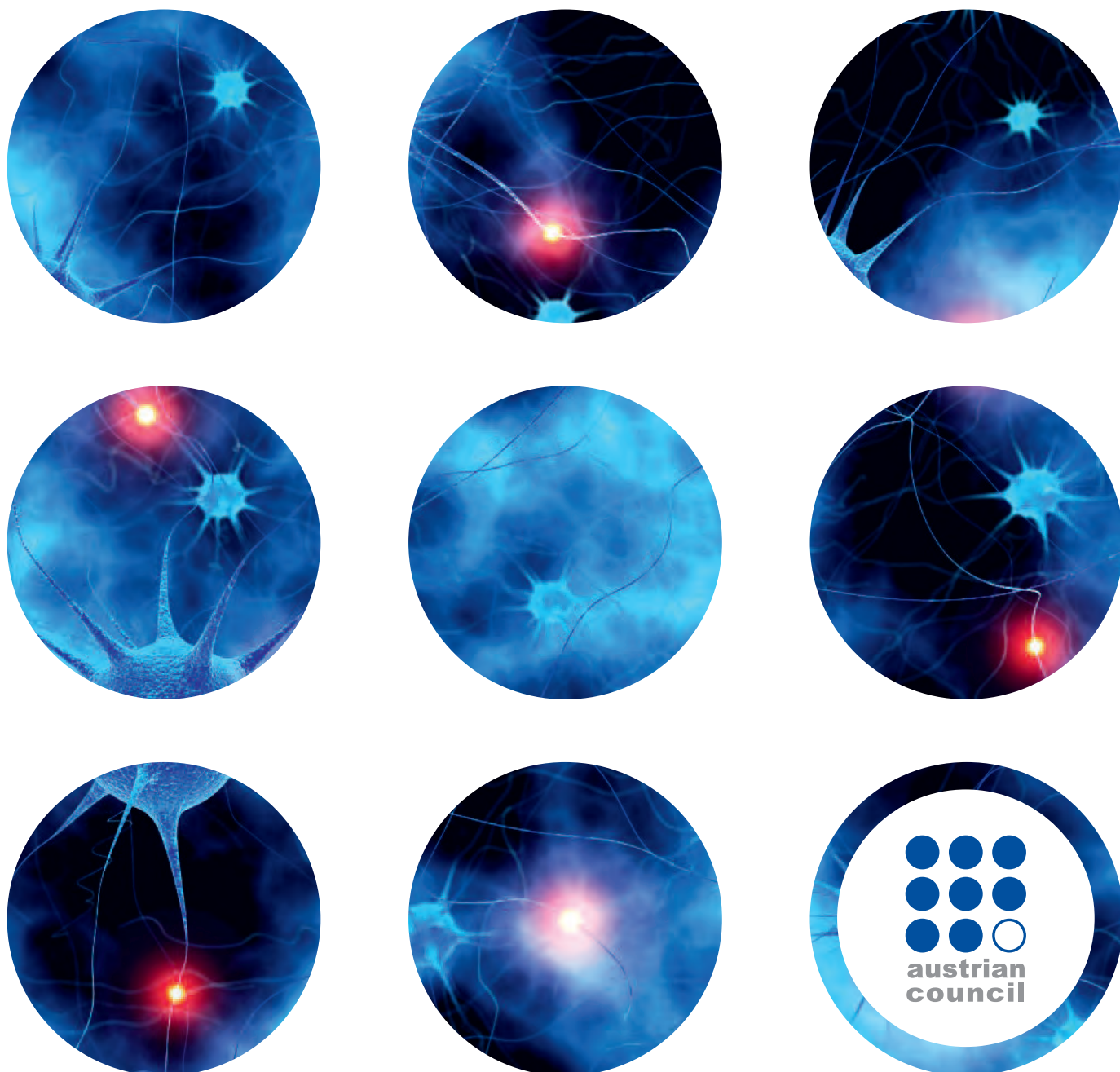




Report on Austria's Scientific
and Technological Capability
2015

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preamble

In October 2009, the Austrian Government launched an ambitious project when it commissioned a Strategy for Research, Technology and Innovation. This RTI strategy was drawn up with the participation of six government ministries, coordinated by the Federal Chancellery, with the explicit aim of positioning Austria among the leading innovation nations by 2020.

In its working programme for the period 2013 to 2018, the Government stated that the strategy would remain an important framework for its RTI policy. The Austrian Council also considers the strategy to be an important milestone in Austrian RTI policy, a view it has expressed several times in its statement concerning the RTI strategy as well as in past reports on Austria's scientific and technological capability.

Five years after the project was initiated, and five years before the end of the time horizon, the Austrian Council has carried out a provisional assessment in which it explored the following questions: How is the implementation of the RTI strategy progressing? Where does the Austrian RTI system stand today? Will the goals set out in the RTI strategy be achieved? Will Austria be an innovation leader in 2020? However, it is al-

so vital to answer the question as to how much energy and how many resources are needed to actually achieve this goal.

The Report on Austria's Scientific and Technological Capability 2015 seeks to provide answers to the questions posed above. It is intended as a mid-term review that evaluates the extent to which the targets of the RTI strategy have been met halfway through the time horizon. This undertaking is consistent with the task given to the Austrian Council by the cabinet of strategically monitoring the implementation of the RTI strategy and evaluating its goal orientation. In its analysis, the Austrian Council is keen to draw attention to positive developments but also just as clearly to address failures and omissions.

The Austrian Council will engage in an exchange with the Government as regards the necessary consequences from the mid-term review and will continue to support it with the implementation of the RTI strategy. The Report on Austria's Scientific and Technological Capability 2015 may offer fresh impetus to the innovation policy agenda. In the opinion of the Austrian Council, this also includes fleshing out and quantifying the goals of the RTI strategy, whereby the Austrian Council will be happy to support the Government during this process.



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Hannes Androsch
Chairman



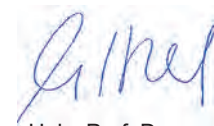
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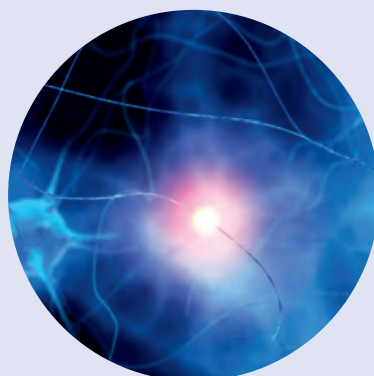
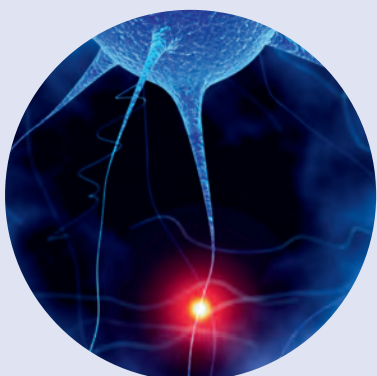
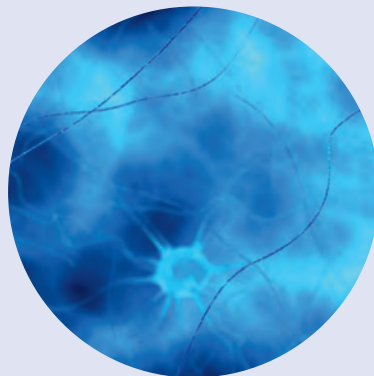
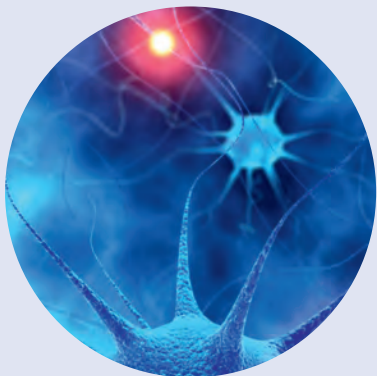
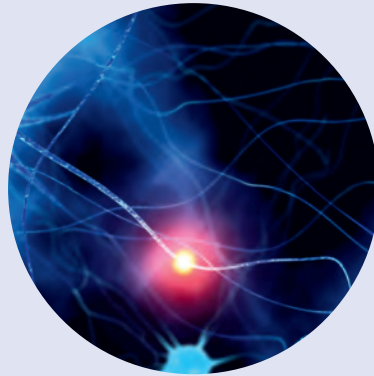
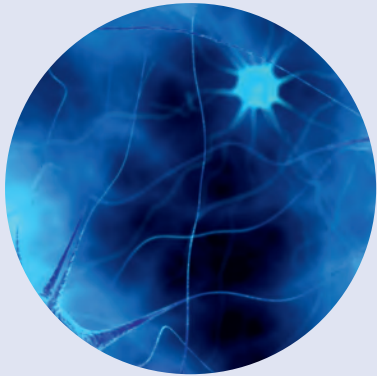
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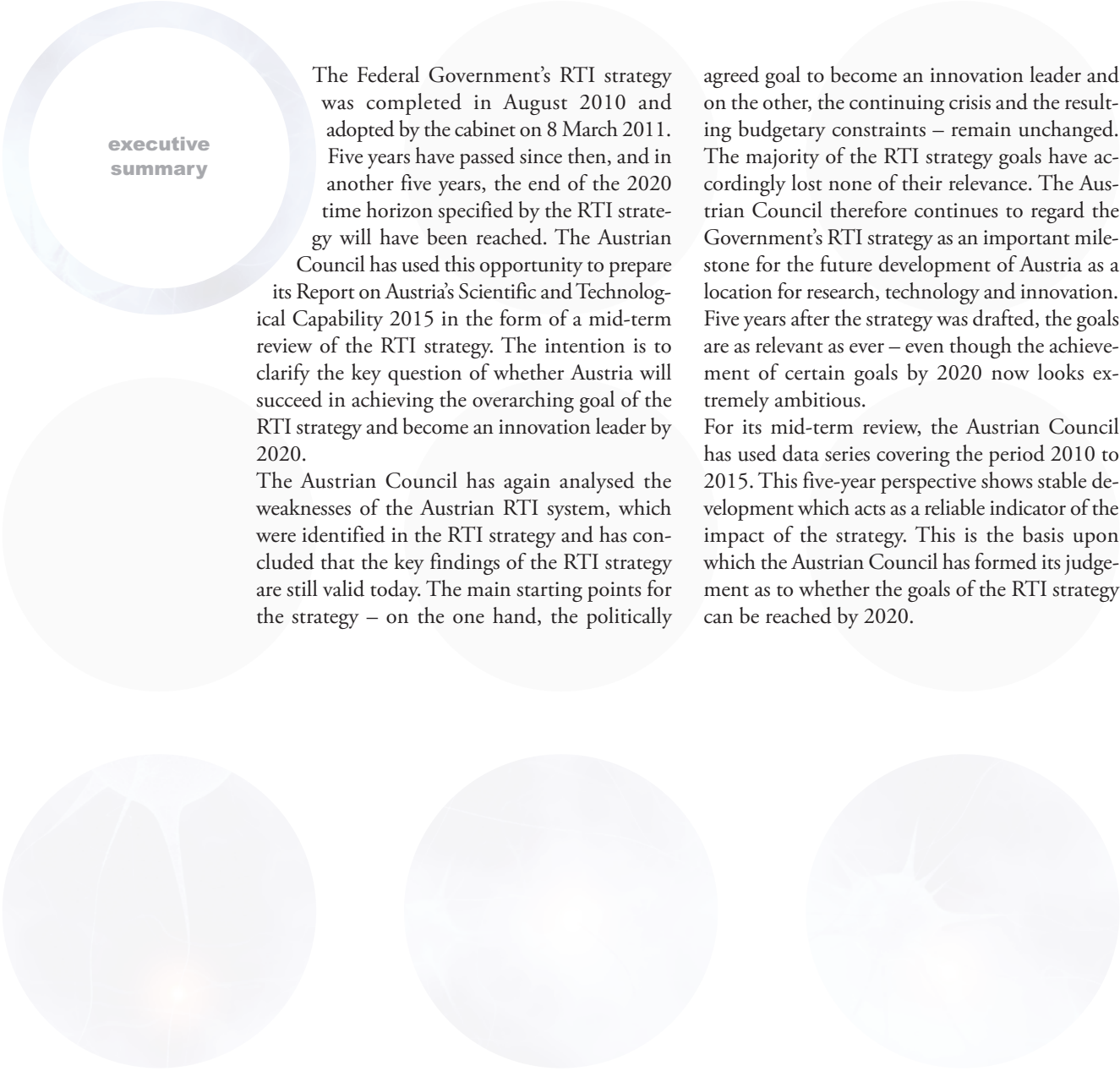


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executive summary

The Federal Government's RTI strategy was completed in August 2010 and adopted by the cabinet on 8 March 2011. Five years have passed since then, and in another five years, the end of the 2020 time horizon specified by the RTI strategy will have been reached. The Austrian Council has used this opportunity to prepare its Report on Austria's Scientific and Technological Capability 2015 in the form of a mid-term review of the RTI strategy. The intention is to clarify the key question of whether Austria will succeed in achieving the overarching goal of the RTI strategy and become an innovation leader by 2020.

