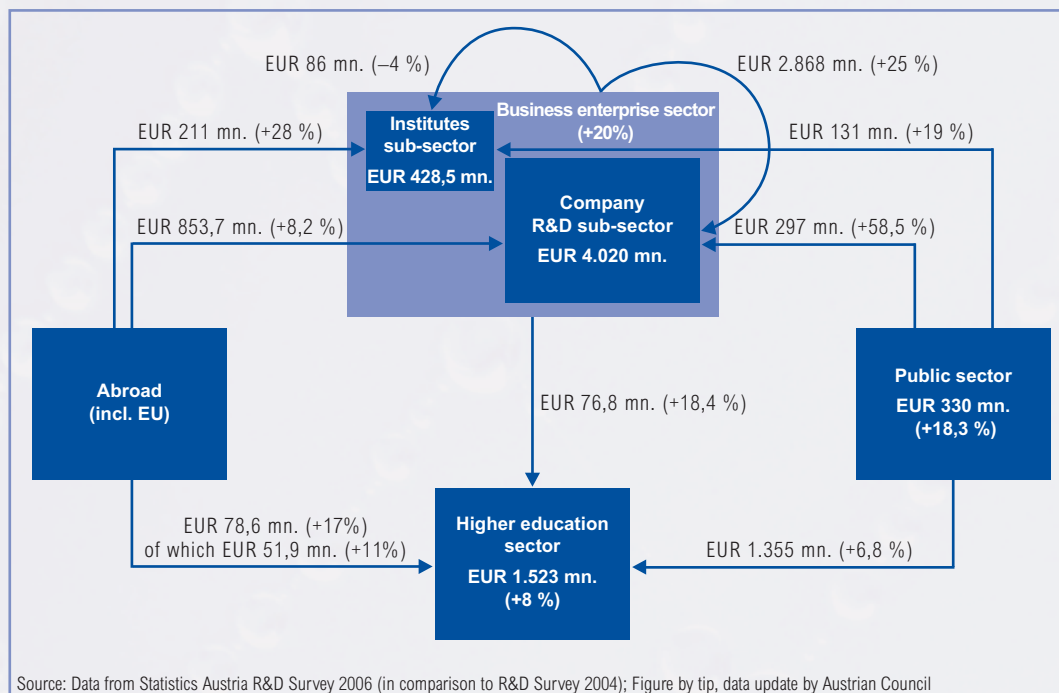


Figure 7:
Financing and
performance
of R&D in
Austria 2006

Element Key Research Areas). In the medium term, work must be undertaken jointly with the organisations collecting the data to develop a process in which the strategically relevant collection and evaluation of data can be carried out on a regular basis and with a sufficient degree of accuracy. The results of this process will firstly improve the de-

cision-making basis regarding the key areas defined in the strategy element Key Research Areas which are of social and strategic relevance for Austria. Secondly, the continuous evaluation of existing key areas and the identification of new ones proposed in the strategy element Key Research Areas must be reflected in the data collection process.

Impacts on Productivity and Growth (Output Indicators)

In recent years Austria has registered a sharp increase in total R&D spending (public, private, foreign funded) relative to GDP. With rising R&D expenditure, especially in the corporate sector,⁴⁷ the question of the impact of R&D spending on economic growth and productivity is repeatedly raised. The Austrian Council has therefore taken the initiative and is in coopera-

tion with research institutions working to solve the question of the direct social and economic impact of expenditures off all types of research (basic research, applied research, experimental development).

While the positive effects of RTI on growth and employment can be empirically well quantified on the basis of different time periods, coun->

⁴⁷ Gassler, H. / Polt, W. / Rammer, C. (2008): Priority setting in technology policy: historical developments and recent trends, in: Nauwelaers, C. / Wintje, R. (eds): Innovation Policy in Europe. Measurements and Trends, Cheltenham (UK), Northampton (US)

input/output



tries, sectors and company data,⁴⁸ it is difficult to isolate the direct contribution of individual funding schemes to macro-economic variables (GDP, employment, productivity). Although it is possible to trace the impact of support measures at subsidised companies, the lack of information regarding all other promotion measures does not permit an empirical assessment of the impacts of the subsidy system.⁴⁹ Collecting data on support measures, output data and indicators and linking it with elementary key figures from the subsidised companies would create a basis for estimating the actual impacts.

The effects of innovations and new technologies are analysed at the macro, meso and micro levels. Over time the underlying empirical models have been continuously improved and refined. In principle research and development expenditure, innovation, human capital, knowledge and learning are attested to have rather positive effects on growth and productivity, something that has also been empirically pro-

ven.⁵⁰ It is, for example, estimated that approximately two thirds of real economic growth in Austria is generated by research and improvements to the quality of production factors (e.g. improved qualification of the labour force).⁵¹ Studies confirm that in almost all industrialised nations, research expenditure at home contributes to a rise in total factor productivity and GDP per capita.⁵² The productivity effects of all research and development capacities tend to be higher in Austria than the OECD average. The influence of the domestic RTI capital stock on productivity and GDP per capita has increased with the passage of time.⁵³

Evidence of the positive effects, especially in relation to employment, at the company level is also considered to be convincing, notwithstanding the relatively small number of studies.⁵⁴ At the micro-economic level (agency data), study results⁵⁵ show that the RTI intensity of companies engaged in research at the start of a period has a positive impact on employment growth in the next two following years. This effect is

⁴⁸ Falk, M. / Hake, M. (2008): Wachstumswirkung der Forschungsausgaben (Study on behalf of the Federal Ministry for Economy and Labour), Vienna; Falk, M. (2004): An empirical analysis of factors explaining the level of R&D subsidies and their productivity effects, Tip Working Paper, Vienna; Wieser, R., (2005): Research and Development – Productivity and Spillovers, Empirical Evidence at the Firm Level, Journal of Economic Surveys, pp. 587-621.

⁴⁹ Falk, M. / Hake, M. (2008): Wachstumswirkung der Forschungsausgaben (Study on behalf of the Federal Ministry for Economy and Labour); Vienna; Falk, M. (2004): An empirical analysis of factors explaining the level of R&D subsidies and their productivity effects, Tip Working Paper; Vienna.

⁵⁰ Cameron, G. (1998): A survey of the empirical evidence, Innovation and Growth; Nuffield College Oxford, <http://www.nuff.ox.ac.uk/users/cameron/papers/empiric.pdf>; Leo, H. / Falk, R. / Friesenbichler, K. S. / Hölzl, W. (2006): WIFO Weißbuch: Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation, Teilstudie 8 Forschung und Innovation als Motor des Wachstums; Vienna.

⁵¹ Peneder, M. (Coord.) / Falk, M. / Hölzl, W. / Kaniovski, S. / Kratena, K. (2006): WIFO-Weißbuch: Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation. Teilstudie 3: Wachstum, Strukturwandel und Produktivität, Disaggregierte Wachstumsbeiträge für Österreich von 1990 bis 2004; Vienna.

⁵² Falk, M. / Hake, M. (2008): Wachstumswirkung der Forschungsausgaben (Study on behalf of the Federal Ministry for Economy and Labour); Vienna.

⁵³ Elasticity of 0.26 means that a 1% increase in headcount results in an increase of GDP by 0.26 %.

⁵⁴ See OECD (2004): Understanding Economic Growth, Paris; Wieser, R., (2005): Research and Development – Productivity and Spillovers, Empirical Evidence at the Firm Level, Journal of Economic Surveys, p. 587–621.

⁵⁵ Falk, M. / Hake, M. (2008): Produktivitätseffekte und Bestimmungsfaktoren der steigenden F&E- Ausgaben in Österreich (Study on behalf of the Austrian Council), WIFO; Vienna.

intensified among newly founded and export intensive companies.⁵⁶ Studies carried out as part of the evaluation of the FFF show that companies engaged in a high level of RTI grow significantly faster, and that there is a proportional linkage: the higher the RTI intensity, the greater the growth in employment and sales in the next two years.⁵⁷ On average, companies engaged in research have a significantly higher momentum of growth and employment than the corporate sector as a whole.

Employment growth is led by young RTI intensive companies which also have a high export quota. They are important creators of new jobs. While the agency data shows an average increase in employment of between 0.9 % in 2002 and 3.7 % in 2006, it is young RTI intensive companies that in each case register the highest rates of change (increase) in employment.⁵⁸

Moreover, it emerges that there is a positive link between companies' RTI intensity and export success. Companies that engage in a great deal of research are more successful in international competition. This is especially true of medium-sized companies and large corporations.⁵⁹ The impact of research and innovation on companies and the national economy depend to a significant degree on the structures and interactions in the RTI system. Institutions of higher

education play relevant roles for entrepreneurial research and the economy in general.⁶⁰ If Austria wishes to join the group of innovation leaders it will be basic research at institutions of higher education and in the corporate sector that will pave the way.

Both research at institutions of higher education and the quality of teaching are becoming increasingly important to companies. The market is increasingly calling for independent innovations, making access to outstanding research and human capital ever more important. Consequently, the investments made in institutions of higher education not only generate inventions and make an important contribution to the innovative strength of business enterprises by means of education and further training⁶¹ – they also find their way into actual products and services.

A study carried out by the Swiss Federal Institute of Technology Zurich (ETH Zurich) on the role of basic research in the science system provides empirical evidence to support the assumption that the closer a country operates to the technological frontier, the more resources should be invested in basic research. Basic research supports and strengthens innovation while a higher volume of innovation in turn improves the efficiency of basic research.⁶² In the context of >



⁵⁶ Estimates on the basis of cross-sectional data conclude that, depending on the period, a 10 % increase in R&D intensity (e.g. from 5 to 5.5 %) leads to an increase in employment growth of between 0.6 and 1.8 percentage points in the next two years.

⁵⁷ Falk, M. (2004): An empirical analysis of factors explaining the level of R&D subsidies and their productivity effects, Tip Working Paper; Vienna.

⁵⁸ Detailed figures on the results: Falk, M. / Hake, M. (2008): Produktivitätseffekte und Bestimmungsfaktoren der steigenden F&E-Ausgaben in Österreich (Study on behalf of the Austrian Council), WIFO; Vienna, p. 39 ff.

⁵⁹ Falk, M. / Hake, M. (2008): Produktivitätseffekte und Bestimmungsfaktoren der steigenden F&E-Ausgaben in Österreich (Study on behalf of the Austrian Council), WIFO; Vienna.

⁶⁰ Narin, F. / Kimberley, S. / Hamilton, S. / Olivastro, D. (1997): "The Increasing Linkage between U.S. Technology and Public Science", Research Policy, 26 (3), p. 317–330; Salter, A. / Martin, B. (2001): The Economic Benefits of Publicly Funded Basic Research: A Critical Review, Research Policy, 2001, 30, p. 509–532; Martin, B. R. / Tang, P. (2006): The Benefits from Publicly Funded Research, University of Sussex, Working Paper, 2006, (161).

⁶¹ See Falk, M. / Hake, M. (2008): Produktivitätseffekte und Bestimmungsfaktoren der steigenden F&E-Ausgaben in Österreich (Study on behalf of the Austrian Council), WIFO; Vienna.

⁶² Gersbach, H. / Schneider, M. / Schneller, O. (2008): On the Design of Basic Research Policy, Working Paper 08/79; ETH Zürich, p. 22.

input/output



financing basic research, the public sector plays a central role: In Austria, as in most other OECD countries, basis research is mainly financed by public funds.

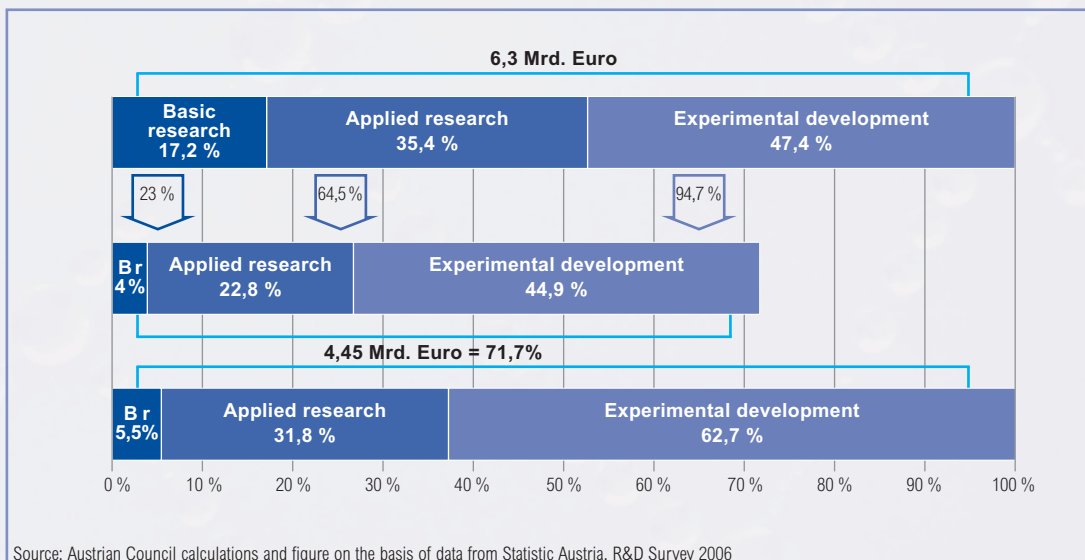
It is not possible to quantify the direct impacts of scientific research since the results are not usually directly focused on economic utilisation. The indirect benefits of scientific research have been studied and proven in numerous studies.⁶³ Empirical studies demonstrate that in Austria there is a clear and positive link between the R&D capacities of industry and the public sector. Public spending on basic research thus generates R&D expenditure from the private sector.

A differentiated funding policy that takes into account the situation, size and capabilities of enterprises is therefore advisable not just with regard to new businesses. The different capabi-

lities of companies (innovator typologies⁶⁴) also lead to significant differences in RTI spending. Consequently, the different starting points must be taken into consideration when developing support programmes. One option for raising RTI expenditure would therefore be to improve companies' "capabilities" with a view to improving the sustainability of their innovation efforts.

However, a high level of RTI intensity and rising RTI expenditure also leads to greater demand for qualified RTI personnel and then subsequently for skilled workers. Personnel expenses account for over 50% of RTI expenditure.⁶⁵ This means that the educational system must ensure that people are excellently qualified. Furthermore, and many years in advance, more people than in the past must be empowered to enter higher education.⁶⁶ However, given the prevailing demographic trend, the additional demand for qua-

Figure 8:
R&D according
to type of research
and performance
sector – corporate
research including
the collaborative
sector



⁶³ Gersbach, H. / Schneider, M. / Schneller, O. (2008): On the design of basic-Research Policy, Working Paper 08/79; ETH Zürich.

⁶⁴ Hollanders, H. (2008): Strategic Innovators Drive Innovation Performance at the Sector Level: A Sectoral Analysis of Innovation Modes, Europe Innova, Systematic, www.europe-innova.org.

⁶⁵ Statistics Austria (2006): R&D statistics; Vienna.

⁶⁶ Compared to other industrialised nations with a similar level of development and technology Austria has a significantly lower percentage of people with secondary school qualifications (see Strategy Element "People").

lified human resources will increasingly have to be met abroad, either by bringing Austrian scientists home (although this will only cover a small proportion of the demand) or through the immigration of qualified foreign researchers.

However, it is people migration background who are already living in Austria and possibly offer the greatest potential as they would be “immediately” available if their qualifications were improved.



Strategic Guidelines and Recommendations

Based on this analysis and the current challenges in relation to the development of the input and output of investments in research, the Austrian Council has defined the following strategic guidelines and formulated the following recommendations.