The Austrian Council has again analysed the weaknesses of the Austrian RTI system, which were identified in the RTI strategy and has concluded that the key findings of the RTI strategy are still valid today. The main starting points for the strategy – on the one hand, the politically

agreed goal to become an innovation leader and on the other, the continuing crisis and the resulting budgetary constraints – remain unchanged. The majority of the RTI strategy goals have accordingly lost none of their relevance. The Austrian Council therefore continues to regard the Government's RTI strategy as an important milestone for the future development of Austria as a location for research, technology and innovation. Five years after the strategy was drafted, the goals are as relevant as ever – even though the achievement of certain goals by 2020 now looks extremely ambitious.

For its mid-term review, the Austrian Council has used data series covering the period 2010 to 2015. This five-year perspective shows stable development which acts as a reliable indicator of the impact of the strategy. This is the basis upon which the Austrian Council has formed its judgement as to whether the goals of the RTI strategy can be reached by 2020.

Detailed Results of the Mid-Term Review

Priority Objectives: Above-Average Economic Performance, Deficits in Innovation Performance

Austria continues to report a better-than-average economic performance, which also compares very favourably with that of the innovation leaders Denmark, Germany, Finland and Sweden. Per capita GDP in Austria has risen slightly since 2010 and this is reflected in a level of national prosperity which clearly exceeds that of the leading innovation nations. Despite some deterioration, unemployment in Austria remains comparatively low. The overall employment rate has effectively remained unchanged in the last five years, although there has been a significant increase in the female employment rate.

This contrasts with the areas of innovation, the environment, health and quality of life, where there is little realistic prospect of achieving the goals by 2020. This shows that Austria's economic success is not based solely on innovation,

and that in addition to intensifying RTI activities in general, there is still scope to boost innovation activities in the fields of the environment, health and quality of life, even if these are also influenced by a host of other factors.

In respect of innovation performance, there is still a significant amount of catching up to do. Although a differentiated analysis shows that Austria's performance is better than suggested by the Innovation Union Scoreboard (IUS), the country continues to show a performance deficit vis-à-vis the leading innovation nations. Based on the results of the mid-term review, the Austrian Council concludes that the pace of development expected in the field of innovation will not suffice to enable Austria to join the ranks of the leading nations by 2020.

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Education System (Without the Tertiary Sector): Not Possible to Reach the Goals, Despite Positive Trends

Developments in the primary and secondary sectors of the education system were consistently positive in the period 2010 to 2015, although not as dynamic as those in the leading nations. This means that – although the trend is moving in the right direction – there is insufficient momentum to catch up with the innovation leaders.

The performance of the Austrian educational system is very good in a number of areas, for example the higher-than-average staff-to-student ratio in the secondary sector and the small number of early school leavers. However, in other areas, such as the quality of academic achievement or the social selectivity of the educational system, Austria's performance remains well below

that of the innovation leaders. The results of the PISA survey 2012 showed that although there had been progress, performance in many areas was still not equal to that of comparison countries.

For countries on the technological threshold, which are aiming to catch up with the leading innovation nations, it is less the quantitative and more the qualitative aspects in the educational system that are crucial. Based on the results of the mid-term review, it is questionable whether the goal of the RTI strategy to improve the performance of the educational system can be achieved by 2020 without additional efforts being made.



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Tertiary Education System: Performance Clearly Inadequate

Austria's performance in the tertiary education sector is clearly inadequate. With the exception of the steadily increasing number of university graduates, which has consistently exceeded the target horizon since 2010, none of the indicators has registered a notable improvement in goal distance, let alone achieved the particular goal.

Although there are positive developments in a number of areas, such as, for example, the number of women studying STEM subjects or the immigration of highly qualified persons, these are inadequate to achieve the goals by 2020. In

fact, the majority of indicators show a declining trend, especially in areas such as the number of graduates and PhDs in STEM subjects or the level of university spending per student, where the development has consistently fallen below that of the innovation leaders since 2010. From today's perspective, only four of the 15 indicators available for the tertiary education sector are likely to have reached the target value of either the leading innovation nations or the targets defined for Austria. In the opinion of the Austrian Council, this is far too little for Austria to advance into the group of innovation leaders.

Universities and Basic Research:

Weaknesses in the Framework Conditions Threaten Above-Average Research Performance

The research output of Austrian universities and academic research institutions has risen continuously since 2010. This is demonstrated above all by the higher-than-average number of successful project applications to the European Research Council and to individual universities improving their positions in international ranking tables.

This positive trend is threatened by weaknesses in key framework conditions for research quality, such as competitive funding for basic re-

search or the transition to modern doctoral programmes. In both areas, Austria's performance is well below that of the leading countries. Given the inadequate development, this will not change by 2020, and accordingly from the present perspective it is unlikely that the goal will be achieved. If Austria's performance remains at current levels, it is doubtful whether Austria will be able to achieve its aim of joining the group of leading nations in terms of universities and basic research.

Research and Innovation in the Corporate Sector: Competitive Edge at Risk in Key Areas

The competitive edge Austria has enjoyed in corporate research and innovation is at risk in a number of key areas. In respect of one third of the indicators, the goals for 2020 have already been met and for several other indicators there is only a small goal distance to the innovation leaders. This is the case for example in relation to the corporate sector's positive ex-

port performance or the relatively intensive cooperation between science and industry. However, many of the indicators in which Austria is ahead of the leading countries, e.g. attractiveness as a location, have shown a steadily declining trend since 2010, in particular due to the improved performance of the innovation leaders.

In addition, the goals in the majority of indicators have not yet been reached and progress in a number of indicators is inadequate for the goals of the RTI strategy to be achieved by 2020, or was actually negative. This is true mainly for the weaknesses identified in recent years and even earlier in respect of start-ups, venture capital intensity, the intensity of research and development of Austrian industry

and the radicality of innovation activity. Based on the result of its mid-term review, the Austrian Council concludes that both the improvements in the area of corporate research and the development dynamics are insufficient to allow Austria to join the group of leading innovation nations by 2020.

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R&D Financing: Negative Trend Compared to the Innovation Leaders

Both key indicators for R&D financing – the GERD-to-GDP ratio and the proportion of private-sector research spending – have been stagnating for years without any prospect of change. In view of the target date of 2020 for the RTI strategy, momentum is even expected to be negative in comparison with the leading nations. So far, the measures contained in the RTI strategy, which would be able counter this decline, have not been implemented with sufficient rigour, if – as in the case of the Research Financing Act – at all.

In the opinion of the Austrian Council, the momentum of this trend is certainly inadequate for a country aspiring to become an innovation leader. A comparison of current spending on R&D, with the “target” levels based on the steady increase in expenditure since 2011 with a view to achieving the target in 2020, shows that it is highly unlikely that the GERD-to-GDP target ratio of 3.76 percent will be achieved by 2020.

Summary Conclusion of the Mid-Term Review: Progress is Inadequate to Achieve the Goal of Becoming an Innovation Leader if the Trend Remains Unchanged

The Austrian Council believes that the goals set out in the RTI strategy are still valid. However, the results of the mid-term review clearly indicate that the strategy alone – no matter how correct and important its goals are – will not be enough to achieve the overall aim of advancing to join the group of innovation leaders by 2020. While it is evident that the trends for half the goals are moving in the right direction, it is equally apparent that the current measures to implement the RTI strategy are inadequate to allow Austria to keep up with the pace of development of the leading countries. This means that if the trend remains stable, the innovation leaders will forge ahead and leave Austria be-

hind. In the remaining five years, the intensity with which the strategy is implemented must be drastically increased. Otherwise Austria will not only not be an innovation leader in 2020, it will actually be at risk of falling behind other nations.

Thus to achieve the goal of becoming an innovation leader, a new phase of policy-making is needed. Instead of the previously fragmented individual measures, a package of reforms must be successively implemented, which must be adapted to suit the entire RTI system. However, this requires a stronger political commitment and a greater degree of political will-power.



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The key question posed in the Austrian Council's mid-term review, and previously in its white paper on steering research, technology and innovation in Austria, is therefore: How serious is the ambition formulated in the RTI strategy to become an innovation leader? If this ambition is to be taken seriously, policymakers must give much greater priority to education, research, technology and innovation – as key factors for Austria's future – than they have in the past.

While the Federal Government's RTI strategy is ambitious, it does not set out binding targets in respect of individual measures; it is more of an orientation paper. To press forward with implementation of the strategy more decisively, the

Austrian Council urges that an active reform process be initiated. This must receive support at the highest political level. It is the opinion of the Austrian Council that this will require an RTI reform agenda led by the Federal Chancellery and carried out in cooperation with all ministries with responsibility for RTI. This must contain binding political targets and clear mandates for the RTI Task Force. The research action plan recently adopted by the BMWWF could form one element of this stronger focus on implementation.

If there is no increased focus on the key issues education, research, technology and innovation, the Austrian Council believes that the goal of establishing Austria as a leading innovation nation by 2020 will clearly not be achieved.

Priority Areas of Action and Recommendations

On the strength of the indicator-based analysis and evaluation of the capability of the Austrian RTI system, the Austrian Council has identified five priority fields of action:

- The educational system (including the tertiary sector)
- Basic research
- Start-ups and growth of innovative early-stage companies
- Governance structures
- Private-sector R&D financing

In some cases, no progress has been made in these areas for many years. Due to their importance for the RTI system, the Austrian Council takes the view that greater efforts are needed in these areas

in particular, in order to improve the performance of the Austrian innovation system as a whole. The Austrian Council therefore recommends

- Intensifying the reform of the education system
- Increasing competitively allocated financing for basic research
- Further optimising the legal and financial framework for business start-ups and growth
- Improving governance structures for the implementation of the RTI strategy
- Promoting measures to increase the private-sector share of R&D funding

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Recommendations of the Austrian Council Regarding Priority Fields of Action

Intensify Reform of the Education System

The Austrian Council recommends further reforms to modernise the structures of the education system, in particular by implementing specific measures to strengthen school autonomy and streamline the division of competences between the Federal Government and the provinces. The Austrian Council once more recommends that to overcome early-age selection in the education system, there be a commitment to, and implementation of, comprehensive all-day schooling in secondary education first stage, alongside ability differentiation and talent development.

Furthermore, the Austrian Council considers that there is an urgent need to increase early-childhood education (by means of a second year of kindergarten and the promotion of German and other first-language skills), to increase the number of multi-lingual educators (including in particular Turkish speakers) and to provide schools facing special challenges (especially in terms of the socio-economic background of the pupils) with increased financial and human resources.

The Austrian Council recommends that the goal set out in the Work Programme of the Austrian Federal Government to increase to 2 percent of GDP the amount spent on universities should be defined as a minimum target and that the additional annual expenditure, of on average 400 million euros, that is required should be made available for the tertiary sector. Furthermore, the Austrian Council recommends that when taking the necessary legal steps to implement study-place financing, emphasis should be given above all to measures to improve study conditions and in particular to increase the number of graduates in STEM subjects. Further reforms of university career models can contribute to making Austrian universities more competitive in an international context.

Increase Competitively Allocated Financing for Basic Research

The Austrian Council urgently recommends a substantial and sustainable increase in competitively allocated funds for basic research to expand the numbers of those engaged at the top of excellent research and to improve research

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conditions of Austria as a location for science. Failing this, both the improved quality of research performance and Austria's attractiveness as a location for science are seriously endangered.

Further Optimisation of Legal and Financial Framework Conditions for Business Start-ups and Growth

The Austrian Council recommends implementing innovative concepts and supporting funding models with the goal of optimising framework conditions to encourage start-up activity in the knowledge- and technology-intensive sector. The Austrian Council again recommends examining whether international models of tax concessions can be applied to early-stage and small knowledge- and technology-based companies in Austria. A differentiation in the research premium with higher percentages for early-stage and small innovative companies should therefore be considered and, if and where necessary, developed and implemented in detail.

The Austrian Council also recommends developing financing opportunities for innovative young entrepreneurs and SMEs. Crowdfunding, including peer-to-peer lending and crowd investing should be encouraged by an effective and efficient legal framework and should be incorporated into a competitive overall strategy for corporate growth. In this context, the Austrian Council welcomes the BMFWF's recent crowdfunding initiatives agreed by the Government at its closed-door conference, and in particular, the Alternative Financing Act.

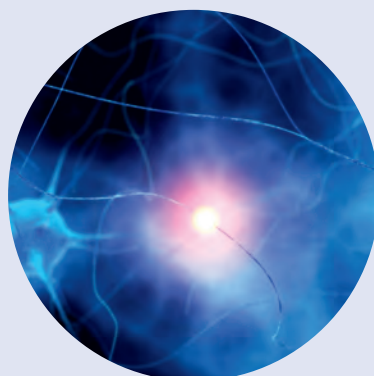
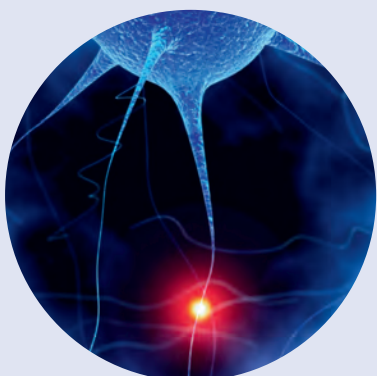
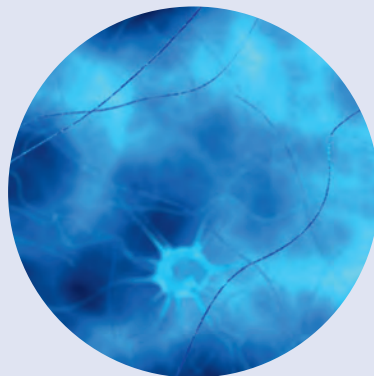
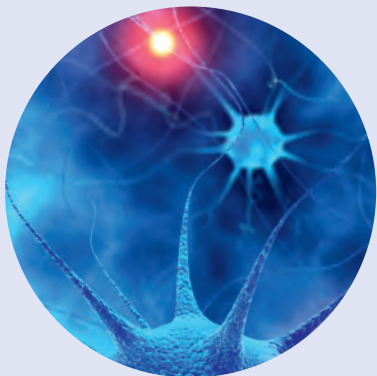
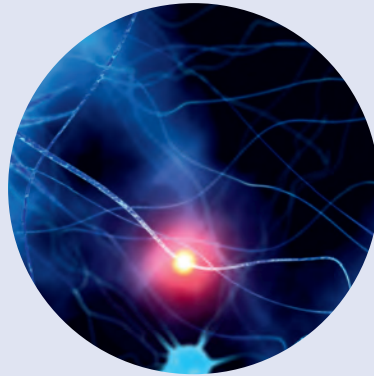
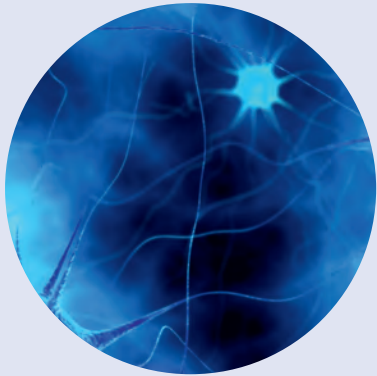
Furthermore, consideration should also be given to introducing a tax allowance for business angels to increase equity investments and to reduce ancillary wage costs for start-ups and companies engaged in research. In addition to this, the Austrian Council backs innovative funding models, which fund guarantees in conventional early-phase programmes.

Improve Governance Structures to Implement the RTI Strategy

The Austrian Council recommends initiating an active and sweeping process of RTI policy reform with a view to moving ahead with the implementation of the strategy more decisively. This must be backed at the highest political level. To this end, the Austrian Council believes that an RTI reform agenda is required that should be led by the Federal Chancellery and implemented in co-operation with all those ministries with responsibility for RTI. This agenda should be embedded in government plans and must contain politically binding, specific and quantifiable targets. These must form the basis for clear terms of reference for the RTI Task Force, which must in future play a more active role in steering the implementation of the RTI strategy.

Promote Measures to Increase the Private-Sector Share of R&D Funding

The Austrian Council recommends focusing on measures to increase the proportion of private-sector R&D funding. This can be done, for example, by improving framework conditions for philanthropic gifts and donations, for foundations and for private venture capital funding. In this context, it is essential to concentrate the use of public-sector funds in a way that strengthens their leverage effect with a view to increasing incentives for private-sector R&D spending and increasing the share of financing provided by the private sector. The Austrian Council therefore recommends the relevant initiatives adopted at the government's closed-door conference, such as the non-profit package or the crowdfunding initiative be vigorously implemented. Given the substantial increase in the volume of the research premium, the Austrian Council also recommends conducting a detailed evaluation of its impacts. This evaluation should be based on existing (micro) data and should follow a micro-econometric approach.





introduction

On 31 August 2009 the cabinet ministers agreed to set up an inter-departmental working group to formulate a Strategy for Research, Technology and Innovation (RTI) in a process that would be politically coordinated by the chancellor and vice chancellor. The goal was to define “strategic goals and measures for Austrian

RTI policy for the period up to 2020, based on the results of the evaluation of the research funding system, the Research Dialogue and the RTI recommendations submitted by the Austrian Council for Research and Technology Development.”¹ The steering group commissioned to develop the strategy met for the first time on 5 October 2009. During 30 meetings held over several months, five working groups, each with its own thematic focus, developed strategic goals and a package of measures for each chapter of the strategy document. Furthermore, each of the working groups invited stakeholders to participate in developing the strategy. The RTI strategy was completed in August 2010 and adopted by the cabinet on 8 March 2011.

This is the first time that Austrian RTI policy actors had worked together in this form to jointly draw up and agree binding goals and implementation-orientated measures. The fact that the RTI strategy constitutes an agreement between six government ministries demonstrates the great importance the Federal Government attaches to education, research, technology and innovation. The setting up of an inter-ministerial task force to coordinate the implementation of the RTI strategy is also a positive signal.

The findings and analyses regarding the status quo at the time the strategy was drawn up provide a realistic and critical picture of Austria’s position as a location for RTI as it was then. Five

years later, however, political, economic and social framework conditions have in some cases changed significantly on both the global and national level.² Thus we are confronted with a sustained weakening of global economic growth, which presents Europe in particular, and to an increasing degree Austria, with huge challenges. This goes hand in hand with a crisis of the European Union, the consequences of which for Austria are not yet entirely foreseeable. At any rate, the effects of the resulting budget constraints and fiscal consolidation can already be felt in Austria.³

Of course, this has also affected the Austrian innovation system, which has to come to terms with the end of a period of dynamic growth and with steadily declining resources. One innovation policy consequence of this, which affects the responsible ministries, academic institutions, research institutions and companies with R&D activities in equal measure, is the growing need to develop and effectively implement mechanisms for alternative forms of resource allocation. Targeting resources more effectively and – as the Austrian Council has already demanded in its strategy for excellence – selecting and supporting the best projects in a much more focused way than in the past will be central in this regard.⁴ Although the RTI strategy references this by defining an increase in competitively allocated funding as a key goal, this should be made even clearer and above all implemented with an appropriate urgency.

However, it is not just the financial impacts of the economic crisis that are changing the context within which the RTI strategy has to be implemented. The increasing importance of the European Research Area, for example, is leading to much greater mobility of, and increasing

¹ Presentation to the cabinet on 3 February 2010, p. 1

² See, for example, PWC (2015): *The World in 2050: Will the shift in global economic power continue?*; Kissinger, H. (2014): *World Order*. Penguin Press, New York; Keuschnigg, C. et al. (2014): *Vision Österreich 2050 – Vorsprung durch Bildung, Forschung und Innovation*. Holzhausen Verlag – Vienna, p. 19ff.

³ Aiginger, K. (2015): *Die Wende vom Konflikt zum Brückenbau*. In: *Der Standard*, 3./4. January 2015, p. 38.

⁴ Austrian Council for Research and Technology Development (2007): *Exzellenzstrategie*.

competition between, researchers. The effect is to force universities to make themselves more attractive to their own research personnel and to improve conditions with a view to attracting foreign researchers and stemming the increasing brain drain out of Austria. At the same time, increasing competition for European funds from Horizon 2020 such as the European Research Council (ERC), is playing an increasingly large role.

The situation is exacerbated by the global grand challenges such as climate change, resource scarcity, population growth, demographic change, urbanisation, the third industrial and digital revolution, etc. all of which are having an impact on Austria's society and economy – and thus on the domestic RTI system.⁵

All these challenges and changes have contributed to a situation in which an increasing number of voices within the Austrian RTI community are questioning the relevance of the RTI strategy. The Austrian Council has therefore again analysed the main weaknesses of the Austrian RTI system which were identified in the findings of the RTI strategy. In particular, these were the performance of the educational system which is not realising its potential, a system for financing basic research with competitively allocated funds that is uncompetitive in an international comparison, inadequate start-up dynamics and poor business growth rates among start-ups together with a lack of suitable capital investment as well as a share of private-sector R&D funding that is basically too low.

The results of the relevant analyses and the Austrian Council's monitoring of Austria's innovation performance in recent years show that the RTI strategy's key findings are still relevant today. The central starting points for the strategy

– on the one hand, the politically agreed goal to position Austria as an innovation leader and on the other, the continuing crisis and the resulting budgetary constraints – remain unchanged. The majority of the RTI strategy goals have accordingly lost none of their relevance.

The Austrian Council therefore continues to regard the Government's RTI strategy as an important milestone for the future development of Austria as a location for research, technology and innovation. Five years after the strategy was drafted, the goals are as relevant as ever – even though the achievement of certain goals by 2020 now looks extremely ambitious.⁶

At the half-way point before the target date for the RTI strategy is reached, the Austrian Council has raised the following questions: How is implementation of the RTI strategy progressing? Where does the Austrian RTI system stand today? Will the goals set out in the RTI strategy be achieved? Will Austria be an innovation leader in 2020? However, it is also vital to answer the question how much energy and how many resources are necessary to actually achieve this goal.

The Report on Austria's Scientific and Technological Capability 2015 is intended to be a mid-term review, which takes stock of the progress that has been made five years after the RTI strategy was commissioned and five years before the end of the time horizon is reached. As in its previous reports, the Austrian Council evaluates the extent to which the goals of the RTI strategy have been fulfilled – but now from the perspective of the halfway point to the time horizon. For the mid-term review, the Austrian Council has used data series covering the period 2010 to 2015. This five-year perspective

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⁵ Cf. Androsch, H. / Gadner, J. (2013): Austria's Future in the World of Tomorrow (ed.): Austria 2050 – FIT for the Future. Holzhausen, Vienna. pp. 254-272

⁶ Failure to achieve the goals by 2020, however, is no reason not to implement the necessary RTI policy measures as swiftly as possible so that developments can be set in motion that will result in the achievement of the goals – even this is only after 2020.