Strategic Guideline 6: Consistently Adhere to the Path

The 3 % target figure has proven its value in a smoothly growing economy. In a more volatile economic environment, a different target will have to be set if steady growth in R&D spending is to be achieved. It is important to safeguard long-term budgets to ensure planning certainty for stakeholders (agencies, research community). This will make it possible to adopt a course with which Austria will be able to close the gap on the leading research nations. In the current economic situation the achievement of the 3 % target could be delayed from 2010 to 2013, as it is foreseeable that the corporate sector will be unable to finance the originally planned growth path by 2010.⁶⁷

The Austrian Council recommends

■ Recommendation 6.1

The previous aim of a 3 % research quota should be turned into a transitional target. The long-term goal for 2020 is to join the ranks of the leading research nations. The necessary framework conditions will be analysed in more detail on the basis of the best competing countries by 2010. The appropriateness of the 4 % research quota defined in the Government Programme as the target for 2020 should be subjected to a renewed review in the light of the current economic situation. ►2010

■ Recommendation 6.2

The current structure of R&D expenditure for basic research, applied research and experimental development provides a tried and tested point of departure for the next few years. The structure of research types should be balanced and further developed with a stronger emphasis on output similar to that found among the European innovation leaders. ►2020

Monitoring: Both recommendations will be monitored jointly in yearly stages on the basis of the Global Estimates of Statistik Austria and supplementary estimates by the Austrian Council secretariat, if necessary together with other institutions; orientation toward international benchmarks.

Strategic Guideline 7: Improve Data Base and Data Analysis

Improving the information basis for RTI policy (statistics, indicators, microdata) is an important methodological aspect. In some cases, appropriately organised and defined RTI-related data is not available or even when it is, it is inaccessible. The Austrian Council is of the opinion that comprehensive data on the distribution of funding between key areas of research in the corporate sector and in higher education must be collected as the basis for any RTI strategy. This is especially important for deducing the output generated by research activities. In the case of the universities this data can be obtained by amending the Intellectual Capital Report Regulation. In the case of the corporate sector, the data could be collected in conjunction with the 2-yearly survey carried > out by Statistics Austria.

⁶⁷ This statement is based upon calculations of scenarios by the Austrian Council taking into account the available budget figures, forecasts and its own estimates of the main influencing factors GDP as well as federal, corporate and foreign sources of R&D funding.



The Austrian Council recommends

■ Recommendation 7.1

Together with those organisations that collect the data (Statistics Austria, funding agencies, ministries) a process should be developed in which data that has a strategic relevance for RTI policy studies is regularly collected and evaluated.

►2013

Monitoring: The Austrian Council will take over the monitoring function and together with the other players that have been addressed in this connection will develop a coordinated solution.

■ Recommendation 7.2

Methods and models for analysing the RTI system and for impact research must be developed further and additional scientific expertise built up. Developments in other areas which are of relevance for research (e.g. in the economy as a whole and the higher education sector) should also be included. ►2013

Strategic Guideline 8: Improve Locational Factors

Suitable framework conditions are required for RTI investments that will help stimulate innovation in the corporate sector and facilitate business growth. In this context, it is vital that the areas education, research and innovation (“knowledge triangle”) are developed together and that there is a strong degree of interaction between them. This also involves gearing the structure of the educational and training system to quality and quantity.

The Austrian Council recommends

■ Recommendation 8.1

Companies’ innovative ability should be strengthened so that they can improve the sustainability of their innovation efforts. This may entail providing support for the following activities:

- Training and education in the area of innovation management
- Structuring relations with cooperation partners and third parties in innovation projects (i.e. contact with universities, universities of applied sciences and non-university institutions)
- Supporting internal processes to detect ideas (e.g. internal suggestions through “community-based innovation” approaches) ►2010

■ Recommendation 8.2

The framework conditions for RTI investments (human resources, the tax system, adapted instruments) should be further developed so that leading competence units (LCU) can be expanded and new ones attracted from abroad. ►2013

■ Recommendation 8.3

Support for the transfer of technology should be expanded and intensified, for example by implementing the following measures:

- Exchange of scientific personnel between scientific institutions and business enterprises.
- Support in safeguarding licences and intellectual property rights (IPR) while upholding the interests of all parties concerned (companies and research institutes)
- Promotion of spin-offs
- Support with access to the patent system and technology exchanges

This should make it easier for companies to bring innovations to market. ► 2010 ■

⁶⁸ European Commission (2006), Communication from the Commission to the Council and the European Parliament delivering on the modernisation agenda for universities: education, research and innovation. Brussels, 10.5.2006, COM(2006) 208 final.

key research areas



key research areas



Status and Challenges

Defining key research areas is becoming an increasingly important aspect of RTI policy all over the world.⁶⁹ Among the nation states it is countries such as the USA, France or Japan that play a pioneering role in defining key research areas and in mission-orientated RTI policy. However, similar activities are also being undertaken by the EU. Thus when looking forward to the EU Seventh Research Framework Programme, the European Research Advisory Board (EURAB) recommended focusing more strongly on key areas based on mission-orientated strategic research activities such as the Joint Technology Initiative.⁷⁰ The European Commission considers it essential to identify and act upon common thematic priorities defined through joint foresight activities involving the scientific community, society and industry.⁷¹ However, identifying focal areas also involves trying to combine the conflicting priorities of reaping the benefits of specialisation and those of a broadly diversified research and technology portfolio.⁷² Accordingly, all highly developed countries are seeking the correct mix of non-theme-specific and thematically-orientated instruments and programmes.⁷³ Key research areas and priorities are then usually defined using the following arguments:⁷⁴

- Science push – the use of new scientific-technological developments/paradigms
 - Demand pull – safeguarding a presence on the expected markets of the future
 - Classical mission orientation – the concentration on key industrial sectors
 - New mission orientation – the development of solutions for social challenges and opportunities
 - Technology diffusion – keeping up with international economic and technological developments
- The definition of thematic priorities is therefore no longer solely focused on specific areas of technology or contributions to coping with economic challenges, but to an increasing degree on solving societal problems.⁷⁵

In an international context the definition of thematic foci and priorities is strongly based on systematic approaches such as foresight activities and technology prognoses.⁷⁶ However, the problem with predicting scientific and technological developments is that science and technology are complex areas for which it is difficult to build models. There are no sound methods for predicting them, but instead a host of methods and forecasting techniques which to an increasing degree also include participatory elements.⁷⁷

⁶⁹ Gassler, H. / Polt, W. / Rammer, C. (2008): Priority setting in technology policy: historical developments and recent trends, in: Nauwelaers, C. / Wintje, R. (eds): *Innovation Policy in Europe. Measurements and Trends*, Cheltenham (UK), Northampton (US)

⁷⁰ EURAB (2005): FP6 assessment with a focus on instruments and with a forward look to FP7, final report, http://ec.europa.eu/research/eurab/pdf/eurab_05_014_wgi_final_report_en.pdf

⁷¹ European Commission (2007): *Green Paper – The European Research Area: New Perspectives*; Brussels.

⁷² ARC systems research & Joanneum Research (2003): *Zukunftspotentiale der österreichischen Forschung*, p. 10.

⁷³ Gassler, H. / Polt, W. / Rammer, C. (2006): Schwerpunktsetzungen in der Forschungs- und Technologiepolitik – eine Analyse der Paradigmenwechsel seit 1945. In: *Österreichische Zeitschrift für Politikwissenschaft (ÖZP)*, 35(1), pp.7–23: 16.

⁷⁴ ARC systems research & Joanneum Research (2003): *Zukunftspotentiale der österreichischen Forschung*, Vienna, p. 11.

⁷⁵ Weber, M. (2008): *Forschung zur Bewältigung gesellschaftlicher Herausforderungen – neue Programme und Programmarchitekturen*. In: *Österreichischer Forschungsdialog: Ergebnisdokumentation*; Vienna, pp. 119–121. See also Gassler, H./ Polt, W./ Rammer, C. (2006): Schwerpunktsetzungen in der Forschungs- und Technologiepolitik: Eine Analyse der Paradigmenwechsel seit 1945, *Österreichische Zeitschrift für Politikwissenschaft (ÖZP)*, 35 (1), p. 7–23.

⁷⁶ See <http://cordis.europa.eu/foresight/what.htm>. (last access: 22.7.2009)

⁷⁷ See Cuhls, K. (2008): *Methoden der Technikvorausschau – eine internationale Übersicht*; Stuttgart.

Small Countries – No or only Small Priorities?

A systematic definition of priorities and key research areas must, especially in small countries, enhance the RTI landscape where existing strengths can be expected to generate extraordinary scientific or economic output and thus significantly improve Austria's position in international competition. RTI activities should also be stimulated where important social questions must be tackled in a focused manner. Only by focusing on a small number of selected "scientific-technological" and "social-mission-orientated" key areas and their widespread implementation in all sectors of the RTI system – and beyond – is it possible to ensure economic, scientific or social success on an international scale for a small country.

The way in which key research areas are identified in Austria and thematic programmes are developed and established is in need of improvement. In Austria key research areas are still only partly defined on the basis of comprehensive strategic analyses and this is also true of the way in which thematic programmes are designed.⁷⁸

In addition, there are a large number of only inadequately coordinated actors.⁷⁹

The results of the system evaluation suggest that this deficit should be urgently remedied. Taking into account the research priorities and emerging thematic areas already recommended in 2004 the Austrian Council has, in Strategy 2020, laid the basis for defining future priorities in the Austrian research landscape. With the help of a catalogue of criteria and a comprehensive analysis (trend analysis on the basis of international technology prognoses⁸⁰, identification of national strengths⁸¹, the results of national and international foresight activities⁸², analysis of the long-term importance of an area for the state, science, the economy and society⁸³) these key research areas were re-evaluated and adjusted to current framework conditions.

The definition of the key research areas is based upon an evaluation of the performance of a variety of research fields. The evaluation applied the criteria of: scientific performance, economic and technological potential and relevance for solving important societal problems.⁸⁴ Priority was >



⁷⁸ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 5: Das Angebot der direkten FTI-Förderung in Österreich, p. 93 ff.; and Report 2: Strategische Governance – Der Zukunft von Forschung, Technologie und Innovation ihren Möglichkeitsraum geben, p. 29 f.; see Schibany, A. / Jörg, L. / Nones, B. (2005): Instrumente der Technologieförderung und ihr Mix (Study on behalf of the Austrian Council for Research and Technology Development), Joanneum Research, and Technopolis, InTeReg 37-2005; Vienna, p. 41 f.

⁷⁹ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 3: Governance in der FTI-Politik im Wechselspiel zwischen Ministerien und Agenturen, p. 69 ff.

⁸⁰ See VDI Technologiezentrum (2006): Aktuelle Technologieprognosen im internationalen Vergleich. (Study on behalf of the German Federal Ministry of Education and Research); Dusseldorf. Consideration was also given by the Austrian Council to the list of fields of science and technology of the future compiled by the Fraunhofer Institute for Technological Trend Analysis (INT).

⁸¹ See Austrian Research and Technology Report 2008; Vienna, p. 32 ff.

⁸² See ARC systems research & Joanneum Research (2003): Zukunftspotentiale der österreichischen Forschung; Vienna. See also http://cordis.europa.eu/foresight/kte_expert_group_2005.htm.

⁸³ See Forschungsdialog: "Missionen: Fragestellungen der Gesellschaft an Forschung und Entwicklung". In: Österreichischer Forschungsdialog: Ergebnisdokumentation; Vienna, p. 117–126.

⁸⁴ See also ARC systems research & Joanneum Research (2003): Zukunftspotentiale der österreichischen Forschung; Vienna.

key research areas



also given to three dimensions that are of crucial importance for evaluating research and technology:

- Scientific performance interpreted as the scope and quality of the scientific output generated in the main fields of research in Austria.

- Economic-technological performance interpreted as the ability to implement the results of scientific research in commercially viable products and services.

- The ability to use the social opportunities and challenges that arise from the combination of new scientific knowledge, societal priorities and the grasping of opportunities for social development.

Finally, in spring 2008, the Austrian Council conducted its own survey of the budgets of the ministries responsible for research (BMF, BMVIT, BMWF, BMWFJ), the funding agencies (AWS, Austrian Research Promotion Agency (FFG), Austrian Science Fund (FWF), universities (Universities Austria) and non-university research institutions (AIT [formerly ARC], CDG,

LBG, ÖAW) and business (Austrian Federal Economic Chamber) – supplemented by data from Statistik Austria –, in order to obtain a rough overview of the thematic distribution of R&D expenditures in Austria (see Figs. 9 and 10).

On this basis, the Austrian Council was able to carry out a thorough analysis of the status quo in every thematic area. This covered public funding, research spending and the sales generated by business, employees in science and industry, research institutions and companies as well as international competitiveness. Furthermore, global trends, development potential, opportunities and goals were identified. In turn these formed the basis for defining areas of action, possible input factors and control variables in each individual thematic area. The results of this process are the key thematic areas listed in Table 2. They represent current strengths or exhibit significant future potential both in an international context and within the Austrian RTI landscape. The emphasis is upon application and mission-orientated topics. These include both “scienti-

Figure 9:
Distribution of
corporate R&D
funding by key
research areas, in
EUR billion

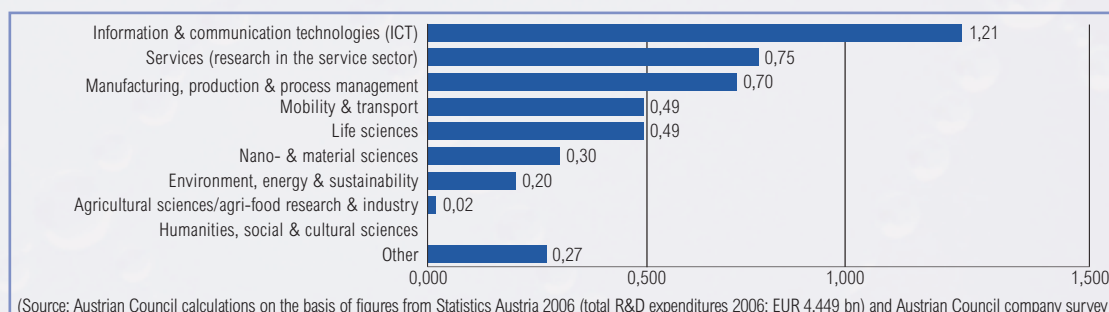
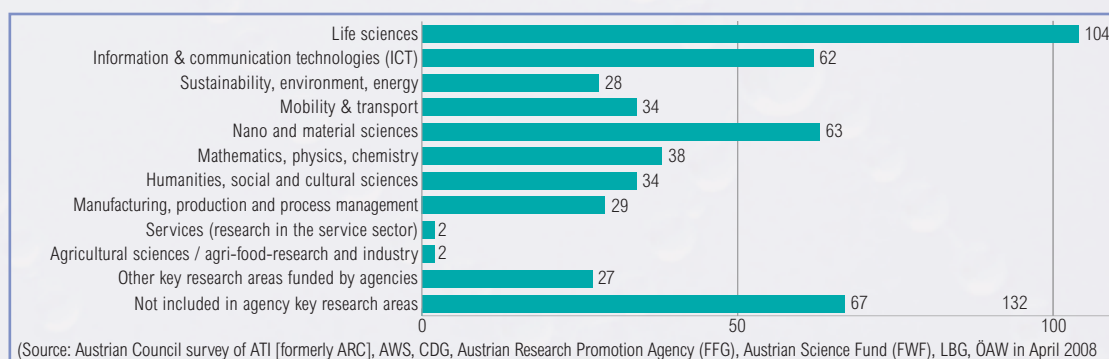


Figure 10:
Distribution of
funding between
key research
areas in 2007, in
EUR million



key research areas

Table 3: Key Thematic Areas and Areas of Emerging Research

Life Sciences
Information and Communication Technologies
Sustainability, Environment, Energy
Mobility and Transport
Nano-Technology and Material
Mathematics, Physics, Chemistry
Humanities, Social and Cultural Sciences
Manufacturing, Production and Process Management
Services
Agri-Food Research and Industry

fic-technological” priorities (such as the life sciences, ICT, the humanities, social and cultural sciences, nano-technology and material), i.e. “classic mission-orientated” areas and “societal mission-orientated” areas (such as the environment, energy and sustainability or mobility and transport). Detailed strategies have already been drawn up for ICT and the life sciences and there is a particularly urgent need to prepare detailed strategies for the areas of sustainability, environment, energy, mobility and transport. With regard to the other key thematic areas, further analysis is required to sound out the potential for the development of detailed strategies.