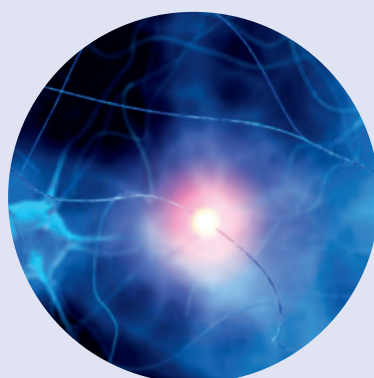
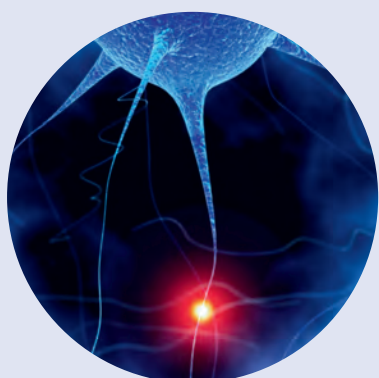
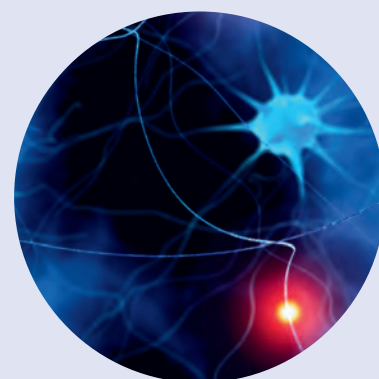
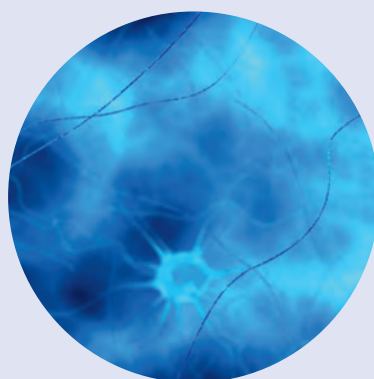
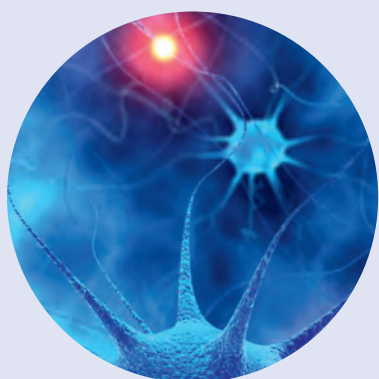
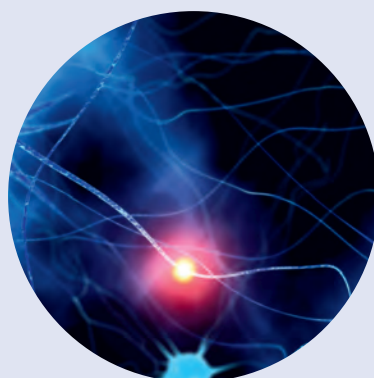
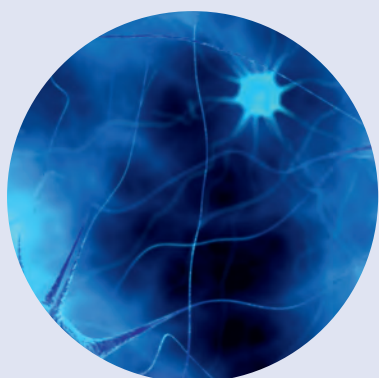
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shows stable development which acts as a reliable indicator of the actual impact of the strategy. This is the basis upon which the Austrian Council has formed its judgement as to whether the goals can be reached by 2020.

Furthermore, this year the Global Innovation Monitor, which was presented by the Austrian Council at the Alpbach Technology Forum in 2014, will form part of the report for the first time. The Global Innovation Monitor compares selected Austrian statistical parameters with those of the leading innovation nations outside the EU. Such a comparison on

both the European and global levels should help shed light on Austria's performance in the context of worldwide trends.

This report follows the same methodology as previous reports – details are provided in Appendix 3 and on the Austrian Council's website under the menu item Performance Reports (<http://www.rat-fte.at/annual-reports.html>). As well as information about the report and a range of download options, the site offers an interactive depiction of the indicator sets, which makes it possible to retrieve detailed information about the status quo and developments in individual areas interactively.



Evaluation of Austria's Performance Relative to the Goals
and Measures of the RTI Strategy

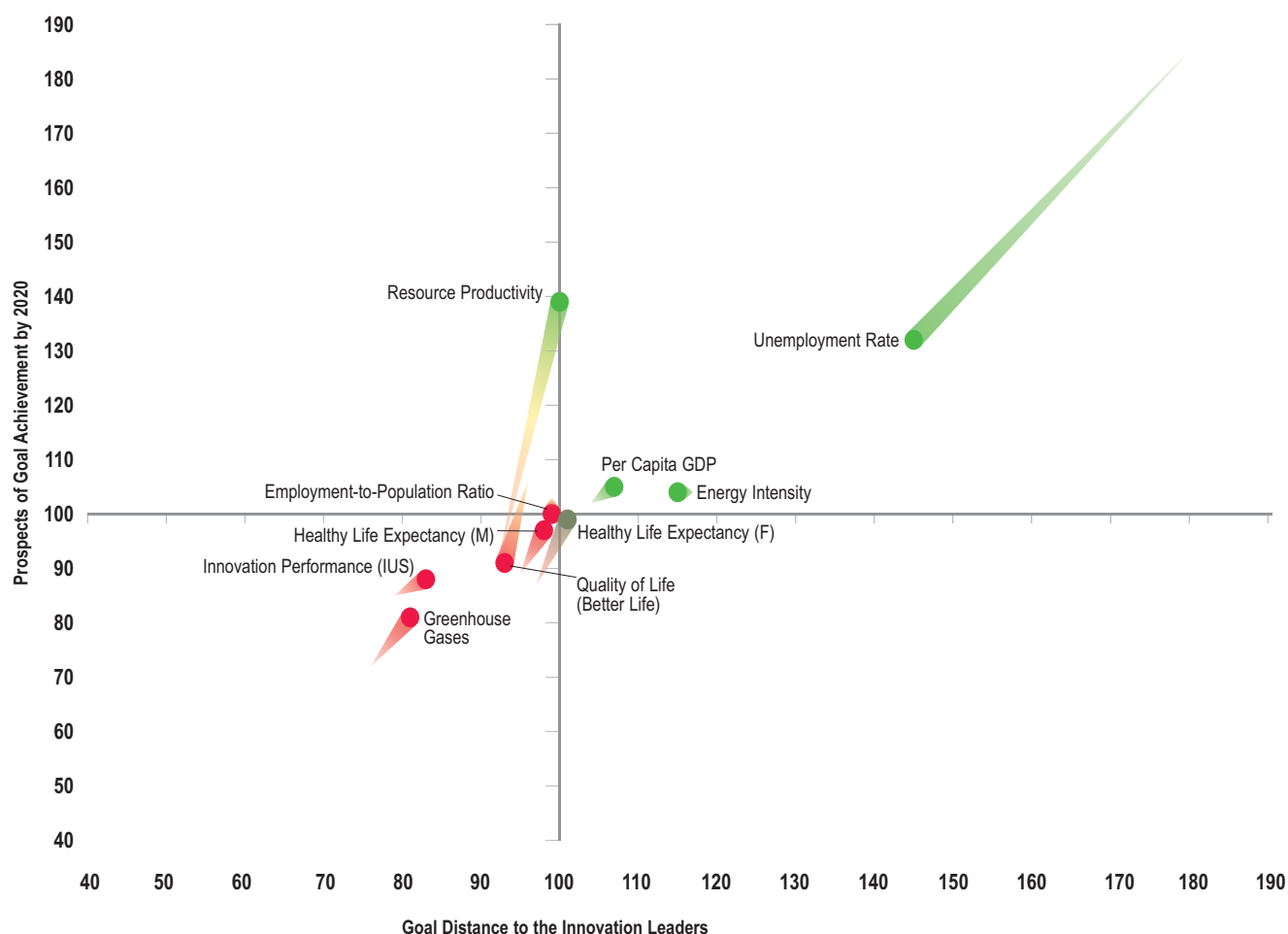
priority
objectives

Priority Objectives

An RTI policy strategy should not just be measured by the extent to which its detailed objectives are achieved, but also in broader terms by the overriding impacts that RTI activities can unleash. This chapter describes the effect of RTI

activities on the economy and society (priority objectives of the RTI strategy), on innovation performance indicators and on the quality of inventions, and thus offers a broad overview of the various aspects of the impact of RTI activities.

Figure 1: Development of Goal Distance and Prospect of Goal Achievement in Relation to the Priority Objectives, 2010-2015



Sources: See Appendix 1, WIFO presentation, Raw Data see Appendix 2. Explanation see Appendix 3

Note: Goal Distance = Austria's actual value relative to the actual value of the innovation leaders (average value most recent available year DE, DK, FI, SE) or to the national target;

Prospect of Goal Achievement = Value projected for Austria in 2020 relative to the national target or the value projected for the innovation leaders in 2020

Priority Objectives: Innovation Impacts at the Economic and Societal Level

The priority objectives address areas, which the superior target of political measures and which are especially important for citizens. In particular, these include economic performance (per capita GDP, the unemployment and employment rates), performance in the area of the environment (greenhouse gases, energy intensity and resource productivity) as well as quality of life and life expectancy. In addition, this chapter addresses Austria's overall innovation performance, one of the RTI strategy's priority objectives, as measured by the index of the Innovation Union Scoreboard (IUS).

Figure 1 provides an overview of developments from 2010 to the present day. In total, five, and thus half of the indicators, show that the level of the innovation leaders has already been reached, and one other indicator shows that this level will be reached by 2020 if the trend remains stable. Although there were a number of areas which showed positive developments, these usually lacked the momentum of the innovation leaders.

It is conspicuous that it is mainly the indicators associated with economic performance, which showed a positive performance. This contrasts with the areas of innovation, the environment,

health and quality of life, where there is little realistic prospect of achieving the goals by 2020 – and thus of becoming an innovation leader. This shows that Austria's economic success is not based solely on innovation, and that in addition to intensifying RTI activities in general, there is still scope to boost innovation activities in the fields of the environment, health and quality of life, even if these are also influenced by a host of other factors.

Compared to the innovation leaders Denmark, Germany, Finland and Sweden, the Austrian economy is performing very well: Per capita GDP in Austria has risen slightly since 2010 and this is reflected in a level of national prosperity which clearly exceeds that of the leading innovation nations. Despite some deterioration, unemployment in Austria remains comparatively low. The overall employment rate has effectively remained unchanged in the last five years, although there has been a significant increase in the female employment rate.

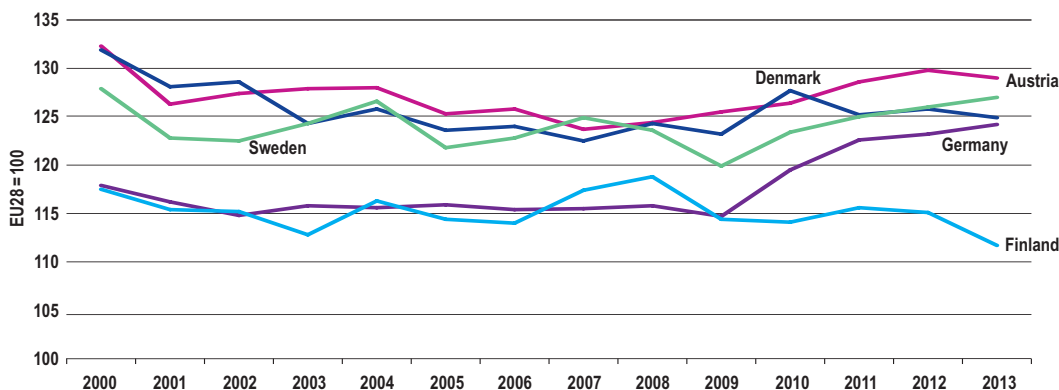
Austria is among the top countries both in terms of real GDP growth and the development of GDP per capita (see Figure 2): GDP per capita has been among the highest in the world for

priority objectives

RTI Strategy Objectives

- Join the ranks of the leading innovation nations in the EU by 2020
- Strengthen the competitiveness of the Austrian economy
- Enhance social prosperity
- Overcome the major social and economic challenges of the future

Figure 2: Development of Per Capita GDP, 2000-2013



Source: Eurostat.

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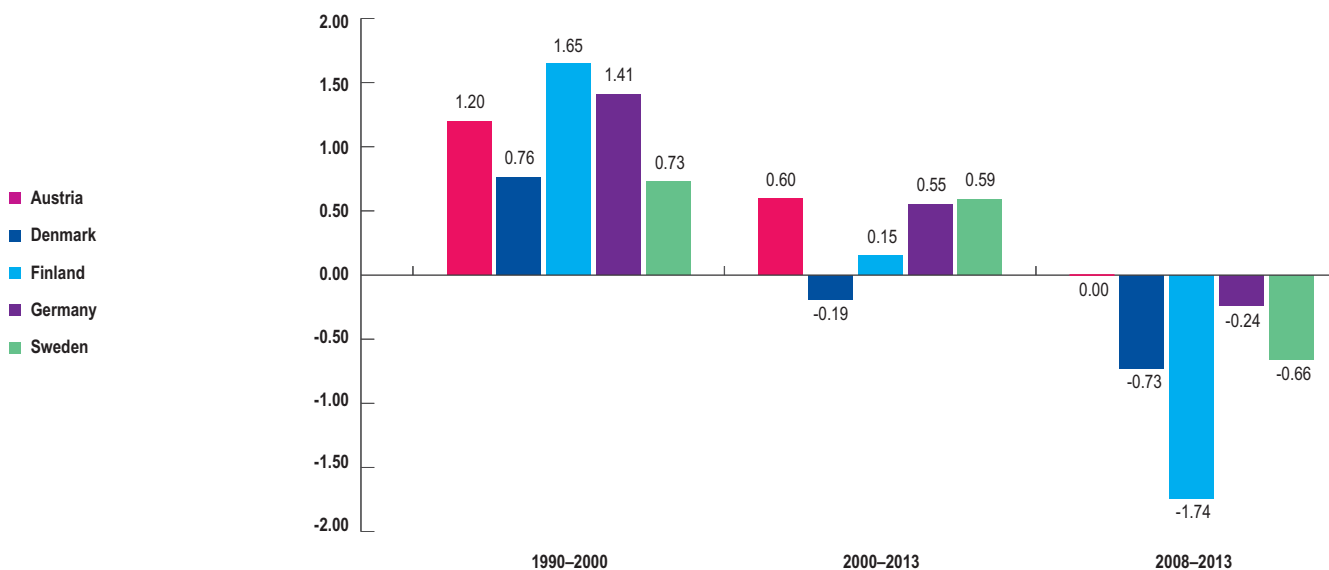
many years. For a long time, Austria enjoyed a higher rate of real GDP growth⁷ compared to other countries with a similar level of development – even during the financial crisis⁸ – although in recent years this has slowed. In 2014-2015 growth is forecast to slide below the euro zone average for the first time in many years.

One of the key determinants of GDP growth is growth of productivity. Innovation generally has an impact on GDP as a result of higher

productivity, i.e. the possibility to achieve higher economic output with existing resources. Productivity can be measured in GDP per hour worked or purely as changes in efficiency (total factor productivity).⁹ Figure 3 shows that Austria's efficiency between 2000 and 2013 grew at roughly the same pace as that of Germany and Sweden, mainly due to improved performance in the crisis years 2008-2013.

Figure 4 shows growth of GDP per hour worked. While Finland has been left behind here, Swe-

Figure 3: Austrian Efficiency Gains (Total Factor Productivity) Relative to the Innovation Leaders, 1990-2013



Sources: The Conference Board Total Economy Database™, WIFO Calculations.

⁷ Growth of real GDP must always be compared with countries that have similarly developed economies, as less-developed countries that are catching up tend to grow at faster rates (which then slow down as development progresses). This is known as the convergence process.

⁸ International Monetary Fund, Article IV Consultation Austria, Washington, p.4.

⁹ GDP per hour worked can be compared in levels, but there are many other factors that influence GDP per hour worked besides innovation (e.g. capital intensity). In principle, changes in efficiency are strongly driven by innovation but as they cannot be compared in levels, it is only possible to compare Austria's performance in terms of productivity growth with the innovation leaders

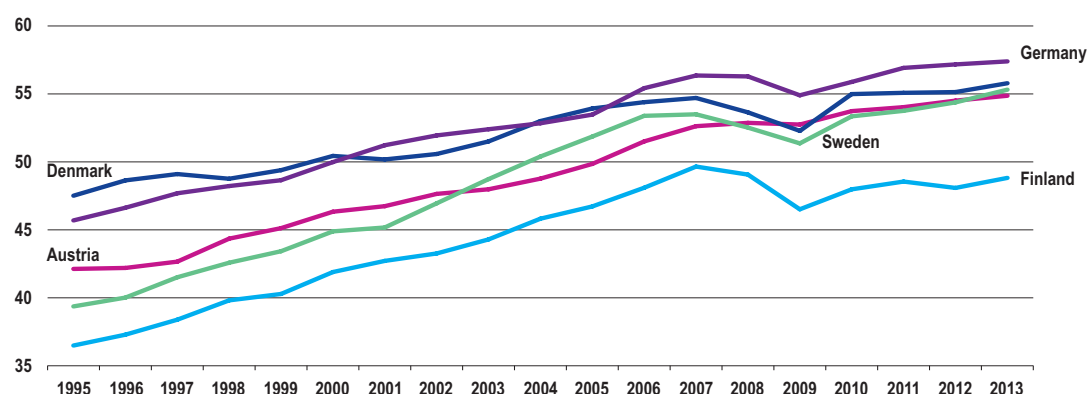
den has recently overtaken Austria. Denmark and Germany in particular have long been well ahead of Austria in this respect.

In terms of unemployment, Austria is traditionally one of those industrial nations that boast a relatively low rate of unemployment. Although unemployment has risen sharply recently and at 8.4 percent (AMS definition) or 5.0 percent (Eurostat definition) is unusually high by Austrian standards, it remains relatively low compared to the leading innovation nations.

Changes to the observation period are also unlikely to contribute to any alteration in Austria's top-ranking position in the years before 2020.

Life expectancy among both men and women in Austria has continued to rise in the last decade, in line with the trend in many developed economies. In 2012, life expectancy for both sexes together exceeded 80 for the first time and will probably rise still further in the years and decades to come.

Figure 4: GDP per Hour Worked in Purchasing Power Parities, 1995-2013, in euros



Sources: The Conference Board Total Economy Database™, WIFO Calculations.

With regard to quality of life, it is difficult to make a reliable statement, as this is a factor that cannot be captured by a single indicator.¹⁰ One composite indicator that is commonly used, at least internationally, is the OECD's Better Life Index, which measures the quality of life as a summary of diverse individual indicators in social, ecological and economic criteria.

In most of these, Austria has a good mid-range ranking; recently, however, performance in the categories education, work-life balance and housing has been negative.

The environmental indicators, and in particular resource productivity, have improved dramatically since 2010, meaning that Austria is already now level with the leading nations. In-

¹⁰ Quality of life is a highly subjective notion that is interpreted very differently by individuals and in particular at the country level. Aspects of quality of life that are important to the population of one country may differ from those that are important to the population of another country. Aggregat comparisons of quality of life should therefore always be interpreted with a great deal of caution or should be carried out on the basis of weighting the different aspects of quality of life.

priority objectives

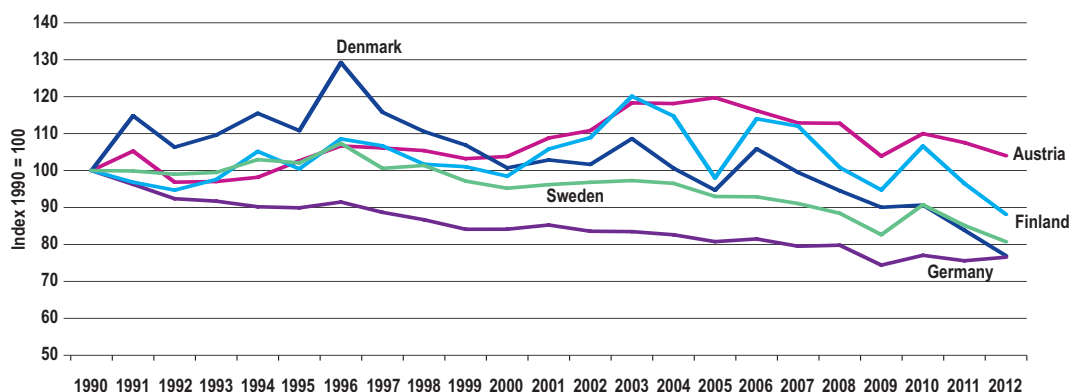
creases in resource productivity are generally considered to be the result of technological progress.¹¹ Austria has evidently gained considerable ground here in the last five years, permitting the conclusion that Austrian industry is basically using resources more efficiently.

The Ministry of the Environment has calculated that in the last 50 years, resource productivity in Austria has improved by a factor of 2.5 or 146 percent. In 1960, one material input tonne generated the equivalent of 550 euros of GDP, whereas in 2008 the figure was already 1,353 euros. However, notwithstanding these considerable efficiency gains, in absolute terms material consumption has risen by 73 percent. Of course, in the same period, the economy has grown by a factor of 4.3 or 325 percent.¹² Despite falling back slightly since 2010, Austria is still well ahead of the leading nations in terms of energy intensity. This means that Austria's

economy is significantly less energy-intensive than those of the leading nations. According to a study by the Ministry for Science, Research and Economy, energy intensity in Austria has fallen steadily since 1990 due to declining energy consumption, above all in the transport, domestic and service sectors.¹³ In the long term, in Austria and all other OECD countries alike, increasing energy efficiency is accompanied by a decoupling of energy consumption from economic growth. Although GDP in Austria grew by 138.5 percent between 1973 and 2012, energy consumption in 2012 was only 54.8 percent higher than in 1973, i.e. energy intensity has fallen by 35.1 percent.¹⁴

As regards emissions of greenhouse gases, there has been a perceptible improvement compared to 2010; however, this is not sufficient to even come close to achieving the goal by 2020. As a result, Austria is the only country among all wealthy EU member states that has failed to

Figure 5: Development of Greenhouse Gas Emissions, 1990-2012



Source: Eurostat.

¹¹ Hawken, P. / Lovins, A. / Lovins, L.H. (2008): Natural Capitalism: Creating the Next Industrial Revolution. Little, Brown and Company: Boston-New York-London.

¹² Ministry of Agriculture, Forestry, the Environment and Water Management, Ministry of Economic Affairs, Family and Youth (ed.): Report Use in Austria – Report 2011. Vienna.

¹³ Ministry of Science, Research and Economy (2014): Energieeffizienz in Zahlen 2014. Vienna, p. 4f.

¹⁴ Ministry of Science, Research and Economy (2014): Energieeffizienz in Zahlen 2014. Vienna, p. 2.

achieve a reduction in greenhouse gas emissions compared with the base year 1990, and thus finds itself in a group with countries such as Spain, Portugal and Greece. In contrast, the leading innovation nations have in some cases made robust efforts to cut their greenhouse gas emissions to meet the Kyoto targets – in particular to reduce emissions of greenhouse gases to 13 percent below the 1990 level. Finland has cut its greenhouse gas emissions by twelve percent below the 1990 level, Sweden by 19 percent, Denmark and Germany by as much as 23 percent (see Figure 5).

Denmark offers a good example of successful climate policy and the economic stimulus it can provide, having adopted a climate policy plan of achieving independence from fossil fuels by 2050. The goal is to reduce emissions of greenhouse gases by 40 percent relative to 1990 levels by 2020 and by 80 percent by 2050.¹⁵ This energy policy is applied consistently at every level, from the legal framework, and funding decisions in relation to investments to research and innovation projects.¹⁶

Innovation Output, Effectiveness and Efficiency

As the achievement of the priority objectives is also influenced by other policy areas, such as taxes and administrative efficiency etc., and not just by innovation efforts, the economic and social trends described in the previous section cannot be clearly attributed to innovation activities. However, by analysing corporate and structural performance indicators, it is possible

In line with this policy, there has been a ban on the installation of oil- and gas-fired boilers in new buildings since 2013. As of 2016, it will be forbidden to install new oil-fired boilers in existing buildings where district-heating or natural gas are available. Half of all buildings in Denmark are already heated with district heating.¹⁷

Danish business also benefits from the goal of full conversion to renewable energy. Thus Denmark is the country with the most smart grid projects and the highest density of expertise in this area in the EU, which is regarded as a key prerequisite for a further surge in economic growth and increasing employment.¹⁸ Individual branches of industry, such as the manufacturers of alternative power plants, are already benefiting: Vestas Wind Systems, for example, is the world's largest global manufacturer of wind turbines. The company employs some 15,000 people and came into being as a result of the Danish government's decision to phase out fossil fuels.¹⁹

**priority
objectives**

to obtain a sounder assessment of the impacts of innovation on economic developments and to assess the efficiency and effectiveness of innovation efforts. This section begins by depicting the effectiveness of RTI activities in Austria on the basis of selected output or impact indicators. Their efficiency is then shown as inputs relative to outputs.

¹⁵ IEA (2011): Energy policies of IEA Countries. Denmark 2011 Review, p. 7.

¹⁶ Climate Consortium Denmark (2014): Broad Danish Agreement on Climate Bill and Ambitious Climate Goals.

¹⁷ Mandl, C. / Kuttner, T. (2014): European Smart City Initiative – Assessment of Best Practices to Stimulate Market- / Demand-Pull. In: bmvit (ed.): Berichte aus Energie- und Umweltforschung 37/2014. Vienna, p. 31f.