The following points should be borne in mind when interpreting Table 3:

- The key thematic areas listed in Table 3 do not refer to the technologies themselves, but to wider thematic areas which include a host of technologies, interdisciplinary approaches and scientific disciplines. Thus, ICT for example, was not chosen because of its importance as a basic technology, but because Austria has good chances of becoming one of the best three European ICT nations and thus a world leader.

- Although sustainability is listed here as a key thematic area in its own right, it also represents an overarching guiding principle for all other key thematic areas.

- A key aspect of the societal mission-orientation is the potential to create jobs, not only in research but also in the production of high-tech and medium-tech goods.

- Although mathematics, physics and chemistry are actually pure sciences, the Austrian Council suggests that consideration be given to defining an overarching key thematic area – possibly with other instruments.

- It can be assumed that the high level of research investment in manufacturing, production and process management is one of the factors that contributes to the success of Austria’s industrial structure which has only a small number of large leading companies and widely ramified but in some cases highly specialised SMEs. The Austrian Council considers that further-reaching strategic analyses need to be carried out here. These will then form the basis for deciding whether it is appropriate to draw up a concentrated priority strategy.

- In the case of Services and Agri-Food Research and Industry there was no clear direct evidence of national strength, nor did the available data suggest any such strength. However, the Austrian Council considers these topics to be so future-orientated and socially relevant that a further evaluation should be carried forward.

It is clear from Fig. 10 that funds are distributed very differently between the key thematic areas. A judgement as to whether these are adequate or not can only be made if the intended objective and the measures taken in a key thematic area are also evaluated as part of an overall assessment. But because Austria has no systematic approach to defining and managing key thematic areas, any such process usually begins and ends with a funding scheme. Concepts that include the “sup->



key research areas



port measures” needed for an efficient and effective definition of priorities (in the educational sector, the legal framework, in terms of regulation, standardisation, procurement etc. – see the Strategy Element “Instruments”) are not being drawn up to the required extent.

The conception of priorities for the purpose of the new mission-orientation is especially important. In the view of the Austrian Council these are of particular significance as they contribute both to solving societal problems and strengthening the economic position of the companies engaged in activities in this area. While technological progress and innovation can make important contributions to solving societal problems, they – only have an effect if the complete repertoire of policy measures is brought to bear in a coordinated manner. Otherwise the solutions that are developed diffuse only slowly and their societal and economic potential is not fully utilised.

This requires inter-ministerial and transnational

coordination and cooperation when defining key research areas so that management structures can be developed that go beyond the direct responsibility of the RTI ministries and also the currently prevailing programme logic. Only if these steps are taken there can be an efficient process. The prerequisite for this are detailed strategies for the respective key areas. The Austrian Council has already presented detailed strategies for the ICT sector (October 2008) and the life sciences (2005).⁸⁵

A further step toward systemising the process of defining key research areas involves thinking about the basic relationship – in monetary units – between top-down and bottom-up activities – in a way which ensures that the latter offer sufficient scope for future-orientated, more high-risk research projects.⁸⁶ An even balance between bottom-up and top-down activities with a clear preponderance of non-theme-specific instruments must be preserved.

Strategic Guidelines and Recommendations

Based on this analysis and the current challenges in relation to the development of a systematic practice of identifying key research areas, the Austrian Council has defined the following strategic guidelines and formulated the following recommendations.

Strategic Guideline 9: Develop Inter-Ministerial Key Research Areas

Defining key research areas should promote existing strengths and position Austria among the

leaders in international competition. Preference should be given to strengthening existing RTI activities which emerge from within the RTI system (= scientific-technological key areas).⁸⁷ Above and beyond this, key research areas can be understood in terms of a mission-orientation which, within the context of socially relevant thematic areas, specifically stimulate RTI activities (= societal mission-orientated priorities) while simultaneously strengthening Austria’s economic or scientific position.

⁸⁵ Austrian Council for Research and Technology Development (2008): IKT-F&E-Strategie; Vienna.

http://www.rat-fte.at/tl_files/uploads/Strategie/2008112_IKT-FE-Strategie-2020_final.pdf

Austrian Council for Research and Technology Development (2005): Strategie für die Entwicklung der Life Sciences in Österreich; Vienna. http://www.rat-fte.at/tl_files/uploads/Empfehlungen/050812_LifeSciences_Empfehlung_revidiert%20mit%20Grafiken%20Briefpapier.pdf

⁸⁶ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 5: Das Angebot der direkten FTI-Förderung in Österreich; Vienna, p. 98 ff.

⁸⁷ In this context methods must be developed that will permit emerging bottom-up activities to be identified and then integrated into key research areas from current RTI and promotion activities.

key research areas

The Austrian Council recommends

■ Recommendation 9.1

Analogously to the existing detailed strategies drawn up by the Austrian Council for ICT and life sciences, additional strategies should first of all be developed for the key research areas shown in Table 2. The need to formulate an overarching strategy involving all players and programmes is especially pressing in respect of the areas sustainability, environment, energy, and mobility and transport. ►2010, 2013

■ Recommendation 9.2

A niche strategy should be adopted when defining thematic priorities. There is little point in Austria focusing solely on international mass markets. Instead, the aim should be to focus on specialised markets and areas of knowledge where Austria can achieve a leading international position by utilising its strengths. ►2010, 2013

Monitoring: The Austrian Council will make an active contribution to the further evaluation of the topics suggested in Table 2 and will support the joint definition of key research areas and strategy

development by the participating ministries. The Austrian Council will regularly update the proposed topics with the status of the evaluations and the strategy development and will make this available to the government as a decision-making aid for defining thematic priorities.

■ Recommendation 9.3

Thematic funding programmes should be focused upon a small number of broad scientific-technological and societal mission-orientated key research areas. These should always encompass the entire RTI landscape and all adjoining areas (e.g. education, international relations, but also tax legislation and public procurement) and thus include the sectoral activities of all ministries. ►2010

■ Recommendation 9.4

An inter-ministerial “project management group” controlled by a steering committee comprising all participating ministries should be installed for each key research area. ►2010

Monitoring: Together with the steering committee the Austrian Council will define key performance >



key research areas



indicators for the key research area and will periodically calculate the results that have been achieved.

■ Recommendation 9.5

A maximum proportion of the funding budget should be committed to thematic programmes. However, in compliance with the results of the system evaluation an appropriate ratio of non-theme-specific and theme-orientated funding should be preserved. ►2010

■ Recommendation 9.6

Parallel to this, a systematic and continuous approach must be developed for national foresight activities and technology prognoses to evaluate existing and identify new key research areas. These should also be geared to the future development of societal needs and market developments. Advice in this regard should be taken from existing bodies in consultation with Austrian and international experts. Consideration should also be given to participatory approaches. Moreover, where necessary, key re-

search areas are to be promoted where a strong scientific performance is set against weak applied technological development at companies or high levels of corporate technological development against a weak (non)university research performance. ►2013

■ Recommendation 9.7

Key research areas must also be defined in a way that is responsive to the definition of key areas at the European level. National thematic programmes must be understood and designed to empower scientists working in Austria to increase their participation in European Framework Programmes. The aim should also be to achieve national critical masses that will allow Austria to shape the European research agenda to a greater degree. ►2010

Monitoring: Further monitoring of successful participation by scientists working in Austria in European Framework Programmes within the scope of Proviso, and coordination and joint analysis of data with the funding agency responsible for the Framework Programme.. ■





Status and Challenges

Infrastructure for research, technology development and innovation is a key determinant for the performance of an innovation system. Internationally, RTI infrastructure is increasingly perceived to be a variable in its own right which requires separate consideration just like other determinants of a country's national innovation performance such as human resources, financing or instruments. This is also reflected in the importance the European Union ascribes to RTI infrastructure for successfully positioning the European Research Area in international competition in the long-term.⁸⁸

RTI infrastructure is an indispensable basis for cutting-edge, internationally prestigious research. Due to the unique nature of the services it provides it is an important resource for strategically positioning individual institutions and the entire research location alike. A high-quality infrastructure is a strong "pull" factor for leading Austrian and international scientists. It forms the basis for unique services for science and industry and thanks to day-to-day operations and associated projects is an important engine of employment.

Based on the definition of RTI infrastructure used by the European Strategy Forum on Research Infrastructures (ESFRI), a comprehensive nationwide review and analysis⁸⁹ was carried out of the infrastructure available both nationally and internationally to Austrian scientists and of its utilised capacity. This subsequently formed the basis for the following strategic considerations. The analysis covered academia, non-university research institutes and also companies which provide or use publicly accessible RTI infrastructure. Four types of infrastructure were distinguished:

1. Large equipment / large-scale facilities, e.g. high-performance lasers, particle accelerators, testing equipment, computer tomographs, etc.
2. Core facilities in the sense of unique combinations/networks of individual pieces of central or dislocated infrastructure in Austria, e.g. materials technology centres, micro-electronic centres, radio telescope groups etc.
3. Collections including electronic databases, e.g. genome structure database, databases regarding natural hazards, social science archives.
4. Building infrastructure that is used solely for research and development activities.

⁸⁸ Austrian Council for Research and Technology Development (2006): Empfehlung zum Offensivprogramm II / FTE-Nationalstiftung 2006, 18 November 2005

Austrian Council for Research and Technology Development (2005): Empfehlung betreffend den Beitritt Österreichs zum European Southern Observatory und betreffend die Mitgliedschaft in internationalen forschungsrelevanten Einrichtungen, 22 February 2005

Austrian Council for Research and Technology Development (2004): Empfehlung zu Offensivprogramm und Nationalstiftung, 16 November 2004

Austrian Council for Research and Technology Development (2004): Ergänzende Empfehlung zum Offensivprogramm II / 2004 – Programme BMBWK, 6 April 2004

Austrian Council for Research and Technology Development (2002): Empfehlung zur Universitätsorganisation, 15 March 2002

Austrian Council for Research and Technology Development (2002): Empfehlung zur Förderung für universitäre Infrastruktur und akademische Karrieren, 14 / 15 February 2002

Austrian Council for Research and Technology Development (2001): Empfehlung zur geplanten Großforschungseinrichtung AUSTRON, 27 March 2001

Pock, H. / Feichtinger, T. / Pock, L. / Höfler, B. / Alkan, S. (2009): Erhebung österreichischer Forschungsinfrastruktur (Study by Austin, Pock and Partner on behalf of the Austrian Council for Research and Technology Development), Graz.

Lack of Coordination, Undefined Responsibilities

As the analysis shows, the topic of RTI infrastructure in the Austrian funding landscape is inadequately coordinated. It is usually only included indirectly within the framework of initiatives and programmes organised by a variety of institutions. What are missing are suitable top-down approaches and contact persons with clear responsibility for research infrastructure. In terms of the strategic development of RTI infrastructure there is a lack of balanced top-down and bottom-up approaches with a long-term focus. There are three different infrastructure levels that are of importance for the innovation system:

- International participation in RTI infrastructure (see Strategy Element "Internationalisation")
- Cutting-edge research infrastructure in Austria
- Basic research infrastructure in Austria

Without participation in international light-house research infrastructure Austrian science and industry will only ever attain second rate status. Cutting-edge research requires links with international RTI infrastructure in specific thematic key areas (see Strategy Element Key Research Areas) Furthermore, there are niche areas in which Austria can play a leading role in European RTI infrastructures; for example within the framework of an ESFRI project regarding Biobanking and Biomolecular Resources Research Infrastructure.

With the exception of the Structural Programmes of the Austrian Research Promotion Agency (FFG) and the university infrastructure programme there is no means of directly subsidising basic

infrastructure. As a result, funding structures are largely project orientated, which has a negative impact on the development of RTI infrastructure. As infrastructure funding is limited to payments to cover overhead costs or depreciation within the scope of project funding, applicants are forced to pre-finance infrastructure themselves, whereby the service life in most cases also exceeds the duration of the funding period.

A major weakness is the lack of planning for the long-term, collaborative and supra-regional use of infrastructure investments. Impacts that go beyond the immediate region and project duration are neglected. Consequently, there is a risk of underinvestment in RTI infrastructure as some infrastructure investments cannot be justified for individual projects and only make sense if there is longer-term, collaborative and / or supra-regional use.

The poor quality of basic infrastructure is also problematic. At universities, universities of applied sciences (Fachhochschulen) and non-university research institutes basic research infrastructure is generally only partially covered by the universities' global budget or the core budget of the non-university/collaborative research institutes. Respective resources from basic funding are also frequently used for purchasing special equipment as there are no adequate alternatives available. In terms of basic infrastructure, universities are on average underfunded and poorly positioned in an international comparison. Basic infrastructure is distributed between institutes very differently and frequently sub-critically.



Strategic Guidelines and Recommendations

Against the background of this analysis and the current challenges in developing RTI infrastructure in Austria, the Austrian Council has defined the following strategic guidelines and formulated the following recommendations.

Strategic Guideline 10: Link Research to International Infrastructure

To facilitate cutting-edge research, links are

needed with international RTI infrastructure in specific thematic key research areas. The aim should be to engage in fewer projects but on a larger scale at international research infrastructure facilities with a view to assuming more positions of leadership. Critical masses in terms of equipment, scientists and technicians at the location are essential to ensure that international participation is effective. >

infrastructure



The Austrian Council recommends

■ Recommendation 10.1

Top-down measures to promote participation in international research infrastructure should be expanded and improved. This includes, for example, active marketing and appropriate preparation of the possibilities for participation by Austrian research institutes as well as their improved networking. This should stimulate momentum and motivation to participate and should be done from the bottom-up. ►2013

Monitoring: The Austrian Council will examine the effectiveness of top-down measures on the basis of a regular survey (roughly every two years) of international participation by Austrian research institutes or scientists in foreign RTI infrastructure facilities (see Strategy Element Internationalisation).

Strategic Guideline 11: Holistic Infrastructure Planning

The orientation of RTI infrastructure should not be viewed in isolation. Creating sustainable structures for the innovation system requires the coordinated

interaction of RTI infrastructure, secure funding along the infrastructure lifecycle and personnel to perform the research at, or with, the infrastructure (including an adequate supply of technical and administrative personnel). Combined with the related research and cooperation projects, this framework will make an important contribution to raising Austria's profile and international visibility. It is also important to build up large-scale infrastructure facilities in thematic niches that possess international potential, however, redundancies at the national level must be avoided. Greater shared use should basically be made of RTI infrastructure.

The Austrian Council recommends

■ Recommendation 11.1

A specific platform should be established for the strategic planning of RTI infrastructure. In addition to representatives of the responsible ministries and the Austrian Council, the platform should also include representatives of the parties concerned (Austrian Research Promotion Agency (FFG), Austrian Association of Universities of Applied Sciences (FHK), Austrian Science Fund



(FWF), Federation of Austrian Industries (IV), Universities Austria, Austrian Federal Economic Chamber, etc.) and independent international experts. It should focus its planning work both on suitable international participations and on defining national key research areas taking into account regional aspects. It should also ensure the provision of their day-to-day funding. In terms of the strategic development of RTI infrastructure, balanced top-down and bottom-up approaches are needed. Here the platform should draw up a road map in the sense of a master plan for the long-term focus which should be adopted across all the relevant ministries at the highest political level. The road map should be consistent with the ESFRI road map and take into account the RTI infrastructure measures envisaged within the framework of ESFRI. ►2013

The platform should also draw up a uniform catalogue of criteria for evaluating and funding the new acquisition of RTI infrastructure. It should also identify and support thematic hubs in the infrastructure sector throughout Austria under the motto "Allowing for regional gaps" as RTI infrastructure is mainly thematically and not so much regionally based. Finally, it should also ensure a professional international presentation of Austrian RTI infrastructure segments with a view to raising the country's profile as a research location in cooperation with the BMVIT, BMWF and BMWFJ.