¹⁸ Danish Ministry of Climate, Energy and Building (2013): Smart Grid Strategy: The intelligent energy system of the future, p. 7.

¹⁹ Salzburger Nachrichten (16.11.2014): Österreich ist kein Öko-Vorreiter mehr.

priority
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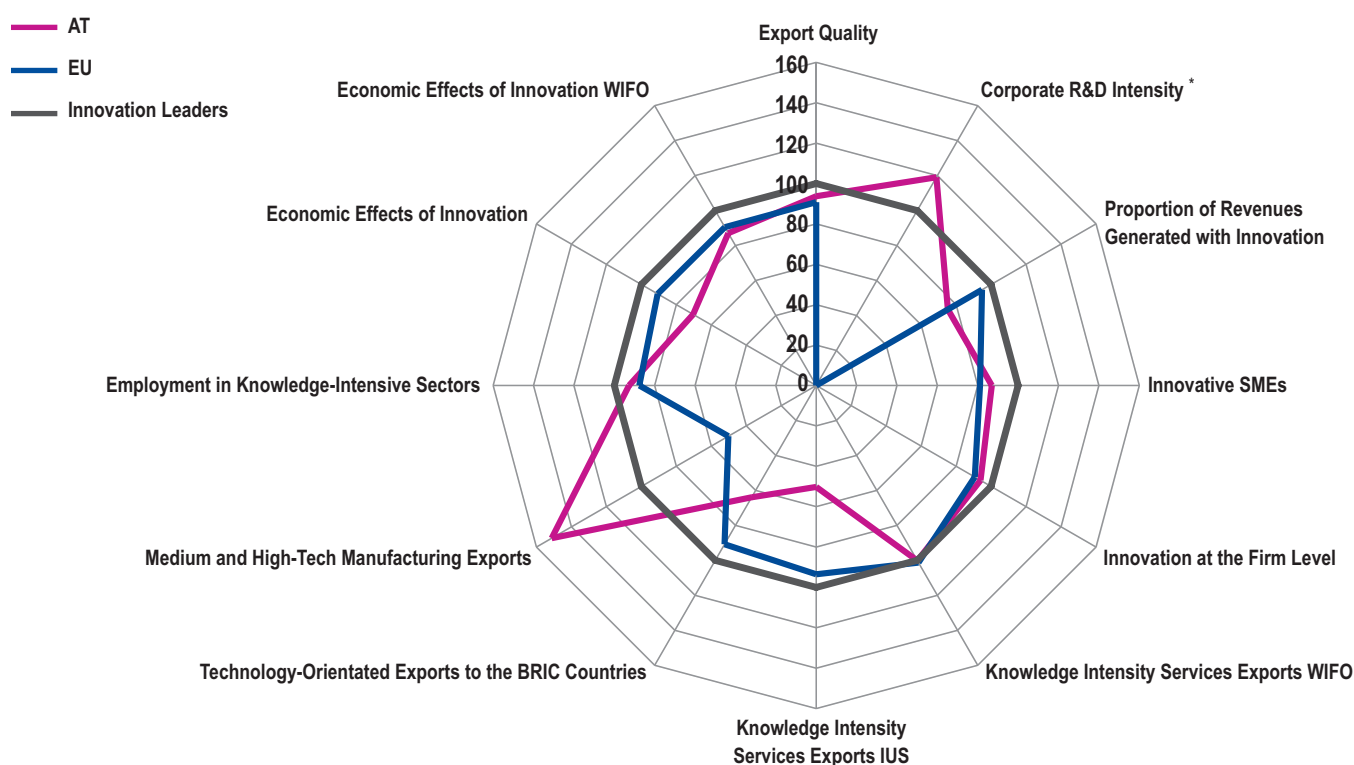
Effectiveness of Innovation

Basically, successful innovation efforts must impact either as an increase in innovation performance, in knowledge intensity within companies or existing sectors (**intra-sectoral structural change, sectoral upgrading**), or as a realignment of economic structures towards more knowledge-intensive sectors (**inter-sectoral structural change**). Figure 6 shows indicators for both effects. The five indicators from “Export

Quality” to “Innovation at the Firm Level” read clockwise, show the sectoral upgrading, the others inter-sectoral structural change.²⁰

In some of the IUS indicators for inter-sectoral structural change, Austria not only trails relatively far behind the leading innovation nations, it sometimes even fails to reach the EU average. The exception to this is the “Export of Technology-Oriented Goods”. But as these indicators do not take into account the real content of the innovation activity or sectoral upgrading, they

Figure 6: Innovation Output indicators, Austria Relative to the Innovation Leaders and the EU Average



Sources: Innovation Union Scoreboard, WIFO Calculations.

* EU 27 without PL, IE, LU, values were normalised.

²⁰ See appendices I and IV for a detailed description of the indicators used.

present only an inadequate picture of the economic impacts of innovation.²¹ The Austrian Institute of Economic Research (WIFO) has therefore recalculated these indicators and adjusted them to eliminate distortions, which as a rule provides an average level.²² Austria's innovation performance is driven less by structural change than by steady improvement, i.e. sectoral upgrading. In these indicators Austria generally trails slightly behind the innovation leaders, although its performance is still well above the

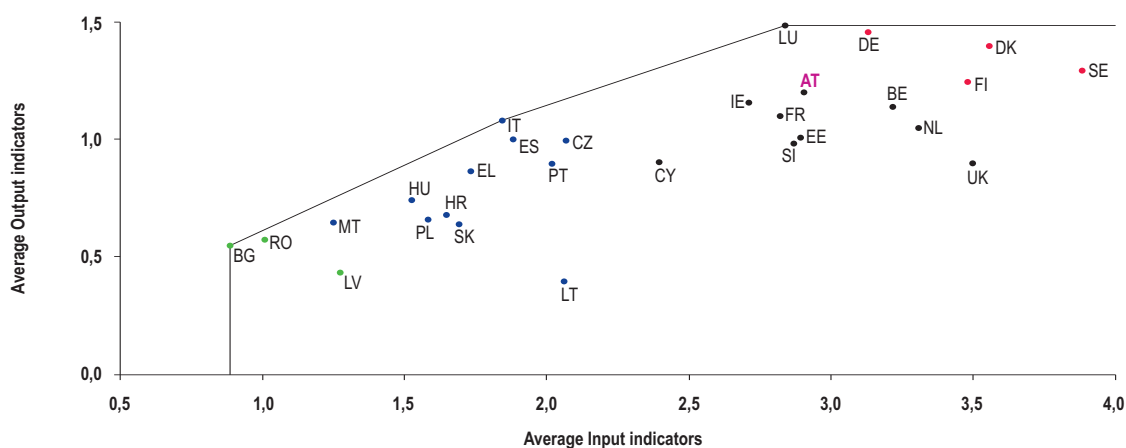
EU average (with the exception of the indicator "Proportion of Revenues Generated by Innovation").²³

Innovation Efficiency

Innovation efficiency is calculated by comparing input indicators to output indicators. On behalf of the Austrian Council, WIFO conducted a Data Envelopment Analysis (DEA) to obtain statistical data about the innovation efficiency of the 28 member

priority
objectives

Figure 7: Innovation Efficiency in the EU: Ratio of Input to Output



Sources: Eurostat, IUS, WIFO Calculations.

²¹ Hungary, for example, has an excellent IUS ranking in respect of economic effects, yet a glance at the very low values for the sectoral upgrading indicators "Structurally-adjusted R&D Intensity" and "Export Quality" demonstrate that Hungary is positioned in the production sector of the value creation chain and not in the research and innovation sector or the product development sector. Austria's ratings in the IUS indicator "Economic Effects of Innovation" are massively distorted by the high proportion of tourism in the "Services Exports" (35 percent vs. 13 percent among leading innovation countries) and by the net technological performance balance. The latter also has little informative value due to the internal payment flows to the many foreign parent companies of Austrian firms.

²² Cf. Section 4.3 of the Research and Technology Report 2014.

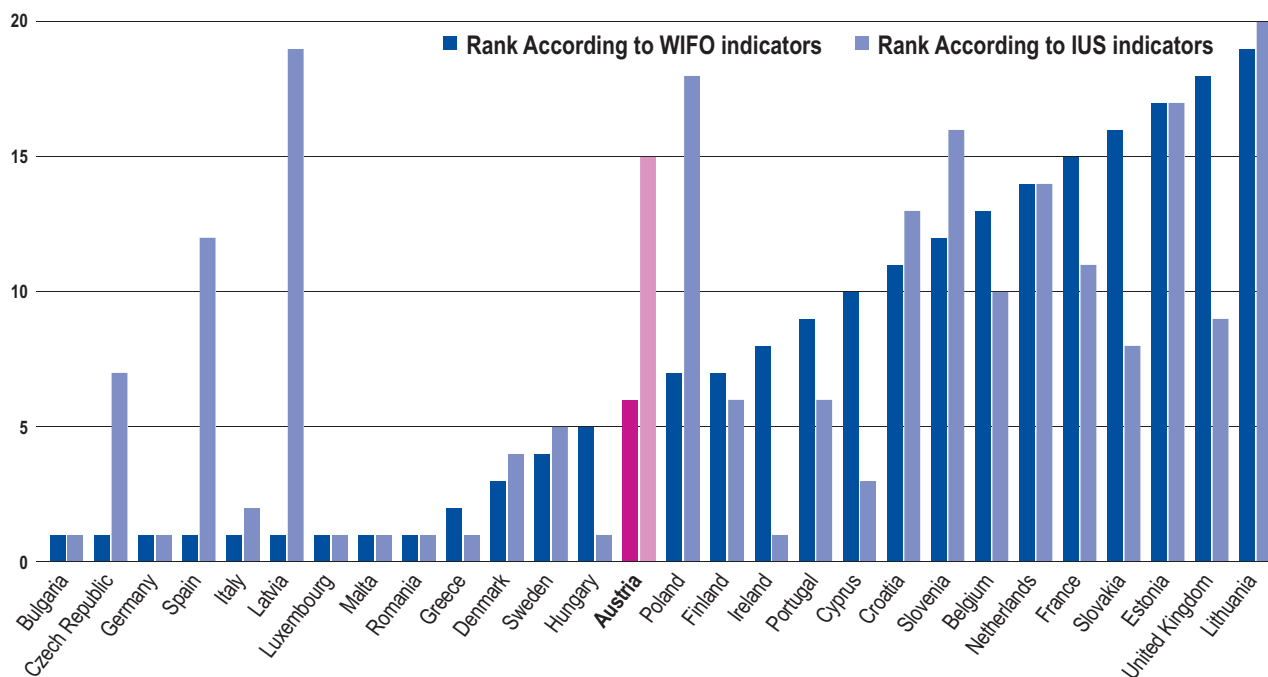
²³ In this context, it should be pointed out that these CIS indicators reflect the results of survey questions, which makes them very volatile and limits their informative value. The assessment of market innovations, for example, is subject to country-specific distortions. Thus companies from the emerging markets in Eastern Europe all regard their products as very new for the market or the company, which is why they outperform even the leading nations in the IUS.

priority objectives

states of the EU. Based on the input and output ratios of the innovation indicators of the EU member states, the most innovation efficient countries were identified. These are not necessarily the most innovative nations, as the degree of efficiency is determined by how much output can be produced with the available input resources. Applying the same method that was used in the section “Effectiveness of Innovation”, output was measured using both the IUS indicators and the indicators corrected on the basis of the WIFO calculation. Figure 7 depicts the efficiency frontier calculated for the EU 28 assuming variable returns to scale based on the WIFO method, Figure 8 shows the country rankings according to both methods.

As is the case with the effectiveness analysis, if a method is used that takes into account the specific characteristics of Austria’s innovation output and puts a stronger focus on indicators for continuous sectoral upgrading instead of on inter-sectoral structural change, Austria is positioned relatively high up in the rankings, although not among the leading nations. Among the leading innovation nations, it is Germany that translates input into output most efficiently. Austria has not yet caught up with Germany and still trails (slightly) behind Denmark and Sweden, but is ahead of Finland. Figure 8 shows the country rankings. The multiple first places show the efficiency frontier that can be achieved with differing input and output combinations. However, the results should

Figure 8: Ranking of Countries By Innovation Efficiency



Sources: Eurostat, IUS 2014, WIFO Calculations

be treated with caution as the statistical determination is based on a large number of assumptions. However, the basic trend of the data confirms that although Austria is among the front-runners in the EU with regard to innovation effectiveness and efficiency, further steps are required to improve effectiveness and efficiency

in order to achieve the goal laid down in the RTI strategy. One measure might involve making greater use of evaluations based on micro-data (i.e. calculating causal effects using individual, anonymised corporate data) as is the case in Sweden and Denmark for example.

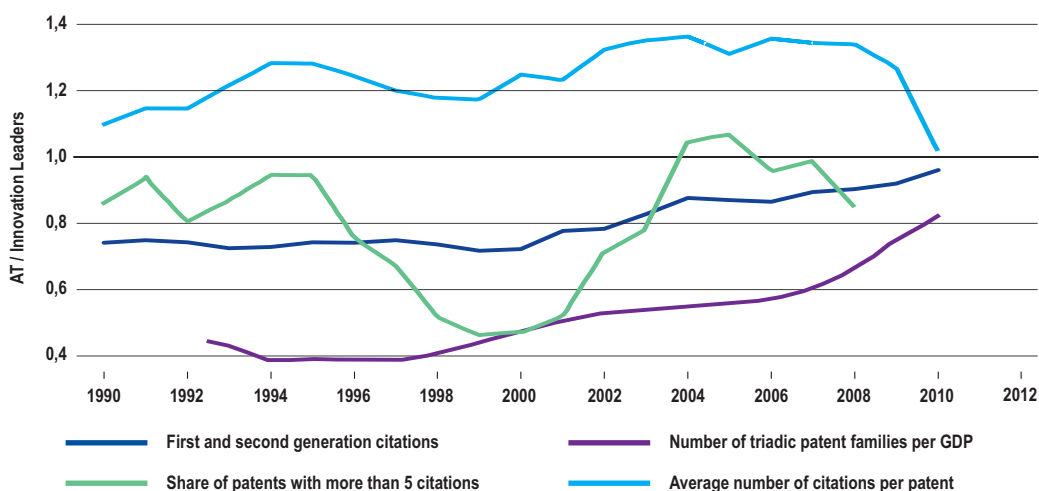
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Quality of Inventions: Performance of RTI Activities at the Micro-Level

In the preceding sections, Austria's innovation efforts were juxtaposed with macro- and meso-economic variables. This section will analyse the impact of research and innovation efforts one level lower: at the level of patented inventions. The quantity and quality of these inventions compared to the leading innovation nations can provide

even more detailed information about Austria's technological capability.²⁴ In this context, it is important to remember that not all inventions are patented and that patent indicators do not therefore depict a country's entire technological spectrum. Furthermore, there is sometimes a significant time lag for patent data.

Figure 9: Quality of Austrian Patent Activities: Applications to the European Patent Office (EPA), According to Inventors in Relation to Innovation Leaders (= 1.0), 1990–2012



Sources: OECD, Regpat Database, July 2014; OECD, Citation Database, July 2014; OECD, Triadic Patent Families Database, July 2014; World Bank, WIFO calculations. Innovation Leaders: Average of DE, DK, FI, SE=1.0. First and second generation citations, Share of patents with more than 5 citations, average number of citations per patent: indicators were adjusted by families.

The share of patents with more than 5 citations is not shown after 2008 due to insufficient sample size.

²⁴ Cf. Unterlass, F. / Hranyai, K. / Reinstaller, A. (2013): Patentindikatoren zur Bewertung der erfinderischen Leistung in Österreich. Study on behalf of the Austrian Council for Research and Technology Development



priority objectives

If the number of times a patent is cited in subsequent patents is used as a measure of quality, Austria has succeeded in narrowing the gap to the innovation leaders in the last two decades (see Figure 9, indicator “First and Second Generation Citation Counts”). The indicator “Average Citations per Patent” shows a significantly higher value than the innovation leaders, whereas patents that have received more than five citations, and which can therefore be considered qualitatively significant, are found comparatively less frequently in Austria. This also reveals a pattern of gener-

ally high-quality inventions that contributes to upgrading existing products. In contrast, inventions with far-reaching implications which can usher in structural change are much rarer. Furthermore, Austria boasts fewer triadic patent families relative to GDP, i.e. patents registered at all three of the world’s major patent offices in Japan, the USA and Europe (see Figure 9, indicator “Number of Triadic Patent Families Relative to GDP”). Registrations at all three of these patent offices indicate the high quality of a patent. Both indicators, however, suggest that Austria is clearly catching up.

Summary

The analysis of the effects of the innovation system based on innovation output and the quality of inventions shows that while Austria’s performance is better than suggested by the Innovation Union Scoreboard (IUS), the country continues to show a performance deficit vis-à-vis the leading innovation nations. In some cases, this performance gap has even widened slightly since 2010. Based on the results of the mid-term review, the Austrian Council concludes that the pace of development expected in the field of innovation

performance will not suffice to enable Austria to join the ranks of the leading nations by 2020.

This summative evaluation is analysed in detail and in terms of the relevant objectives and measures in the RTI strategy in the following sections (from the “Education System” to “Financing of Research, Technology and Innovation”). In particular, the Austrian Council wishes to address those measures that are most urgently needed to achieve the goals of the RTI strategy in the second half of the time horizon.

Education System

The education system is the foundation upon which every country's research and innovation system is built. If it is to fulfil its most crucial task of providing education and training to all children and young people regardless of their origin, sex, socio-economic background etc, it must be permeable, adaptable and offer equality of opportunity. Only then can students develop the skills and abilities that will enable them as individuals to live successful lives later on and which also form the basis for a country's economic and cultural development.

In Austria one problem that is still completely unresolved is that the education system in its current form, "distinguishes very early on between vocational and academic paths; access to education is strongly influenced by social strat-

ification."²⁵ In other words, as education in Austria is still "inherited", large numbers of talented young people are unable to fully develop their skills and talents – a situation, moreover, which is almost impossible to rectify later on.

The Federal Government's RTI strategy succinctly described the challenges that exist in this area, but was less specific when it came to defining the measures that are needed to tackle them, especially with regard to the problem of the "selectivity" of the education system. As it takes many years, sometimes decades, before the kind of structural reforms announced in the RTI strategy actually take effect and changes become manifest, swift action is imperative.

education
system

Education System (Without the Tertiary Sector):

This section analyses the primary and secondary education system, putting the focus mainly on developments in the following two areas:

- The quality and quantity of the pre-school sector (indicators on the availability of personnel and places as well as the teaching qualifications of the staff)
- The quality, quantity and social selectivity of the secondary education system (PISA performance indicators, indicators on relevance for the labour market, inheritance of education and secondary school graduates/early school leavers)

On the whole, the indicators for the primary and secondary education system show virtually no significant changes to Austria's position relative to the leading countries and compared to previous years. Figure 10 shows that although development between 2010 and 2015 was consistently positive, it was also insufficiently dynamic. The results of the PISA survey 2012 showed that although there had been progress

in many areas, performance was still not on a par with that of comparison countries. But for countries on the technological threshold, which are aiming to catch up with the leading innovation nations, it is precisely the quality of the education system that is crucial.

In detail, a small number of goals have already been achieved ahead of the target date – these include the indicators "Early School-Leavers", "Early School-Leavers with an Immigrant Background", "PISA Top Students – Mathematics", "Student-Staff Ratio Primary Level" and "Skill Mismatch". As matters stand, there is a realistic prospect of achieving the targets for the indicators "PISA Risk Students – Science" and "Early Childhood Care", provided that the development dynamic remains stable.

Yet notwithstanding steady improvements, Austria remains far removed from the goal in many performance areas and – even more alarmingly – lacks the momentum to draw level with the leading nations. This is largely because the in-

RTI Strategy Objectives

- We want to promote the talents of people in all levels of education, awaken their passion for research, and facilitate the best possible training for business dealings and scientific research. This should guarantee universities, research institutions and firms a sufficient pool of highly-qualified researchers.
- To do this, the entire education system must be optimised, from the early childhood phase to models of lifelong learning.
- These reforms attempt to mitigate social selectivity, to improve permeability between education courses and tracks, to implement thorough quality improvements in (...) instruction [and] to better integrate immigrants,
- The proportion of drop-outs should be reduced to 9.5 percent by 2020.
- The proportion of pupils graduating with a school-leaving certificate for an age cohort should be raised to 55 percent by 2020.
- Among the pupils whose first language is not German, the share of those who do complete upper secondary school should increase from 40 percent to 60 percent.

²⁵ RTI Strategy of the Austrian Federal Government, p. 14

education system

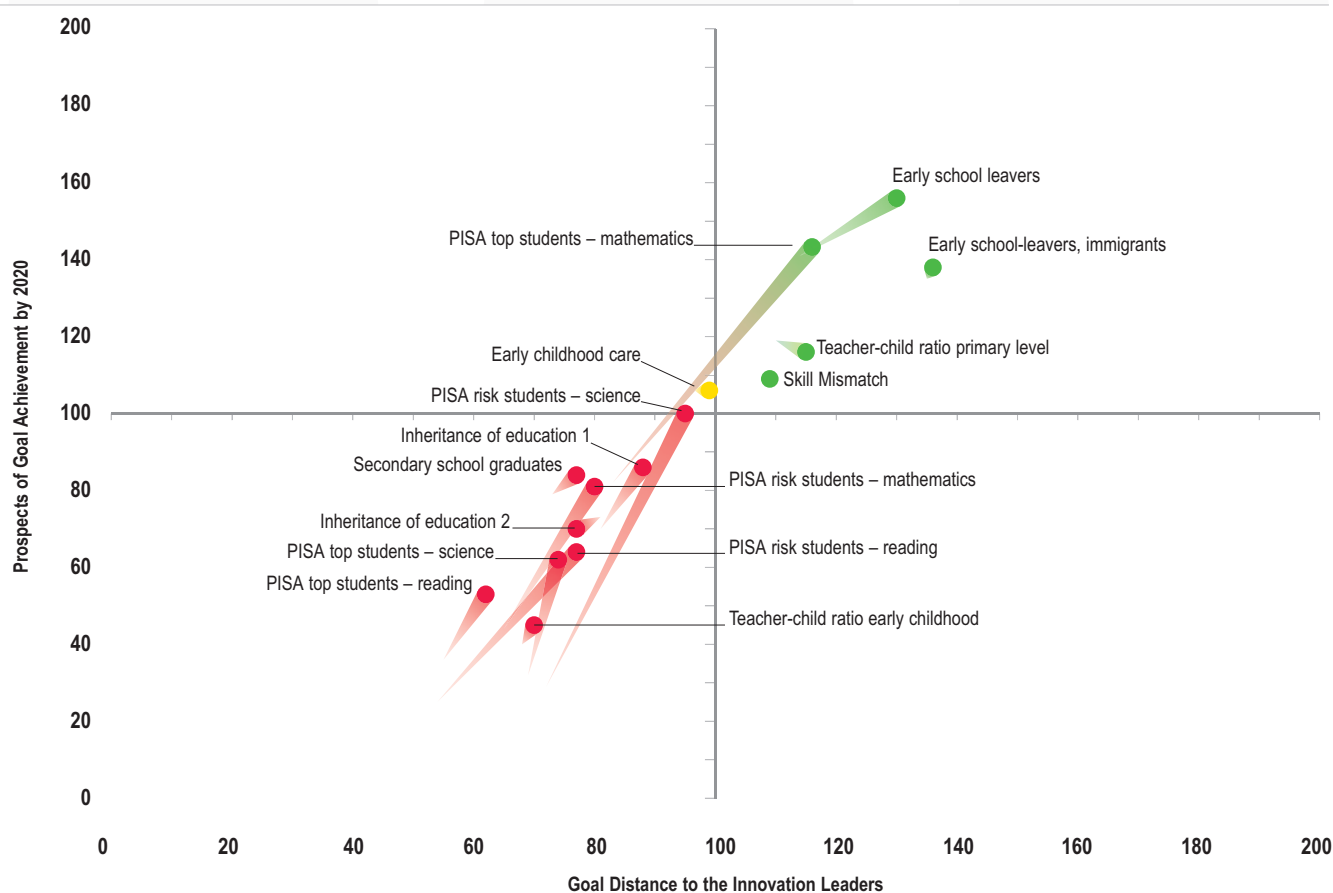
novation leaders have on average developed better and faster than Austria in the comparison period. In its mid-term review, the Austrian Council therefore concludes that unless additional efforts are made, it is debatable whether Austria will be able to achieve the goal of the RTI strategy of narrowing the gap to the innovation leaders in key aspects of primary and secondary education or reaching its own national targets by 2020.