Monitoring: The Austrian Council will serve on the platform in an advisory capacity. In this function it will monitor the development and goal achievement of the platform and, where necessary, issue corrective recommendations.

■ Recommendation 11.2

Thematic areas in which large-scale RTI infrastructure can usefully be built up should be identified and established in accordance with the key research areas defined in the RTI Strategy 2020 and with the support of external experts. ►2013

■ Recommendation 11.3

The increased joint (collaborative) use of large-scale RTI infrastructure facilities should be encouraged, if necessary by making it an evaluation criterion in the relevant funding schemes, or as

part of the establishment of key research areas at universities and non-university research institutes. This could be done by giving preference to infrastructure where there are clear concepts for its use by other research facilities and companies. ►2013

■ Recommendation 11.4

Existing and planned programmes and arrangements to promote cooperation should be broadened by a focus on infrastructure, with care being taken to ensure an appropriate balance between basic research and applied research. In principle non-discriminatory access should be ensured at publicly funded infrastructure. The refinancing of facilities by means of external use could constitute part of the funding agreements. ►2013

■ Recommendation 11.5

Business enterprises should also be granted access to RTI infrastructure. The charges for use should be internationally comparable. The service character of easier access to RTI infrastructure for companies should be expanded by means of suitable business and cooperation models. This means actively marketing research services, as a result of which the communication process between science and industry will become closer and mutual suggestions for collaborative research topics will be generated. ►2013

■ Recommendation 11.6

Details of public RTI infrastructure costing in excess of more than EUR 5 million should be centrally collected and published. ►2013

Strategic Guideline 12: Guarantee Budget Resources in the Long Term

The chief objective is the adequate long-term provision and coordination of budget resources for RTI infrastructure with a national or international focus.

The Austrian Council recommends

■ Recommendation 12.1

A multi-year budget of a sufficient order of magnitude should be provided for RTI infrastructure and dedicated to the following three areas:

- International participations that are of particular benefit to Austria



infrastructure



■ Basic infrastructure at research facilities in the higher education and non-university / collaborative sector

■ National participations, preferably in the form of cutting-edge infrastructure for collaborative (supra-regional) use

The development of RTI infrastructure can also be centrally funded (e.g. from a separate programme), its upkeep would be paid for from the funds awarded (e.g. by the Austrian Science Fund in the form of overheads or the Austrian Research Promotion Agency to the project that uses such infrastructure). Important RTI infrastructure should also be established at companies and should therefore be covered by funding schemes. ►2013

■ Recommendation 12.2

In consultation with the platform, the responsible ministry should define the type and scope of basic research infrastructure for scientific institutions taking into account the desire to develop a competitive profile. ►2013

■ Recommendation 12.3

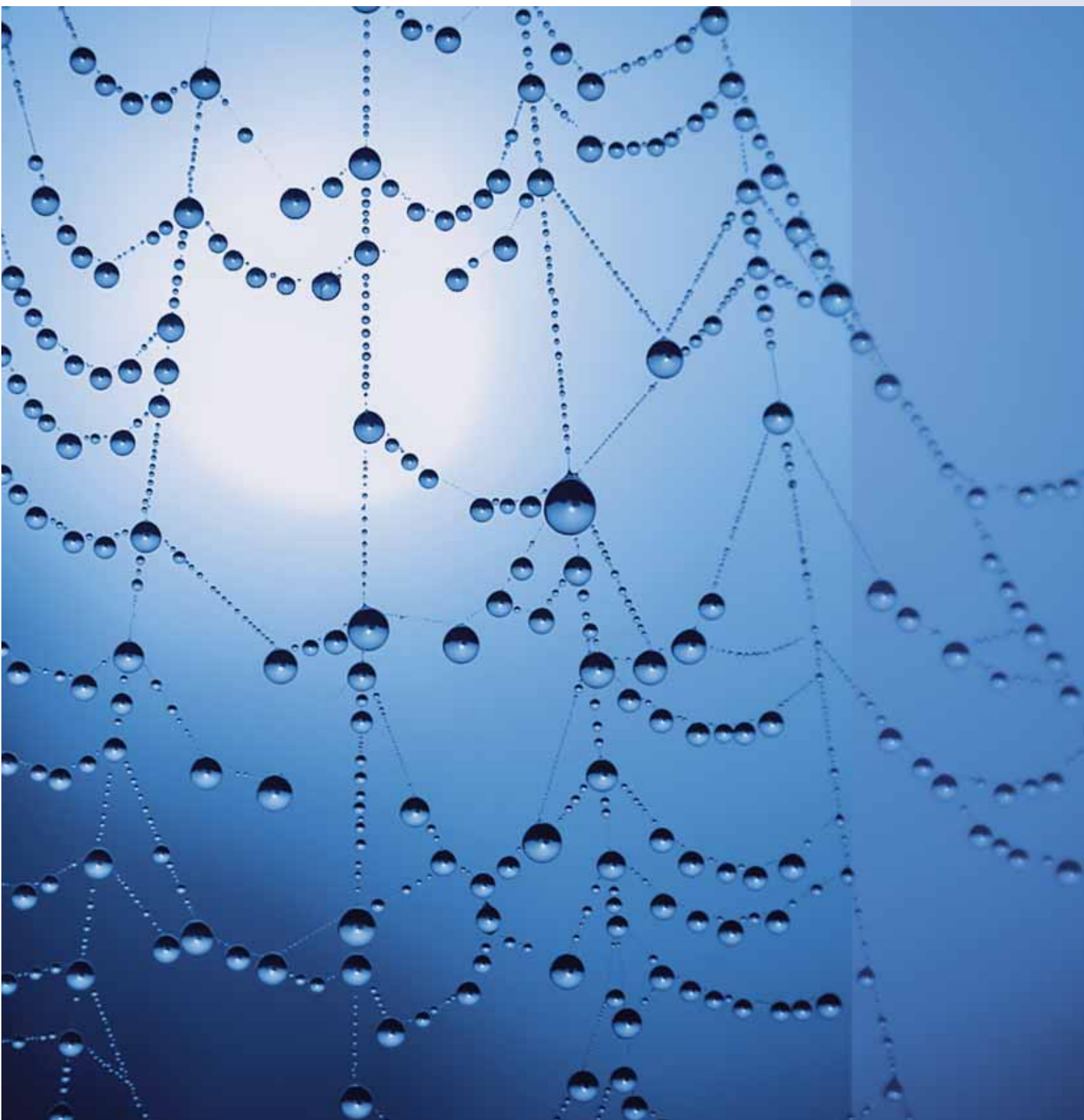
Funding for defined basic research infrastructure should be ensured through the global or basic

budget. A certain percentage of the global or basic budget of scientific institutions (approximately 40 %) should be allotted to safeguard the basic infrastructure. The transfer of university property from the federal property owner Bundesimmobiliengesellschaft (BIG) to the universities should be examined on the premise that it cannot be sold but with a view to mortgaging it.

►2013

■ Recommendation 12.4

Competitive tendering processes should be retained for the financing of additional large-scale research infrastructure. Greater external fund-raising (pursuant to § 26 and/or § 27 of the Universities Act 2002 is an important prerequisite for maintaining and operating large-scale RTI infrastructure. However, the funding of basic infrastructure should not depend on competitive instruments, although an appropriate increase in the overhead cost rate by the Austrian Science Fund (FWF) and other research funding agencies in combination with internationally quality-tested research funding can make an important contribution to financing basic infrastructure at university-level institutions and non-university institutes. ► 2013 ■



instruments



Status and Challenges

The public sector has considerable scope to shape framework conditions that are more conducive to research and innovation. The diversity of the promotion instruments employed in Austria has increased in recent years. As a result it has been possible to react in a more focused manner to the challenges and deficits of the Austrian innovation system. However, a question about the appropriate mix in the portfolio, the instruments and institutional responsibilities arises. The multiplicity of programme and agency evaluations that are now available provide clear indications of inadequately coordinated funding approaches and an imbalanced financial weighting of established instruments. However, in the long run it is not possible to stipulate an optimal mix of instruments.⁹⁰

The system evaluation carried out by the WIFO-led consortium on behalf of the BMVIT and what was then the BMWA (now the BMWFJ) gives an insight into the fitness for purpose and effectiveness of the overall portfolio.⁹¹ Against the background of further studies that have been commissioned by the Austrian Council⁹² it should in summary be noted that: Austria has a very comprehensive support system that with the breadth of its impact provides companies engaged in research with easy access to public funding (bottom-up). Beyond the existing structural and thematic programmes no funding gap can be identified in Austria. However,

it must be noted that there is an extensive lack of coordination between direct and tax-incentivised promotion of RTI.⁹³

The lack of collaboration between science and industry that could still be observed in the 1990s is no longer apparent in this form. A lack of willingness to cooperate is no longer one of the main problems in the Austrian innovation system.⁹⁴

The existence of a large number of small and poorly endowed funding schemes leads to a programme overload. In many cases, the focus is concentrated upon demarcation from neighbouring programme overload, instead of addressing the actual problems in the RTI system. Moreover, such programmes also suffer from low visibility and comparatively high managing costs. In contrast, large and correspondingly well-endowed programmes not only improve the visibility of public funding measures in the RTI sector, they also have an impact beyond Austria's borders.

The large number of thematic programmes that have evolved in the Austrian research funding system over a long period of time and in different ways pose an obstacle to focusing on key areas. These programmes (that in some cases are only distinguishable from one another in minor respects) lead to a lack of transparency and high costs at the operational level without the differentiation producing any clearly recognisable advantages.⁹⁵

⁹⁰ Schibany, A. / Jörg, L. / Nones, B. (2005): *Instrumente der Technologieförderung und ihr Mix* (Study on behalf of the Austrian Council for Research and Technology Development), Joanneum Research and Technopolis, InTeReg 37-2005, Vienna.

⁹¹ WIFO / Prognos / Convelop / KMU Forschung Austria (2009): *Systemevaluierung der österreichischen Forschungsförderung und -finanzierung*; Report 4: Tax Incentive Schemes for Research and Development; and Report 5: Das Angebot der direkten FTI-Förderung in Österreich; and Report 8: Kohärenz des Instrumentenmix.

⁹² Leo, H. (2008): *Die Integration von Exzellenz und Risiko in die österreichische Forschungs-, Technologie- und Innovationslandschaft* (Study on behalf of the Austrian Council for Research and Technology Development), Vienna.

⁹³ WIFO / Prognos / Convelop / KMU Forschung Austria (2009): *Systemevaluierung der österreichischen Forschungsförderung und -finanzierung*; Report 8: Kohärenz des Instrumentenmix.

⁹⁴ Schibany, A./ Jörg, L./ Nones, B. (2005): *Instrumente der Technologieförderung und ihr Mix* (Study on behalf of the Austrian Council for Research and Technology Development) Joanneum Research and Technopolis, InTeReg 37-2005, Vienna.

⁹⁵ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): *Systemevaluierung der österreichischen Forschungsförderung und -finanzierung*; Report 5: Das Angebot der direkten FTI-Förderung in Österreich, p. 93 ff.

The reason for this excessive number of programmes is the tendency to solve problems identified in the RTI system primarily through the funding system instead of giving greater consideration to making framework conditions more conducive to research and innovation with, for example, standardisation, tax and environmental laws as regulating variables.⁹⁷ The economic policy challenges arising from this approach are substantial, but a policy mix must be found which makes coordinated use of the most efficient instruments in the respective context. This contrasts with the current Austrian approach where the most easily available instruments – generally speaking new funding programmes – are em-

ployed.⁹⁸ For companies as a whole, however, it appears that while their propensity to innovate is considerable, their willingness to take risks and ability to introduce radical innovations (measured in terms of introducing new products to the market) is rather low.⁹⁹ Companies should be served in accordance with their development stage on a case to - case basis and with a focus on specific target groups, whereby the specific characteristics of the economic strength of the respective federal state should be catered to. In summary, it can be said that the idea of excellence and support for riskier innovation projects should be integrated into the system to a greater degree. >

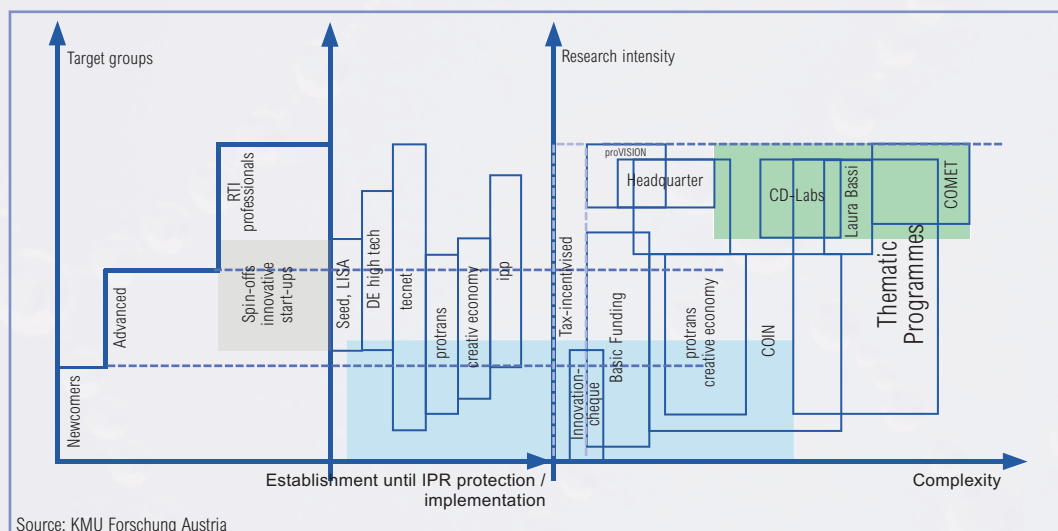


Figure 11:
Programme
categories
according to
funding logic and
target groups
(companies)⁹⁶

⁹⁶ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 5: Das Angebot der direkten FTI-Förderung in Österreich, p. 101; The colour green is used to mark those areas in which the programme category “Excellence – Turning corporate research into high-quality / basic research” is to be found, light blue for those areas which are covered in the category of “low threshold” programmes.

⁹⁷ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 3: Governance in der FTI-Politik im Wechselspiel zwischen Ministerien und Agenturen, p. 70

⁹⁸ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 5: Das Angebot der direkten FTI-Förderung in Österreich, p. 100; Schibany, A. / Jörg, L. / Nones, B. (2005): Instrumente der Technologieförderung und ihr Mix, (Study on on behalf of the Austrian Council for Research and Technology Development) Joanneum Research and Technopolis, InTeReg 37-2005, Vienna

⁹⁹ Schibany, A. / Jörg, L. (2005): Instrumente der Technologieförderung und ihr Mix, Joanneum Research und Technopolis Austria im Auftrag des RFTE, Wien.



Strategic Guidelines and Recommendations

Against the background of this analysis and the current challenges relating to the development of instruments of RTI policy, the Austrian Council has defined the following strategic guidelines and formulated the following recommendations. Two conditions must be created: Firstly, a comprehensive information base that documents funding activities in almost real time, thus creating the necessary basis for a portfolio review. Secondly, an institution that systematically picks up questions concerning the use and mix of instruments irrespective of ministerial and agency boundaries. An important criterion for structuring the strategic guidelines is the distinction between the three performance sectors: (1) Institutions of higher education, (2) the business sector and (3) the collaborative sector. Suitability and sufficient availability of the recommended measures for the groups targeted are key guiding principles for the study. Excellence and risk will span all three sectors as cross-sectional topics.

Strategic Guideline 13: Develop the RTI Instrument as a Whole

The chief objective of this guideline is to develop and present the necessary use and mix of instruments to ensure sustainable performance and international competitiveness of the Austrian innovation system with the target horizon 2020.

The Austrian Council recommends

■ Recommendation 13.1

Indirect research funding is an important instrument for Austria as a research location and, due to its broad impact and the ease with which it can be applied, benefits SMEs in particular. The system of indirect (tax-incentivised) research funding should therefore, in accordance

with the recommendations of the system evaluation,¹⁰⁰ be merged to form one instrument, the research premium ("Forschungsprämie"), and increased to a corridor of 10–20 %. The respective percentage should be defined in accordance with the current economic situation to achieve the appropriate steering effect. At the same time, the cap for contract research should be abolished. ►2013

■ Recommendation 13.2

The wide range of thematic programmes without a critical mass should be streamlined and resources concentrated on a small number of broadly-based key research areas that are of strategic, economic and/or social relevance for Austria. The results of the system evaluation¹⁰¹ should be drawn up as key cornerstones for the further development of the instrument mix. Coordination of the activities of the federal government, the federal states and between the federal states should continue to be carried out within the framework of the Platform RTI Austria ("Plattform FTI Österreich"). ►2020

Monitoring: The Austrian Council will monitor the streamlining of the wide variety of programmes in conformity with the results of the system evaluation. The Council will initiate and follow the development of suitable "niche strategies" for key research areas and key technologies that are of national importance and will subsequently monitor their implementation by the responsible government departments.

■ Recommendation 13.3

Conditions for the award of direct funding should be simplified, kept free of extraneous requirements and designed as unbureaucratically as possible. ►2013

¹⁰⁰ WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 4: Tax Incentive Schemes for Research and Development

¹⁰¹ WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 5: Das Angebot der direkten FTI-Förderung in Österreich; and Report 8: Kohärenz des Instrumentenmix.

Strategic Guideline 14: Diversify the Instruments for Companies

The instruments for the corporate sector should be differentiated according to the specific problem.

In order to increase R&D intensity in the business sector a special effort should be made to address small and medium-sized enterprises, as their potential is still far from exhausted in Austria.

Risk and growth-orientated financing opportunities for young, innovative, technology-orientated companies should be expanded.

The innovation behaviour of Austrian business is characterised by a high level of resource input, but only a very small number of radical innovations. The aspect of risk should therefore be integrated to a greater degree into RTI programmes. Taking into account that the risk level of an innovation is specific to each company and depends on the experiences and abilities of the enterprise.

In order to join the ranks of the European and world leaders in RTI Austria needs strong corporate research centres. This is especially important given the growing competition with-

in corporate groups for research competence. Foundations are relevant actors of research promotion for all scientific disciplines. Many large companies or privately-owned companies allocate substantial long-term funding to support RTI through private foundations. The possibilities of using private foundations as a financing instrument should be looked into.

The Austrian Council recommends

■ Recommendation 14.1

The proportion of companies engaged in research and innovation, in particular among SMEs, should be increased. The following instruments should be employed to achieve this end.

■ Mobility programmes to encourage the transfer of scientists from science into industry or from industry into science

■ Innovation management programmes to create the appropriate internal company conditions for increasing the innovative strengths in SMEs

■ Specific RTI cooperation programmes for small and medium-sized companies ►2013 >



instruments



■ Recommendation 14.2

The availability of and access to external sources of financing in the form of venture capital should be improved and start-up financing expanded to support the research basis in SMEs in the technology and knowledge-intensive sector. ►2013

Monitoring: Verification of the implementation of the Austrian Council recommendations of 14 March and 9 December 2008 and of the need for and the effectiveness of a risk capital initiative by external experts.

■ Recommendation 14.3

Public funding for projects should be linked to the subjective risk for the company. The risk should be high and should enable the company to carry development forward so that it can reach the next step on the innovation ladder. The amount of funding should be accordingly adjusted to the level of risk involved in the project. To do this, companies should be segmented according to innovation types and subsidies adjusted to their individual needs. The definition

of types of innovation and companies must be orientated to the nature of the innovation project, the innovation intensity of the industries and the state of the art and scientific knowledge. For the purposes of delineation, the performance limits of the company (competence) and the criteria “new to the market” / “new to the company” can be used. ►2013

■ Recommendation 14.4

Factors that influence the decisions made by foreign parent companies with R&D units in Austria regarding investments and the choice of locations should be systematically studied so that they can be specifically addressed in regional development policy. ►2013

■ Recommendation 14.5

In addition to expanding indirect research funding, direct funding schemes (e.g. the Headquarter Programme of the Austrian Research Promotion Agency (FFG)) designed to make Austria more attractive as a business location should also be expanded in a targeted manner. ►2013



■ Recommendation 14.6

Suitable instruments should be created and tax incentives for business put in place to stimulate additional private-sector financing of RTI in general and university research in particular. ►2013

■ Recommendation 14.7

It should be examined which incentives are suitable for encouraging the creation and use of foundations to finance RTI. If necessary, the legal basis should be revised. ►2013

Strategic Guideline 15: Continue Successful Models of Cooperation

The successful RTI funding schemes to promote cooperation between science and industry (e.g. the Competence Centres programme COMET, the bridging programme BRIDGE and the Christian Doppler Laboratories) have proven themselves and should be continued in an optimised form. Above and beyond this, non-university and collaborative research institutes require a long-term strategic focus in terms of the overall system as well as budgetary planning certainty.

The Austrian Council recommends

■ Recommendation 15.1

The RTI funding programmes to promote cooperation between science and industry should be optimised and carried forward. Appropriate resources should be earmarked for this purpose. ►2013

■ Recommendation 15.2

A stronger concentration and the closure of subcritical collaborative institutions should be examined within the framework of a portfolio analysis. ►2013

■ Recommendation 15.3

Multi-year funding agreements should be drawn up and introduced for non-university/collaborative research institutions (in terms of performance agreements accompanied by greater planning certainty). ►2013

■ Recommendation 15.4

Work carried out at collaborative research centres should also be attributed to the partici-

pating universities and should be reflected accordingly in the performance agreements (e.g. publications, patents, participation in standardisation and other scientific achievements). ►2013

Strategic Guideline 16: Encourage Universities to Develop their Profiles

Internationally positioning Austria as a location for research in terms of an optimal organisation of the various key research areas – head word lighthouse projects – necessitates a sharpening of profiles within the Austrian system of higher education. Performance agreements that provide a steering system of incentives for the autonomous universities are an effective means for doing this. These are currently negotiated bilaterally with the universities with no overall strategic orientation.

Excellence must be more strongly embedded in the system of higher education. Care should be taken at both the universities and the Austrian Science Fund (FWF) that in the course of this process outdated structures are not preserved in the subsidised disciplines and institutions. Furthermore, competition between the universities and between scientists and research teams should be encouraged in order to stimulate excellence in research.

The Austrian Council recommends

■ Recommendation 16.1

On the basis of the Austrian Science Council's deliberations concerning the portfolio, and on the basis of social and economic requirements, a long-term strategy for the Austrian universities and the tertiary education sector should be developed as a complete portfolio and implemented through performance agreements. ►2013

■ Recommendation 16.2

The goals laid down in the performance agreements have to be more ambitious than at present. They must be individually defined for each university, but must follow the strategic priorities of the long-term strategy for Austrian universities. Future budgets must be tied to the >



instruments



achievement of these clearly defined goals. Goal achievement should be appropriately rewarded and failure to do so penalised. ►2013

Monitoring: The Austrian Council will monitor and comment upon developments in connection with the formulation of a strategy for the Austrian universities and on the future negotiations regarding the performance agreements.

■ Recommendation 16.3

The performance agreements and the formula budget should include “excellence” as a target dimension and provide appropriate monetary support. To do this, the proportion of the formula budget should be increased and the block “research” given greater weighting. This requires treating the teaching and research budgets separately.

Core funding at the universities and the FWF programmes should be used to create incentives to open up new fields of research. In this context, attention should be drawn to the importance of overhead financing as an efficient steering instrument in terms of visibility and importance of high-calibre research which should therefore be further expanded. ►2013

■ Recommendation 16.4

As of 2010 the Austrian Science Fund (FWF) is to be endowed with additional resources amounting to one percent of the general university funds (GUF) to supplement the budget currently planned for it. These funds should be covered out of the BMWF's university budget reserve of up to 2%. ►2010

■ Recommendation 16.5

To increase the volume of excellent research carried out at universities, the proportion of performance-related funding and funding awarded using competitive procedures should be continuously increased. This requires a clear breakdown of the funds that actually flow into research and teaching at all universities and suitable incentives that reward external fund-raising in the performance agreements. ►2013

At this point the importance of the BMWF's cluster of excellence initiative needs to be stressed which has to be implemented. ►2010

Monitoring: The Austrian Council will verify the percentage of the university budget used for research and teaching and monitor the reward of external fund-raising in performance agreements as well as the related increase in the amount of funding at universities generated in competitive procedures. ■





Status and Challenges

It is only in recent years that the concept of governance has started to play a greater role in the European RTI policy discussion. The term is used to broaden the concepts of state power and politics. "The broadest meaning of governance is the regulation of social activities utilizing a variety of modes and mechanisms of societal regulation."¹⁰² In this framework, the concept of governance allows a wider circle of actors to influence the result of the strategy formulation process and the allocation of tasks and resources. Governance deals with the entire web of relationships between institutions that form a collectivity. In the case of RTI policy this collectivity comprises the actors of the RTI system. Inter-institutional interaction is also covered by the concept of governance: "Governance is about the handling of complexity and the management of dynamic flows. It is fundamentally about interdependence, linkages, networks, partnerships, co-evolution and mutual adjustment."¹⁰³

This approach to RTI corresponds to the concept of dynamic RTI systems. According to the European Trend Chart on Innovation¹⁰⁴ governance, defined as the extent to which RTI policy measures are present and realised, constitutes an important indicator of a national system of innovation's performance.¹⁰⁵ In recent years major reforms, especially at the agency level (in particular, AWS, Austrian Research Promotion Agency (FFG), Austrian Science Fund (FWF)) have changed the governance structures of the Austrian RTI system. The ministerial level has not been adapted

to the changed framework conditions to the same extent. There has been no evaluation up to date of the benefits of the existing structures. While to some extent the system evaluation performs this task, it is constrained by the narrow confines of its remit.

Similar problems can be inferred from international comparisons: "As a result of the close ties that exist between several political levels and other players, a network develops that increasingly evades democratic control and transparency, all the more so as the monitors – various government departments – themselves participate in the formulation of the policy and tend to represent department-specific interests."¹⁰⁶ For this reason, answers in the area of governance are generally provided before the right questions have been asked.

An analysis of the governance structures in countries that are classified as innovation leaders in the Summary Innovation Index shows that the Austrian structure is more complex in comparison. Sweden, Finland and Denmark are comparable to Austria in terms of size; Germany and the United Kingdom are the most dynamic countries among the innovation leaders. The comparison shows that in these countries that have very successful RTI policies, responsibility for RTI agendas is apportioned between two ministries according to whether they have a scientific or economic and technological focus.¹⁰⁷

Cooperation between the ministries and agencies is, at least in some cases, not sufficiently trans-

¹⁰² Schneider, V. / Bauer, J. (2007): Prospects of Complexity Theory in Revisiting System Theory, Midwest Political Science Association; Chicago.

¹⁰³ De la Mothe, J. (2001): Knowledge Politics and Governance, in: De la Mothe J. (ed), Science Technology and Governance, Continuum; London, New York.

¹⁰⁴ European Commission (2005): Innovation strengths and weaknesses. <http://trendchart.cordis.lu/scoreboards/scoreboard2005/pdf/EIS%202005%20Innovation%20Strengths%20and%20Weaknesses.pdf>. (last access: 22.7.2009)

¹⁰⁵ Aiginger, K. / Tichy, G. / Walterskirchen, E.. (2006): WIFO-Weißbuch: Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation. WIFO White Paper, Vienna.

¹⁰⁶ Mai, M. (2007): Komplexität als Problem politischer Gestaltung – Thesen zur Governance im Bereich Innovationspolitik; Dortmund.

¹⁰⁷ Vgl. <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home>

parent.¹⁰⁸ The strategic demands of the individual institutions are inadequately coordinated leading to delays and obstacles in day-to-day operations.¹⁰⁹ Accordingly, the Government Programme states that the structure of responsibilities between the ministries and agencies should be treated with priority.¹¹⁰

This finding was confirmed by the peer review of the Austrian RTI landscape carried out by the

CREST Expert Group.¹¹¹ This report suggests that Austria could benefit from a rationalisation of governance structures at the ministerial level, including a clear separation between the ministries and the funding agencies. In particular, the agencies should be given greater control over programme design and implementation on the basis of annual work programmes approved by the ministries.



Strategic Guidelines and Recommendations

Based on this analysis and the current challenges in relation to the interplay between the actors in the innovation system, the Austrian Council has defined the following strategic guidelines and formulated the following recommendations.

Strategic Guideline 17: The Design of the Structure and Governance Cascade

Changes to structures and processes can only be successful if they are based on clear objectives. The organisation of the structures and also improvements to the system must be made from the top down, starting in the ministries. As the results of the system evaluation show, the strategic coordination processes at the ministries can still be significantly improved. A regular exchange between the government ministers responsible for research (and education) and government leaders with the involvement of parliament should form the basis for steering the underlying structures.

Figure 12 shows a model of the desired structure in 2013. With regard to the institutions at the agency level it should be noted that in each case

it is the function as a funding institution that is addressed (e.g. ÖAW), respectively the part that deals with the RTI system (e.g. AWS).

This target model is based on three guiding principles:

- Focus more on strategic competence at the ministries bearing in mind the need for a flexible deployment of human resources to deal with changing structural and content-related priorities
- Projects that have received the best evaluations should be awarded funding by more than one funding agency. The latter should be jointly represented in the steering bodies
- Greater autonomy for the agencies to improve the speed with which services are provided for the research level

It is important in this context that the establishment of the two administrative units for basic and application-oriented research does not result in the creation of an additional administrative level, but that the existing steering and supervisory bodies instead act jointly (personal union). The mutual observer function in the administra-

¹⁰⁸ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 3: Governance in der FTI-Politik im Wechselspiel zwischen Ministerien und Agenturen, p. 47.

¹⁰⁹ See WIFO / Prognos / Convelop / KMU Forschung Austria (2009): Systemevaluierung der österreichischen Forschungsförderung und -finanzierung; Report 2: Strategic Governance: Der Zukunft von Forschung, Technologie und Innovation ihren Möglichkeitsraum geben. Evaluierung der Gestaltungsstruktur und Steuerungskultur der österreichischen FTI-Policy.

¹¹⁰ Government Programme for the XXIV Legislative Period (2008), Chapter "Research, Technology, Innovation (FTI)", p. 44.

¹¹¹ Guy, K. / Lambert, R. / Masson, A. / Mogenson, I. / Sandberg, O. / van der Zwan, A. / Jahn, S. (2008): Policy Mix Peer Reviews: Country Report: AUSTRIA. A Report of the CREST Policy Mix Expert Group (Fourth Cycle of the Open Method of Coordination in favour of the 3 % Objective).

governance



tive units takes into account the fact that the boundary between basic and applied research is increasingly disappearing and that the recommendations regarding the instruments call for a closer relationship between science and industry.

The Austrian Council recommends

■ Recommendation 17.1

In accordance with the governance cascade shown in the figure 12, the following structural principles should be implemented:

■ Application-orientated research agendas should be concentrated at the ministries responsible for applied and commercially-orientated research – BMVIT and BMWFJ

■ The supervisory and steering structures of the agencies should be merged, also with a view to being able to allocate funding to the key areas flexibly and as needed. This requires the functions depicted in the administrative unit. The ministries should draw up strategic guidelines to this effect

and budget corridors within which the agencies can act independently and flexibly.

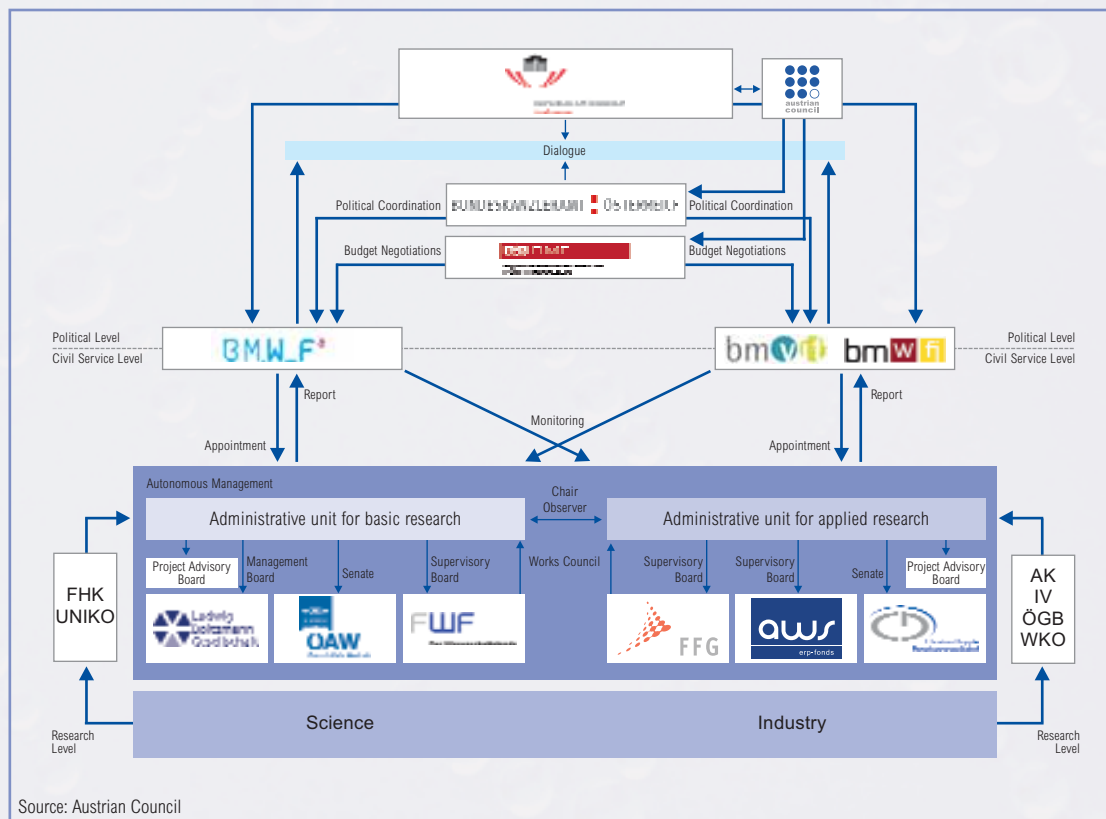
■ Autonomy of the agencies in the sense of agencification in terms of jury and guideline decisions on the basis of the strategic specifications of the ministries. The use of indicators should make coordination with the ministries simpler and more transparent.

In accordance with the Government Programme for the XXIV Legislative Period the tasks, structures and competencies of the Council for Research and Technology Development are to be reorganised.

The intention behind the establishment of the Austrian Council was to create an independent advisory body that would develop strategies, measures for structural improvements and indicator and monitoring systems.

The main focus of its work is upon defining strategic directions, key research areas and the necessary funding levels as decision-making aids for government. The personal involvement of members of the

Figure 12:
Model of
governance
structure
in 2013



government in the Austrian Council's deliberations is a key contributing factor to the efficiency of the Council's work. The Austrian Council gives particular consideration to the policy areas education, science, research, the economy and competitiveness, in each case focusing on their impact on the RTI system. It obtains its information base by means of its observer function in the administrative unit and assumes responsibility for monitoring and evaluating the overall system and the sub-systems. The key parameters for the processes can be derived from the structures described:

- Targets
- Budget requirements
- Indicator corridors

This should initiate a cultural change. The prioritisation of process models as compared to structure models represents a paradigm shift toward thinking in "functional patterns" that will ultimately contribute to enhancing the transparency of the development, implementation and monitoring of intervention models. Positioning institutions when generating, developing and discontinuing instruments and programmes supports the establishment of a culture of intervention that promotes excellence and allows an exit from models that are no longer adequate.¹¹² ▶2013

■ Recommendation 17.2

The federal government should be invited to discuss and adopt before the end of 2009 a target model for governance to be put in place by 2013 and to implement the necessary measures. ▶2010
Monitoring: The extent of implementation will become a fixed item on the agenda at those meetings of the Austrian Council (two per year) that are attended by the responsible members of the government.

■ Recommendation 17.3

The federal and state governments should be invited to actively contribute to the gradual development of cooperation in the RTI sector on the basis of the Platform RTI Austria. In the interests

of the system as a whole it is particularly important here to ensure the optimal design of the interfaces. Responsibilities and (regional) foci should be clearly delineated and overlaps and redundancies avoided. ▶2013

Monitoring: The coordination and integration of regional government instruments and measures at both the regional level and also within the national innovation system will be verified within the framework of the Platform RTI Austria. Implementation will be accompanied by rounds of twice-yearly Platform discussions.

Strategic Guideline 18: Gear Benefit Indicators to Need

In contrast to the currently prevailing top-down focused approach for which an ex-ante evaluation is only available in exceptional cases, the planning of intervention measures in 2020 will be geared solely to the needs of the research level using appropriate survey methods. This must certainly include an ex-ante evaluation of the planned interventions which will be commissioned or carried out by an institution other than the one responsible for the intervention.

The Austrian Council recommends

■ Recommendation 18.1

The Austrian Council recommends the implementation of the proposal made by the National Audit Office – "The National Audit Office suggested to the Austrian Council and the ministries concerned that independent programme evaluations should be commissioned by the Austrian Council".¹¹³ ▶2013
Monitoring: Report in December 2010 to the federal government, the National Audit Office and the public regarding the implementation of the recommendation.

■ Recommendation 18.2

Each planning document for interventions must identify suitable benefit indicators and integrate them according to a transparent pattern. ▶2013 >



¹¹² Details of "Governance RTI Process Structure" can be seen under <http://www.forschungsstrategie.at/Governance/Ablauf>.

¹¹³ RH Bund 2007/16, <http://www.rechnungshof.gv.at/berichte/ansicht/detail/rat-fuer-forschung-und-technologieentwicklung.html>

governance



Monitoring: The Research and Technology Evaluation platform (Plattform fteval) will present a report on the structure and implementation of the benefit indicators model to an interested public at its yearly conference.

Strategic Guideline 19: Increase the Flexibility of Employment Contracts at the Ministries

Focusing more on strategic competence at the ministries requires greater flexibility from employees and in employment contracts. New ideas are generated most efficiently through permanent change. The qualifications of the men and women working at the ministries are the basis for the strategic outlook in the future. Any cementing of structural or thematic processes obstructs the system, thus massively constricting development options. It is therefore essential that employees are motivated to display greater flexibility. Current divisions of responsibility and

contract structures systematically encourage upholding the path-dependent status quo.

The model for 2020 envisages flexible contracts with compulsory transfers within the structure at regular intervals. The European Commission is a useful example here since its staff regularly (e.g. at 5-year intervals) swaps thematic and structural agendas.

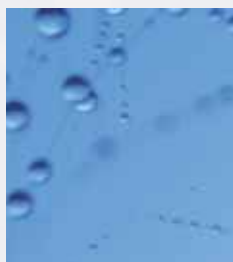
The Austrian Council recommends

■ Recommendation 19.1

Use should be made of the many types of employment contracts that are available within the civil service in order to flexibly adjust staff task structures. Preference should be given to team structures with specific tasks instead of hierarchical structures. ►2020

Monitoring: Each institution (ministry) defines audit routines in its rules of internal procedure for checking the flexibility of its own structures. ■





Status and Challenges

When the Austrian government drew attention to the increasing importance of internationalisation in its Government Programme for the XXIV Legislative Period, it highlighted three areas. In addition to the European Research Area as the core element, existing partnerships with global front-runners should be deepened and new paths of cooperation in the RTI sector sought with the most scientifically and economically dynamic regions in the world with a view to enhancing Austria's scientific and economic competitiveness.¹¹⁴ In Strategy 2010 the Austrian Council formulated the goal of positioning Austria as a strong and active partner in the European Research Area and developing the country into a key network node in the European, and especially the Central and East European Research Area.

Austria's foreign science policy can be organised in five differentiated areas of action:¹¹⁵

- A European dimension involving the European Research Area
- A regionally-orientated dimension within the EU and with South East Europe
- Bilateral cooperation with selected third states (global front-runners and the most scientifically and economically dynamic regions)
- Multilateral cooperation with third states in selected collaborative networks
- International commitments on the basis of global governance processes and international agreements

In recent years there has been a paradigm shift in research policy within the European Union. On the one hand, the establishment of the European Research Council (ERC) has broadened the scope of common research support measures to include basic research (thus increasing competition in this domain). On the other, the implementation of the European Research Area has highlighted

the issue of a common focus for national investments in RTI. Creating a European research infrastructure remains a challenge that will have to be solved at the European level.

These developments require that activities to promote Austria's international integration have a strategic focus. To this end, a concept must be developed and expanded with which basic research can be better supported within the framework of European programmes (structures, financing, subsidies, and infrastructure). At the same time objectives must be defined and it must be agreed how and in which areas Austria will actively have a say in and shape (as well as finance) European tasks. At present, the activities in which Austria participates are neither selected in a targeted manner nor inter-ministerially coordinated.

With a view to the Seventh EU Framework Programme existing programmes (e.g. procurement financing) should be used to ensure continued extensive and successful participation by Austrian scientists. A goal-orientated coordination of national programmes with the Seventh EU Framework Programme will help to improve the international networking of Austrian researchers and intensify research cooperation with the EU and other states. Austria's integration in the European Union and EU enlargement has moved our country from the periphery to the heart of a single research and educational market. The reduction, or in some cases complete elimination, of barriers and transaction costs has created long-term financial and strategic latitude. In those states in Austria's immediate social and economic vicinity where this has not yet been achieved (the Western Balkans and Russia), efforts should be increased to strengthen cooperation and remove barriers.

There are also numerous possibilities for research cooperation with third states via the new Central

¹¹⁴ See Government Programme for the XXIV Legislative Period (2008), p. 43

¹¹⁵ Many points of the analysis are based upon: Schuch, K (2009): Bestandaufnahme und Positionierung der international ausgerichteten FTE Programme Österreichs, (Study of the ZSI on behalf of the Austrian Council for Research and Technology Development), Vienna. The analysis deals with the following aspects: Relevant RTI programmes and initiatives at the national level and at the European level, the ERA-NET with Austrian participation; foreign official RTD-relevant representatives in Austria; official Austrian institutions abroad that implement RTD-relevant agendas; research mobility.

and East European EU member states. Good examples for Austria's formative role in South East Europe can be found within the framework of the "Task Force Building and Fostering Human Capital" and the "Steering Platform on Research with the Western Balkan Countries" and active participation in European bodies (such as the CREST OMC Working Group on Internationalisation in S&T)¹¹⁶. Some of the activities that could potentially be included in future strategic measures are:

- The continuation and expansion of programmes to support strong and successful participation in the Framework Programmes

- Joint agenda setting in the EU (in relation to Central Europe)¹¹⁷

- Political lobbying as the "lead country" for the Western Balkans (within the framework of platforms or the Regional Cooperation Council for South East Europe)

Targeted efforts to promote partnerships with a view to building up "good governance" (e.g. at ministries, agencies, universities, research institutions) should also constitute a central aspect of activities in this region.¹¹⁸

However, much of the world is still largely isolated from the dynamics of science and international innovation processes. Scientific-technological cooperation and development cooperation in Austria should be better coordinated to ensure that modern systems of higher education, schooling, research and innovation are realised and strengthened in the developing countries of Africa, Latin America and Asia and that better conditions are created for closer RTI cooperation with future new centres of science and industry. Until the early 1990s research and educational establishments in Austria were primarily geared to meeting immediate national needs. This focus was supported – as elsewhere in Europe – by nationally segmented education, science and research markets that have been described as regional monopolies.¹¹⁹ Against this background international cooperation was largely centrally steered by the (federal) state. At present, the capacities of Austrian research establishments tend to be too small to successfully take on decentralised internationalisation functions previously carried out by state bodies. Capacities need to be increased here.



Strategic Guidelines and Recommendations

Based on this analysis and the current challenges in relation to the internationalisation of Austrian RTI activities, the Austrian Council has defined the following strategic guidelines and formulated the following recommendations.

Strategic Guideline 20: Refocus the Tasks of the Ministries

The competencies and tasks of the ministries responsible for RTI are still geared to old handling

structures. With advancing international integration the task falls to them of coordinating decentralised national actors, as does responsibility for implementing national experiences in European initiatives and instruments.

The Austrian Council recommends

■ Recommendation 20.1

The allocation of tasks within the ministries should be reorganised to ensure a coherent >

¹¹⁶ See Schuch, K. (2009): Bestandaufnahme und Positionierung der international ausgerichteten FTE-Programme Österreichs (Study of the ZSI on behalf of the Austrian Council for Research and Technology Development), Vienna.

¹¹⁷ Slovakia, Slovenia, Czech Republic, Hungary as well as, in view of future EU membership, Croatia.

¹¹⁸ South East Europe: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania, Serbia, Kosovo, Moldova.

¹¹⁹ See European Commission (2003): Green Paper on Services of General Interest; COM(2003)270, May 2003; Brussels.

internationalisation



national approach to initiatives that are initiated and handled decentrally. The coordination function will replace the management function.

►2010

■ **Recommendation 20.2**

To guarantee efficient coordination, new methods of cooperation between the ministries and programme managers (be they research establishments or agencies) must be established. For this purpose, a federal government coordination group should be founded with the participation of the Austrian Council. It should include representatives from the ministries responsible for research, innovation and education and also from the Ministry of Foreign Affairs.

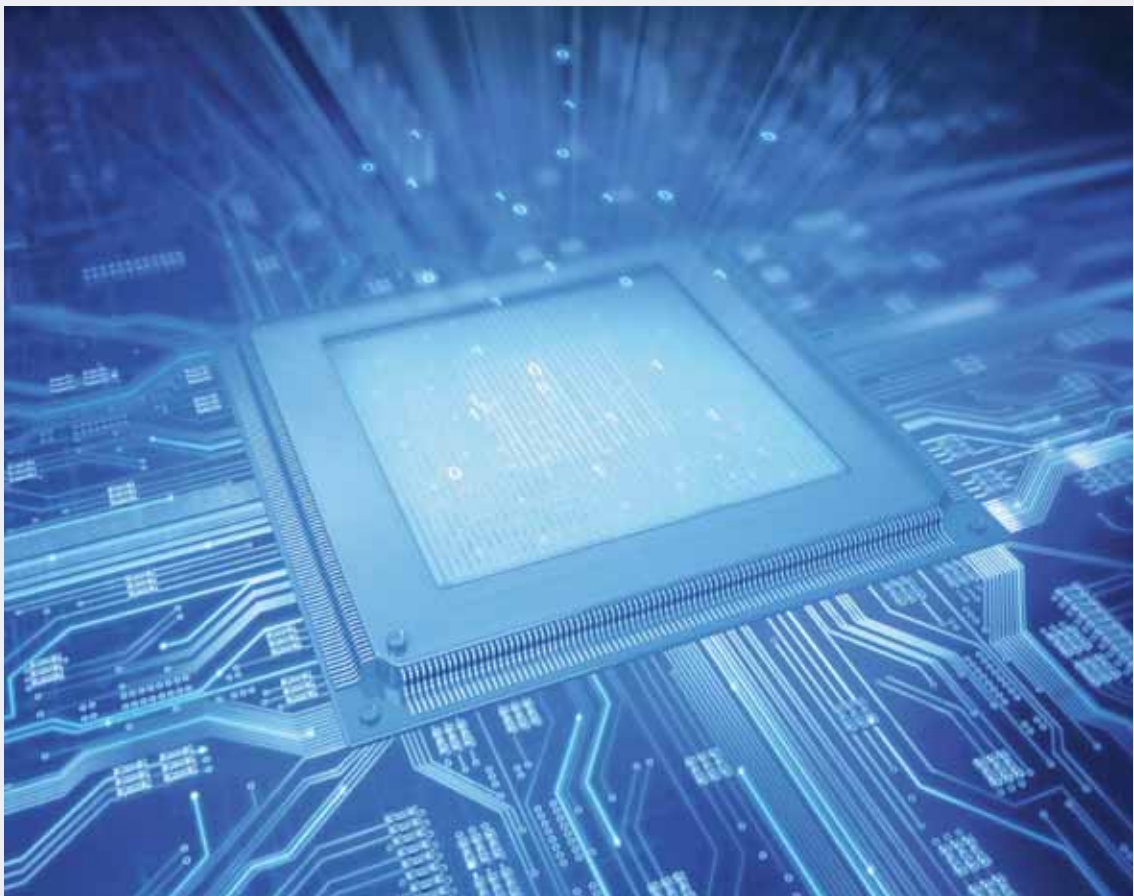
►2010

■ **Recommendation 20.3**

The ministries and the downstream agencies should develop a coherent science and research foreign policy which should be consistently and jointly implemented. Cooperation between the ministries during the development phase, discourse with other stakeholders and a coordinated plan for implementation are essential for the successful realisation of an internationalisation strategy. ►2013

■ **Recommendation 20.4**

The absence of critical mass makes some national internationalisation programmes inefficient. However, they might in certain cases prove decisive in securing competitive advantages and such cases should in any event be articulated.



Priority should therefore be given to making efficient use of European instruments such as ERA-NET projects. ►2010

■ Recommendation 20.5

The ministries should jointly draw up and coordinate Austrian participation strategies for intra-European internationalisation efforts (ERA-NET, ERA-NET Plus, INCO-NET, JTI and Art. 169 etc.): ►2010

■ Priorities should be defined for the participation in ERA-NET Plus projects/programmes. These should be selected on the basis of a catalogue of criteria,¹²⁰ the added value must be articulated and substantiated

■ A central data collection and monitoring system should be developed for Austrian activities carried out as part of intra-European internationalisation efforts with a view to realising synergies

■ The current exchange of information within the framework of the ERA-NET platform is very positive, but greater efforts must be made to create binding structures and processes (information exchange, participation activities, reporting obligations) for the ministries and the agencies

■ Adequate budgets must be provided for preparing and participating in Framework Programmes and for specific calls within the framework of ERA-NET Plus. This should also make it possible to support cooperation with third states as part of the Framework Programme. Sufficient procurement and additional funding must continue to be provided for both domains (intra-European internationalisation efforts and the Framework Programme)

■ Recommendation 20.6

European Commission activities to establish joint programming should be subjected to a critical analysis. The potential benefits for Austria's RTI landscape that would accrue from participation should be assessed. Uncoordinated participation should be avoided under all circumstances. ►2010

Strategic Guideline 21: Strengthen Neighbourhood and Research Foreign Policy

Neighbourhood policy and research foreign policy should be strengthened by intensifying science cooperation and collaboration in education, research and development in the Central, Eastern and South East European research area. Austria should be promoted as a research and university location in Central, Eastern, and South East Europe, in selected non-European countries and in selected collaborative networks in which third countries participate.

The Austrian Council recommends

■ Recommendation 21.1

Embedding RTI cooperation in institutions offers far greater potential in terms of building up capacities than does occasional cooperation in the form of projects. Building upon successful project partnerships institutionalised cross-border networks between research establishments should be expanded. ►2010

■ Recommendation 21.2

As part of the BMWF's "Research for Development" activities, the content of which should ideally be coordinated with those of Austrian Development Cooperation (OEZA), greater efforts should be made to develop and exchange RTI capacities with selected third states. ►2013

■ Recommendation 21.3

To accelerate the development of capacities in Austria the BMWF should have programmes to support the setting up of joint physical or virtual laboratories and centres by Austrian and foreign research establishments. The Eurasia-Pacific Uninet and ASEA Uninet are good examples. ►2010

■ Recommendation 21.4

Existing Austrian foreign and economic policy networks (embassies, foreign trade delegations >



¹²⁰ Within the framework of the ERA-NET information platform the BMWF, also together with experts from other ministries, has drawn up a catalogue of criteria that is used in its own ministry. This can be used as a template.

internationalisation



etc.) should also be used to network the science and research sector. Particular attention should be given to the BRIC (Brasil, Russia, India, China) states. ►2013

■ **Recommendation 21.5**

The internationalisation strategy should be supported by the coordinated presentation abroad of Austria as a centre of science and research, the dissemination abroad of information from the Austrian scientific community and industry about strategic scientific and innovation activities, as well as targeted advertising of Austria as a location for study, research and innovation. ►2013

■ **Recommendation 21.6**

Austrian activities abroad should be better coordinated. Consideration should therefore be given to appointing science attachés. At the same time, communication between the political, economic, scientific and cultural contacts and actors in the field of development cooperation as well as with NGOs should be improved. Furthermore, the Austrian Council recommends that efforts be directed toward increasing the number of Austrian officials at European institutions. ►2013 ■



literature



Aiginger, K./ Tichy, G./ Walterskirchen, E. (2006): WIFO-Weißbuch: Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation. WIFO White Paper (project management and coordination); Vienna.

AMC (2008): Special survey "F&E bei österreichischen Unternehmen im ausländischen Konzernverbund" in cooperation with Statistik Austria; Vienna.

ARC systems research & Joanneum Research (2003): Zukunftspotentiale der österreichischen Forschung; Vienna.

Arnold, E. / Bockholt, P. (2002): The Governance of Research and Innovation: An international comparative study, Synthesis Report, Technopolis-Group.

Austrian Council for Research and Technology Development (2001): Research Strategy Austria "2.5 % + plus" – Prosperity Through Research and Innovation; Vienna. http://www.rat-fte.at/tl_files/uploads/Strategie/25plus_strategy_final_eng.pdf

Austrian Council for Research and Technology Development (2001): Empfehlung zur geplanten Großforschungseinrichtung AUSTRON, 27 March 2001

Austrian Council for Research and Technology Development (2002): Nationaler Forschungs- und Innovationsplan; Vienna http://www.rat-fte.at/tl_files/uploads/Strategie/NFIP_20021203.pdf

Austrian Council for Research and Technology Development (2002): Empfehlung zur Förderung für universitäre Infrastruktur und akademische Karrieren, 14 / 15 February 2002

Austrian Council for Research and Technology Development (2002): Empfehlung zur Universitätsorganisation, 15 March 2002

Austrian Council for Research and Technology Development (2004): Ergänzende Empfehlung zum Offensivprogramm II / 2004 – Programme BMBWK, 6 April 2004

Austrian Council for Research and Technology Development (2004): Empfehlung zu Offensivprogramm und Nationalstiftung, 16 November 2004

Austrian Council for Research and Technology Development (2005): Strategy 2010, Perspectives for Research, Technology and Innovation in Austria, Vienna. http://www.rat-fte.at/tl_files/uploads/Strategie/Strategie%202010_eng.pdf

Austrian Council for Research and Technology Development (2005): Empfehlung betreffend den Beitritt Österreichs zum European Southern Observatory und betreffend die Mitgliedschaft in internationalen forschungsrelevanten Einrichtungen, 22 February 2005

Austrian Council for Research and Technology Development (2005): Empfehlung zum Offensivprogramm II / FTE-Nationalstiftung 2006, 18 November 2005

Austrian Council for Research and Technology Development (2005): Strategie für die Entwicklung der Life Sciences in Österreich; Vienna. http://www.rat-fte.at/tl_files/uploads/Empfehlungen/050812_LifeSciences_Empfehlung_revidiert%20mit%20Grafiken%20Briefpapier.pdf

Austrian Council for Research and Technology Development (2008): IKT-F&E-Strategie; Vienna. http://www.rat-fte.at/tl_files/uploads/Strategie/2008112_IKT-F&E-Strategie-2020_final.pdf

Austrian Research and Technology Report (2008).

Austrian Research and Technology Report (2009).

Autio, E. / Hözl, W. (2008): Addressing Challenges for High-Growth Companies, European Commission, Directorate General for Enterprise and Industry, Europa Innova Paper, (6), <http://www.europe-innova.org>.

Biffl, G. (2006): Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation, Teilstudie 6: Bevölkerungsentwicklung und Migration, WIFO; Vienna.

Biffl, G. (2007): Forschungsstandort Wien: Zur Rolle der Humanressourcen, WIFO; Vienna

Biffl, G. (2008): Bildung und Arbeitsmarkt aus ökonomischer Sicht, WIFO Lectures, 103.

Bodenhöfer, H., et al. (2004): Mitgliedschaften in Internationalen Organisationen, on behalf of the Austrian Council; IHS Kärnten.

Bodenhöfer, H., et al. (2004): Forschungs-, Technologie- und Innovationspolitische Konzepte im internationalen Vergleich; IHS Kärnten.

Bogner, A. (2004): Partizipative Politikberatung am Beispiel der BürgerInnenkonferenz 2003, published by the Institute of Technology Assessment (ITA) of the Austrian Academy of Sciences; Vienna.

Breinbauer, A. (2007): Mobilität österreichischer und ungarischer Mathematiker. Ein Beitrag zur Brain Drain-Debatte in einem kleinen Segment Hochqualifizierter (Dissertation at the University of Vienna).

Cameron, G. (1998): A survey of the empirical evidence, Innovation and Growth; Nuffield College Oxford, <http://www.nuff.ox.ac.uk/users/cameron/papers/empiric.pdf> (last access: 22.7.2009)

Cuhls, K. (2008): Methoden der Technikvorausschau – eine internationale Übersicht; Stuttgart.

Cunningham, P. (2009): Science Policy and Evaluation: the Irish perspective. Presentation at the Second Evaluation Day on 23 March 2009, Vienna.

Dachs, B. / Diwisch, S. / Kubezko, K., et al. (2003): Zukunftspotentiale der österreichischen Forschung. A study on behalf of the Austrian Council.

De la Mothe, J. (2001): Knowledge Politics and Governance, in: De la Mothe, J. (ed.), Science Technology and Governance, Continuum; London, New York.

EURAB (2005): FP6 assessment with a focus on instruments and with a forward look to FP7, final report, http://ec.europa.eu/research/eurab/pdf/eurab_05_014_wgi_final_report_en.pdf (last access: 22.7.2009)

European Commission (2002): Science and Society Action Plan, Brussels.

European Commission (2003): Green Paper on services of general interests, COM(2003)270, May 2003; Brussels.

European Commission (2004): Science and Technology: The Key to Europe's Future – Guidelines for Future European Union Policy to Support Research; Brussels.

European Commission (2005): Building the ERA of Knowledge for Growth, 118 final; Council document 8156/05; Vienna

European Commission (2005): Europeans, Science and Technology. Special Eurobarometer 224; Brussels.

European Commission (2005): Innovation strengths and weaknesses. <http://trendchart.cordis.lu/scoreboards/scoreboard2005/pdf/EIS%202005%20Innovation%20Strengths%20and%20Weaknesses.pdf> (last access: 22.7.2009)

European Commission (2006): Communication from the Commission to the Council and the European Parliament delivering on the modernisation agenda for universities: education, research and innovation, 10.5.2006, COM(2006) 208 final; Brussels.

European Commission (2007): Green Paper – The European Research Area: New Perspectives; Brussels.

European Commission (2008): A Strategic European Framework for International Science and Technology Cooperation, Communication from the Commission to the Council and the European Parliament, COM 588 final.

European Commission (2008): Towards Joint Programming in Research: Working Together to Tackle Common Challenges more Effectively, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM 468 final.

European Commission (2008): European Innovation Scoreboard 2007: Comparative Analysis of Innovation Performance; PRO INNO Europe Paper No. 6; Brussels.

literature

European Commission (2009): European Innovation Scoreboard 2008: Comparative Analysis of Innovation Performance; PRO INNO Europe Paper No. 10; Brussels.

European Commission: ERAWATCH, National profiles; <http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home> (last access: 22.7.2009)

European Council (23./24. 3. 2000): Presidency Conclusions; Lisbon.
European Council (2008): European Research Area Vision 2020; Lubljana.

Falk, M. (2004): An empirical analysis of factors explaining the level of R&D subsidies and their productivity effects, Tip Working Paper; Vienna

Falk, M. / Falk, R. (2006): Do Foreign-Owned Firms Have a Lower Innovation Intensity Than Domestic Firms? WIFO Working Papers 275; Vienna

Falk, M. / Hake, M. (2008): Produktivitätseffekte und Bestimmungsfaktoren der steigenden F&E-Ausgaben in Österreich (Study on behalf of the Austrian Council for Research and Technology Development) WIFO; Vienna.

Falk, M. / Hake, M. (2008): Wachstumswirkung der Forschungsausgaben (Study on behalf of the Federal Ministry for Economy and Labour); Vienna.

Falk, M. / Leo, H. (2004): Die Innovationsaktivitäten der österreichischen Unternehmen. Empirische Analysen auf Basis der Europäischen Innovationserhebung 1996 und 2000, WIFO; Vienna.

Fassmann, H. (2007): Wann kommt der "Knick" des Arbeitskräfteangebots? Prognose der erwerbsfähigen Bevölkerung. In: Fassmann, H. (ed.): 2. Österreichischer Migrations- und Integrationsbericht 2001-2006. Rechtliche Rahmenbedingungen, demographische Entwicklungen, sozioökonomische Strukturen; Klagenfurt, p. 283-284.

Federation of Austrian Industry (2006): The „Human Factor“ in the Field of Innovation; Vienna.

Federation of Austrian Industry (2007): Die besten Köpfe für Innovation, Humanressourcen in F&E als Schlüssel zu Wachstum und Wohlstand in Österreich; Vienna.

Federation of Austrian Industry (2008): Menschen schaffen Zukunft; Vienna.

Felt, U. (2003): O.P.U.S. – Optimising Public Understanding of Science and Technology. European Commission, 5th Framework Programme "Science and Society". Final Report; Brussels.

Felt, U. / Fochler, M. / Müller, A. (2003): Sozial robuste Wissenschaft, Analyse des Wandels von dialogisch orientierten Interaktionen zwischen Wissenschaft, Politik und Öffentlichkeit; Vienna.

Felt, U. / Wynne, B. (2007): Taking European Knowledge Society Seriously. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate; Brussels.

Fochler, M. / Müller, A. (2006): Vom Defizit zum Dialog? Zum Verhältnis von Wissenschaft und Öffentlichkeit in der europäischen und österreichischen Forschungspolitik., ITA-Manuskript 06-04; Vienna.

Forschungsdialog: Missionen – Fragestellungen der Gesellschaft an Forschung und Entwicklung; Österreichischer Forschungsdialog: Ergebnisdokumentation; Vienna. pp. 117-126.

Fritz, O. / Huemer, U. / Kratena, K. / Mahringer, H. / Prean, N. / Streicher, G. (2008): Mittelfristige Beschäftigungsprognose für Österreich und die Bundesländer, Berufliche und sektorale Veränderungen 2006-2012, WIFO.

FWF – Austrian Science Fund (2008): A contest between nations; or how far is Austrian research behind that of the world leader? An analysis on the competitiveness of Austria's scientific research in the natural and social sciences; Vienna.

Gächter, A. / Stadler, B. (2007): Qualifizierung, Dequalifizierung und berufliche Weiterbildung in Österreich 2001 und 2005. Arbeitspapiere Migration und soziale Mobilität No. 3; http://www.zsi.at/attach/p306_iaaus.pdf (last access: 22.7.2009).

Gassler, H., et al. (2008): Priorities in Science & Technology Policy – An international Comparison; Joanneum Research, Study on behalf of the Austrian Council for Research and Technology Development; Vienna.

Gassler, H. / Polt, W. (2008): Systeme der Grundlagenforschung. Dänemark – Niederlande – Schweiz. Joanneum Research, Study on behalf of the Austrian Council for Research and Technology Development; Vienna.

Gassler, H. / Polt, W. / Rammer, C. (2006): Schwerpunktsetzungen in der Forschungs- und Technologiepolitik. Eine Analyse der Paradigmenwechsel seit 1945; Österreichische Zeitschrift für Politikwissenschaft (ÖZP), 35(1); pp. 7-23.

Gassler, H. / Polt, W. / Rammer, C. (2008): Priority Setting in Technology Policy: Historical developments and recent trends; in: Nauwelaers, C. / Wintjes, R. (eds.): Innovation Policy in Europe. Measurement and Trends; Cheltenham (UK), Northampton (US)..

Gersbach, H. / Schneider, M. / Schneller, O. (2008): On the Design of Basic-Research Policy; Working Paper 08/79; ETH Zürich.

Gottweiss, H. / Latzer, M. (2006): Forschungs- und Technologiepolitik, in: Dachs, H. et al. (eds.), Politik in Österreich, Das Handbuch; Vienna, p. 711-725.

Government Programme for the XXIV Legislative Period (2008): <http://www.spoe.at/bilder/d268/Regierungsprogramm.pdf> (last access: 22.7.2009).

Guy, K. / Lambert, R. / Masson, A. / Mogenson, J. / Sandberg, O. / van der Zwan, A. / Jahn, S. (2008): Policy Mix Peer Reviews, Country Report: AUSTRIA. A Report of the CREST Policy Mix Expert Group (Fourth Cycle of the Open Method of Coordination in favour of the 3 % Objective).

Haas, M. (2008): Humanressourcen in Österreich (A comparative Study on behalf of the Austrian Council for Research and Technology Development) University of Vienna, Faculty of Economic Studies; Vienna.

Henrekson, M. / Roine, J. (2007): Promoting Entrepreneurship in the Welfare State, in: Audretsch, D. / Grilo, I. / Thurik, R. (Eds.): Handbook of Research on Entrepreneurship Policy.

Hollanders, H. (2008): Strategic Innovators Drive Innovation Performance at the Sector Level: A Sectoral Analysis of Innovation Modes, Europe Innova, Systematic. www.europe-innova.org

Hölzl, W. (2008): Is the R&D Behaviour of Fast Growing SMEs Different? Evidence from CIS III Data for 16 Countries, WIFO Working Papers No. 327.

Hölzl, W. / Friesenbichler, K. (2008): Final Sector Report Gazelles, Sectoral Innovation Watch; in: Europe Innova (Ed.): Sector Reports, WIFO; Vienna.

Hölzl, W. / Peneder, M. / Silva-Porto, M. (2008): The economics of entrepreneurial activity and SMEs: policy implications for the EU; Background Report, Competitiveness Report.

Institute of Technology Assessment (ITA) (1998): Technologie Delphi II, Ergebnisse und Maßnahmenvorschläge; Schriftenreihe Delphi Report; Vienna.

Institute of Technology Assessment (ITA) (2006): Techpol 2.0. Awareness – Partizipation – Legitimität. Vorschläge zur partizipativen Gestaltung der österreichischen Technologiepolitik; Vienna.

Institute of Technology Assessment (ITA) (2008): Future Search & Assessment. Energie und EndverbraucherInnen (Study on behalf of the Austrian Council for Research and Technology Development, the Federal Ministry for Transport, Innovation and Technology and the Federal Ministry for Economy and Labour); ITA-Projektbericht No. D53; Vienna.

Joanneum Research – Working Group "Ethics in Science and Technology" (2008): Ethik in der Forschung. Ethik-Konzept des Joanneum Research (Living Paper); Graz.

Köpl, A. (2005): Österreichische Umweltindustrie. Branchenanalyse. WIFO; Vienna.



Literature



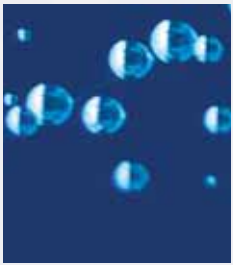
- Kozeluh, U. (2008):** Wissenschaft und Gesellschaft. Verhältnis - Auswirkungen - Einbindung (Report on behalf of the Austrian Council for Research and Technology Development); Vienna.
- Landler, F. / Dell'mour, R. (2006):** Quantitative Entwicklungstendenzen der österreichischen Universitäten und Fachhochschulen 1975-2025. Forschungsbericht 29, Institute of Demography, Austrian Academy of Science; Vienna.
- Leo, H. (2008):** Die Integration von Exzellenz und Risiko in die österreichische Forschungs-, Technologie- und Innovationslandschaft (Study on behalf of the Austrian Council für Research and Technology Development); Vienna.
- Leo, H. / Falk, R. / Friesenbichler, K.S. / Hölzl, W. (2006):** WIFO-Weißbuch: Mehr Beschäftigung durch Wachstum auf Basis von Innovation als Motor des Wachstums. Teilstudie 8: Forschung und Innovation als Motor des Wachstums; Vienna.
- Mai, M. (2007):** Komplexität als Problem politischer Gestaltung - Thesen zur Governance im Bereich Innovationspolitik; Dortmund.
- Martin, B. R. / Tang, P. (2006):** The Benefits from Publicly Funded Research; University of Sussex, Working Paper 161.
- Narin, F. / Kimberley, S. / Hamilton, S. / Olivastro, D. (1997):** The Increasing Linkage between U.S. technology and Public Science; Research Policy 26(3), pp. 317-330.
- Nida-Rümelin, J. (1996):** Wissenschaftsethik; in: Nida-Rümelin, J. (ed.): Angewandte Ethik. Die Bereichsethiken und ihre theoretische Fundierung; Stuttgart, pp. 778-803.
- Nowotny, H. / Scott, P. / Gibbons, M. (2001):** Re-thinking Science, Knowledge and the Public in an Age of Uncertainty; Cambridge.
- OECD (2002):** Frascati Manual. Proposed Standard Practice for Surveys on Research and Development; Paris.
- OECD (2004):** Understanding Economic Growth; Paris.
- OECD (2007):** Main Science and Technology Indicators; Paris.
- OECD (2008):** Education at a Glance. OECD Indicators; Paris.
- Peneder, M. / Falk, M. / Hölzl, W. / Kaniovski, S. / Kratena, K. (2006):** WIFO-Weißbuch: Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation. Teilstudie 3: Wachstum, Strukturwandel und Produktivität. Diagonale Wachstumsbeiträge für Österreich von 1990 bis 2004; Vienna.
- Pichler, R. / Stampfer, M. / Hofer, R. (2007):** Forschung, Geld und Politik: Die staatliche Forschungsförderung in Österreich 1945-2005; Innsbruck, Vienna, Bozen.
- Pock, H. / Feichtinger, T. / Pock, L. / Höfler, B. / Alkan, S. (2009):** Erhebung österreichischer Infrastruktur (Study on behalf of the Austrian Council for Research and Technology Development); Graz.
- Profil: „Die Unvollendeten“, No. 41 (8.10.2007);** pp. 40-42.
- Proviso (2006):** Projekt zur Analyse der österreichischen Beteiligung an den EU Forschungsrahmenprogrammen: Statusreport; Vienna.
- Reinstaller, A. / Unterlass, F. (2008):** Forschungs- und Entwicklungsintensität im österreichischen Unternehmenssektor; WIFO-Monatsberichte 2; Vienna.
- RH Bund 2007/16.** <http://www.rechnungshof.gv.at/berichte/ansicht/detail/rat-fuer-forschung-und-technologieentwicklung.html>
- Rhomberg, W. / Steindl, C. (2006):** Neue Entwicklungen im Bereich der Wirkungsanalyse und -abschätzung FTI-politischer Maßnahmen; ARC Systemresearch; Vienna.
- Salter, A. / Martin, B. (2001):** The Economic Benefits of Publicly Funded Basic Research: A Critical Review; Research Policy, 2001(30); pp. 509-532.
- Schefold, B. / Lenz, T. (2008):** Europäische Wissensgesellschaft - Leitbild europäischer Forschungs- und Technologiepolitik; Berlin.
- Schibany, A. / Jörg, L. / Nones, B. (2005):** Instrumente der Technologieförderung und ihr Mix (Study on behalf of the Austrian Council for Research and Technology Development); Joanneum Research and Technopolis; InTeReg 37-2005; Vienna.
- Schiefer, A. (2008):** Forschung und experimentelle Entwicklung (F&E) im Unternehmenssektor 2006. Statistische Nachrichten No. 11, pp. 1019-1042, Vienna.
- Schneeberger, A. / Mayr, T. (2004):** Berufliche Weiterbildung in Österreich und im europäischen Vergleich (Study of the Institute for Research on Qualifications and Training of the Austrian Economy on behalf of the Federal Ministry for Economy and Labour); Vienna.
- Schneider, V. / Bauer, J. (2007):** Prospects of Complexity Theory in Revisiting System Theory; Midwest Political Science Association; Chicago.
- Schuch, K. (2009):** Bestandsaufnahme und Positionierung der international ausgerichteten FTE-Programme Österreichs (Study of the ZSI on behalf of the Austrian Council for Research and Technology Development); Vienna.
- Schütz, G. / Ursprung, H. W. / Wößmann, L. (2005):** Education Policy and Equality of Opportunity. Cesifo Working Paper 1519.
- Science Center Netzwerk (2009):** Good Practice Elemente von dialogisch/diskursiven Verfahren und niederschweligen Science Center Aktivitäten zur Unterstützung von Good Governance im Bereich Wissenschaft und Gesellschaft (Report on behalf of the Austrian Council for Research and Technology Development); Vienna.
- Science Communications (2008):** "Governing" Wissenschaft und Gesellschaft (A comparative report on behalf of the Austrian Council for Research and Technology Development); Vienna.
- Sonnenburg, J. / Nill, J. / Schuch, K. / Schwaag-Serger, S. / Terlinck, P. / van der Zwan, A. (2007):** Internationalisation of R&D - Facing the Challenge of Globalisation: Approaches to a Proactive International Policy in S&T. Analytical Report on Policy Approaches towards S&T Cooperation with Third Countries; Brussels, Crest.
- Spiel, C. / Schober, B. / Litzenberger, M. (2008):** Evaluation der Eignungstests für das Medizinstudium. Evaluierungsprojekt im Auftrag des BMWF; Vienna. http://www.bmwf.gv.at/uploads/tx_bmwfcontent/Spiel_Studie.pdf
- Statistics Austria (2006):** R&D statistics; Vienna.
- Statistics Austria (2008):** R&D statistics; Vienna.
- Statistics Austria (2008):** Forschung und experimentelle Entwicklung (F&E) im Unternehmenssektor 2006; Vienna.
- Statistics Austria (2009):** Global Estimates 2009; Vienna
- WIFO / Prognos / Convelop / KMU Forschung Austria (2009):** Systemevaluierung der österreichischen Forschungsförderung und -finanzierung (A Report on behalf of the Federal Ministry for Economy, Family and Youth and the Federal Ministry for Transport, Innovation and Technology); Vienna
- Technopolis UK / Technopolis France / Technopolis Netherlands (1999):** The Evolution of Multilateral Public RTD schemes (MPRS) in Europe. Report for DG Research - AP5 (STRATA); Brighton.
- Van Pottelsberghe, B. (2008):** Europe's R&D: Missing the Wrong Targets? Bruegel Policy Brief.
- VDI Technologiezentrum (2006):** Aktuelle Technologieprognosen im internationalen Vergleich (Study on behalf of the German Federal Ministry of Education and Research); Dusseldorf.
- Weber, M. (2008):** Forschung zur Bewältigung gesellschaftlicher Herausforderungen - neue Programme und Programmarchitekturen, in: Österreichischer Forschungsdialog. Ergebnisdokumentation; Vienna; pp. 119-121.
- Wieser, R. (2005):** Research and Development - Productivity and spillovers. Empirical evidence at the Firm Level, in: Journal of Economic Surveys, pp. 587-621.

abbreviations

AIT	Austrian Institute of Technology [formerly ARC, Austrian Co-operative Research]	FWF	Austrian Science Fund
AK	Austrian Chamber of Labour	GDP	Gross Domestic Product
ARC	Austrian Research Center	GUF	General University Fund(s)
ASA	Austrian Space Agency	ICT	Information and Communication Technology
ASEA	ASEAN-European University Network UniNet	ITA	Institute of Technology Assessment of the Austrian Academy of Sciences
AWS	Austria Wirtschaftsservice	IV	Federation of Austrian Industries
BIT	Office for International Technology Cooperation	JTI	Joint Technology Initiatives
BJA	Federal Chancellery	LBG	Ludwig Boltzmann Society
BMF	(German) Federal Ministry of Education and Research	LCU	Leading Competence Units
BMFWK	Ministry of Education, Science and Culture	NGO	Non-governmental organisation
BMF	Ministry of Finance	NSF	National Science Foundation
BMVIT	Ministry of Transport, Innovation and Technology	ÖAW	Austrian Academy of Sciences
BMWA	Ministry of Economic Affairs and Labour	OeNB	Austrian Central Bank
BMWF	Ministry of Science and Research	OECD	Organisation for Economic Cooperation and Development
BMWFJ	Ministry of Economic Affairs, Family and Youth (formerly BMWA)	OEZA	Austrian Development Agency
CDG	Christian Doppler Research Association	OMC	Open Method of Coordination
CORDIS	Community Research and Development Information Service of the European Union	R&D	Research and Development
CREST	Scientific and Technical Research Committee (Comité de la recherche scientifique et technique)	RFTE	(Austrian) Council for Research and Technology Development
ERC	European Research Council	RTI	Research, Technology and Innovation
ESFRI	European Strategic Framework of Research Infrastructure	S&T	Science and Technology
ETH	Swiss Federal Institute of Technology	SFB	Special Research Area
EU	European Union	SME	Small and Medium-sized Enterprises
FFG	Austrian Research Promotion Agency	TIP	Technology Information Policy Consulting Programme
FFF	Austrian Industrial Research Promotion Fund	UniKo	Conference of Austrian Universities
FHK	Conference of Universities of Applied Sciences	VDI	Association of German Engineers
FP	EU Framework Programme for Research and Technological Development	WIFO	Austrian Institute of Economic Research
		WKO	Austrian Federal Economic Chamber (formerly BWK)
		ZSI	Centre for Social Innovation



contact



Geschäftsstelle
A-1010 Wien
Pestalozzigasse 4/D1
Tel.: +43/1/713 14 14-0
Fax: +43/1/713 14 14-99
office@rat-fte.at
www.rat-fte.at