Two fundamental problems can be identified in the Austrian education system:

- the structurally-based inheritance of education which results in the loss of significant talent, and linked to this
- Student performance, measured by the PISA indicators.

Article 14 para. 5a of the Austrian constitution, as amended in 2005, states that schools should secure “for the whole population, irrespective of origin, social situation and financial background the highest possible level of education”. However, in reality, the system fails to live up to this ideal, for according to PISA 2012 the level of parental educational attainment has a

Figure 10: Development of Goal Distance and Prospect of Goal Achievement in the Education System (Without Tertiary Sector), 2010-2015



Sources: see Appendix 1, WIFO presentation. Raw Data see Appendix 2. Explanation see Appendix 3.

Note: Goal Distance=Austria's actual value relative to the national target or the Innovation Leaders' actual value (average value most recent available year DE, DK, FI, SE);

Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders 2020.

powerful influence on children's education performance (see Table 1).

In mathematics, there is a gap of at least 104 points between students whose parents possess higher education qualifications (at the tertiary level) and those whose parents have at best completed compulsory education. The performance gap in respect of reading is 106 points and in science is as high as 117 points.²⁶

Thus the education system in Austria to a large extent reproduces the educational status quo, whereby family socio-economic status is the factor with the strongest influence. Thus with

a score of 15.8 percent for equity of opportunity, Austria comes close to the OECD average of 14.8 percent²⁷, but is still far behind countries like Australia, Canada, Estonia, Finland, Hong Kong (China), Japan, Korea, Liechtenstein and the Netherlands, which, in addition to high PISA test scores, report no substantial differences in the results for children from different socio-economic backgrounds.²⁸ In the OECD countries, the performance gap in mathematics between students with a higher socio-economic status and those from a less-

education
system

Table 1: PISA 2012 – Educational Justice

	Mean Performance in Mathematics	Strength of the Relationship Between Mathematics Performance and Socio-Economic Status	Performance Difference Across Socio-Economic Groups
	Mean Value	Percentage of Explained Variance in Mathematics Performance	
OECD Average	494	14.8	39
Macao (China)	538	2.6	17
Hong Kong (China)	561	7.5	27
Liechtenstein	535	7.6	28
Estonia	521	8.6	29
Finland	519	9.4	33
Canada	518	9.4	31
Japan	36	9.8	41
Korea	554	10.1	42
Netherlands	523	11.5	40
Australia	504	12.3	42
Switzerland	531	12.8	38
Austria	506	15.8	43
Denmark	500	16.5	39
Germany	514	16.9	43
Sweden	478	10.6	36

Sources: OECD (2014): Excellence Through Equity – Giving Students the Opportunity to Succeed; PISA 2012 – Volume 2, Table II.A, p. 15

²⁶ BIFIE (2013); Press Release: PISA 2012 – Erste Ergebnisse, https://www.bifie.at/system/files/dl/pisa12_zusammenfassung_ergebnisse_2013-12-03.pdf

²⁷ This means that 14.8 percent of the variance in student performance in mathematics can be attributed to differences in students' socio-economic status.

²⁸ <http://gpseducation.oecd.org/CountryProfile?primaryCountry=AUT&treshold=10&topic=PI>

advantaged background is on average 39 points.²⁹ In Austria, however, the variance between these two groups is 43 points. While countries such as Germany were able to increase both their mathematics performance and equity in education outcomes between the PISA surveys in 2003 and 2012, no change in either area was observed in Austria.³⁰

The urgent need to improve equity in the Austrian education system is exacerbated by the fact that Austria has become a destination for immigrants. The demographic profile of our country is increasingly being shaped by migration: According to current demographic forecasts, the population of Austria will continue to grow, rising from 8.48 million in the reference

year 2013 to 9.03 million in 2025 (+7%) and to 9.62 million (+11%) in 2060.

This growth will be accompanied by a marked shift towards a much older population structure. While at present 18 percent of the population is aged 65 and over, by 2020 this age group will account for approximately 20 percent and, in the long term (from about 2035 onwards), for more than 25 percent of the total. In absolute terms, by 2030 the number of people over 80 years will have risen by more than half, namely by 53 percent, from 424,000 at present to 648,000. At the same time, the number of people living in Austria who were born abroad (currently 1.37 million) will increase as a result of migration. This group currently accounts for 16 percent of the total population; by 2030

Table 2: Educational Level of Adult National (No Migration Background) and Adult Migrants and/or Their Children (Age Group over 25-Year-Olds) Based on Country of Origin or Origin of Parents, 2011

	Total Population	No Migration Background	EU/EEA/ Switzerland	Former Yugoslavia (Without Slovenia)	Turkey
Total graduates. (in 1,000)	4,657.5	3,700.2	334.3	320.8	154.3
Compulsory school	16.2 %	12.5 %	10.6 %	7.4 %	66.8 %
Apprenticeship, BMS	53.6 %	58.5 %	40.2 %	42.8 %	23.2 %
AHS, NHS, college	15.3 %	14.6 %	23.8 %	14.9 %	6.1 %
University, FH, academies	14.8 %	14.4 %	25.4 %	4.9 %	(3.9 %)
Male graduates (in 1,000)	2,317.3	1,861.1	149.2	155.9	80.8
Compulsory school	11.9 %	8.4 %	8.0 %	29.2 %	60.2 %
Apprenticeship, BMS	59.0 %	63.4 %	45.7 %	53.0 %	29.8 %
AHS, NHS, college	14.9 %	14.6 %	20.2 %	13.9 %	(6.6 %)
University, FH, academies	14.1 %	13.6 %	26.1 %	3.9 %	(3.3 %)
Female graduates (in 1,000)	2,340.3	1,839.1	185.1	164.9	73.5
Compulsory school	20.5 %	16.6 %	12.6 %	45.1 %	74.1 %
Apprenticeship, BMS	48.3 %	53.6 %	35.8 %	33.2 %	15.9 %
AHS, NHS, college	15.8 %	14.7 %	26.7 %	15.9 %	(5.5 %)
University, FH, academies	15.5 %	15.1 %	24.9 %	5.9 %	(4.5 %)

Sources: Münz, R. (2013): Migration Policies for the Ageing Society of Tomorrow. In: Austrian Council for Research and Technology Development (ed.): Austria 2050 – Fit for the Future, Vienna, p. 129. Calculations of Statistik Austria.

²⁹ This is the equivalent of a performance advantage of almost one school year.

³⁰ OECD Country Note Austria, <http://www.oecd.org/austria/PISA-2012-results-austria.pdf>

their number will have risen to 1.99 million (22 percent) and by 2060 to 2.47 million or 26 percent.³¹ These figures clearly demonstrate that because of this “ageing” population and the resulting decline in the number of working age adults, Austria certainly needs this inward migration but that it is essential to create optimal conditions for improving the education structure of the population as a whole in order to safeguard competitiveness in an increasingly competitive global environment.

The available figures (see Tables 2 and 3) and studies³² show that among migrants who have come to Austria and taken up employment since 2000, the proportion of those with a secondary-school leaving certificate or who have completed higher education in the age group “25 years and older” (34 percent) is slightly higher than among the native-born population in the same age group (30 percent) and is roughly the same as the proportion of Austrians in employment who do not come from an immigrant background (35 percent).

At the same time, however, it also becomes clear that the proportion of poorly qualified individuals is significantly higher (28 percent) among immigrant workers than among workers with no

migrant background (7 percent – see Table 3). While almost 50 percent of immigrants from the EU/EEA states (and their adult children) have a secondary-school leaving certificate or have completed higher education, the figure among the native-born population is only 30 percent. In the case of migrants from the former Yugoslavia (and their adult children) the figure is just under 20 percent; in the case of those from Turkey, it is not even 10 percent (see Table 2). Conversely, it is also apparent that outward migration from Austria is leading to a not insignificant brain drain, as more than half these persons have either a secondary-school leaving certificate or have completed higher education (see Table 3).

Greater efforts must therefore be made in future to tackle the persistent problem of educational selectivity and to deal with the fact that migration will remain a significant factor in Austria’s demographic development in the foreseeable future. Measures to increase early childhood education (key word: second compulsory year of kindergarten and the promotion of German and other first-language skills, as the development of adequate language skills is the prereq-

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Table 3: Educational Level of Inward and Outward Adult Migrants in Employment (age 25-55), 2011-2012

	Population of Austria (age 25-55 yrs)	Population with no Immigrant Background	Population with Immigrant Background	Foreign-Born in Employment (foreign citizens)	Emigrants in Employment (Austrian citizens)*
Total graduates (in 1,000)	4,65.5	3,700.2	2,739.8	886.2	56.0
Compulsory school	16.2 %	12.5 %	6.7 %	28.1 %	8.9 %
Apprenticeship, BMS	53.6 %	58.5 %	58.0 %	37.6 %	38.0 %
AHS, BHS, University, FH	30.3 %	30.0 %	35.4 %	34.3 %	53.1 %

* 55,960 people, calculated on the basis of 27,670 empirically observed individuals.

Sources: Münz, R. / Synthesis Forschung (2014): ÖIF-Forschungsbericht: Zuwanderung nach Österreich: Ein Gewinn?

Überlegungen zur Entwicklung der Humanressourcen in Österreich, Vienna, p. 21; Calculations by Statistik Austria and Synthesis Forschung.

³¹ Statistik Austria (2015); Statistische Nachrichten January 2015: Zukünftige Bevölkerungsentwicklung Österreichs und der Bundesländer 2014 bis 2060 (2075); mit Differenzierung nach dem Geburtsland.

³² Münz, Rainer / Synthesis Forschung (2014); ÖIF-Forschungsbericht: Zuwanderung nach Österreich: Ein Gewinn? Überlegungen zur Entwicklung der Humanressourcen in Österreich, Vienna.

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quisite for every educational path), a factor which also influences the participation of women in the labour force, are as urgently needed as greater numbers of multi-lingual educators (including

in particular Turkish speakers) and, above all, increased financial and human resources (i.e. support staff) for schools facing special challenges, especially in terms of the socio-economic background of the pupils.

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy in the Education System (Without the Tertiary Sector)

Based on the preceding analysis of the goals of the RTI strategy and the indicator-based assessment of the extent to which these goals have been achieved, the Austrian Council recommends that particular attention be devoted to the following points:

More must be done in future to tackle the persistent problem of education selectivity and to deal with the fact that migration will remain a significant factor in Austria's demographic development in the foreseeable future. Measures to increase early childhood education (key word: second compulsory year of kindergarten and the promotion of German and other first-language skills), a factor which also influences the participation of women in the labour force, are as urgently needed as more high-quality kindergarten places and a significant increase in the number of qualified, and above all, multi-lingual educators (including in particular Turkish speakers). In addition, increased financial and human resources (i.e. support staff) are urgently required

for those schools, which face special challenges, especially in terms of the socio-economic background of the pupils. In addition, the Austrian Council recommends further reforms to modernise the structures of the education system, in particular by implementing specific measures to strengthen school autonomy and streamline the division of competences between the Federal Government and the provinces.

The Austrian Council recommends that to overcome the (predominantly social) early-age selection in the education system, there be a commitment to, and implementation of, comprehensive all-day schooling in secondary education first stage, alongside ability differentiation and talent development.

RTI Strategy Objectives

- The conditions of study at universities should be fundamentally improved, which will require establishing new financing models for higher education.
- The reforms attempt to implement thorough quality improvements in (...) university instruction, to better integrate immigrants.
- The proportion of 30- to 34-year-olds who have completed a university degree or have an equivalent education certificate should be increased to 38 percent by 2020.

Tertiary Education System and Gender Aspects in the RTI System

This section analyses developments in the tertiary education system between 2010 and 2015 that are of relevance for human resources in the RTI system. The core areas are as follows:

- Quantity of university graduates and quality of university teaching (indicators on "Supervisor-Student Ratios", "Doctoral Students from Non-EU Countries", "Number of Researchers")
- Among university graduates: Quantity of STEM human resources for RTI, young RTI researchers, including gender aspects (women in STEM programmes, number of female scientists)
- Immigration of highly-qualified persons, lifelong further education as additional factors that influence the potential of human resources that are available for RTI
- University financing

Currently, Austria is only likely to meet the targets for the indicators "University Graduates", "STEM Graduates" and "Women in Top Positions" (as measured by the Glass Ceiling Index). Otherwise, although there have been positive developments in several areas – for example, the number of women studying STEM subjects or the immigration of highly qualified persons – these are insufficient to achieve the

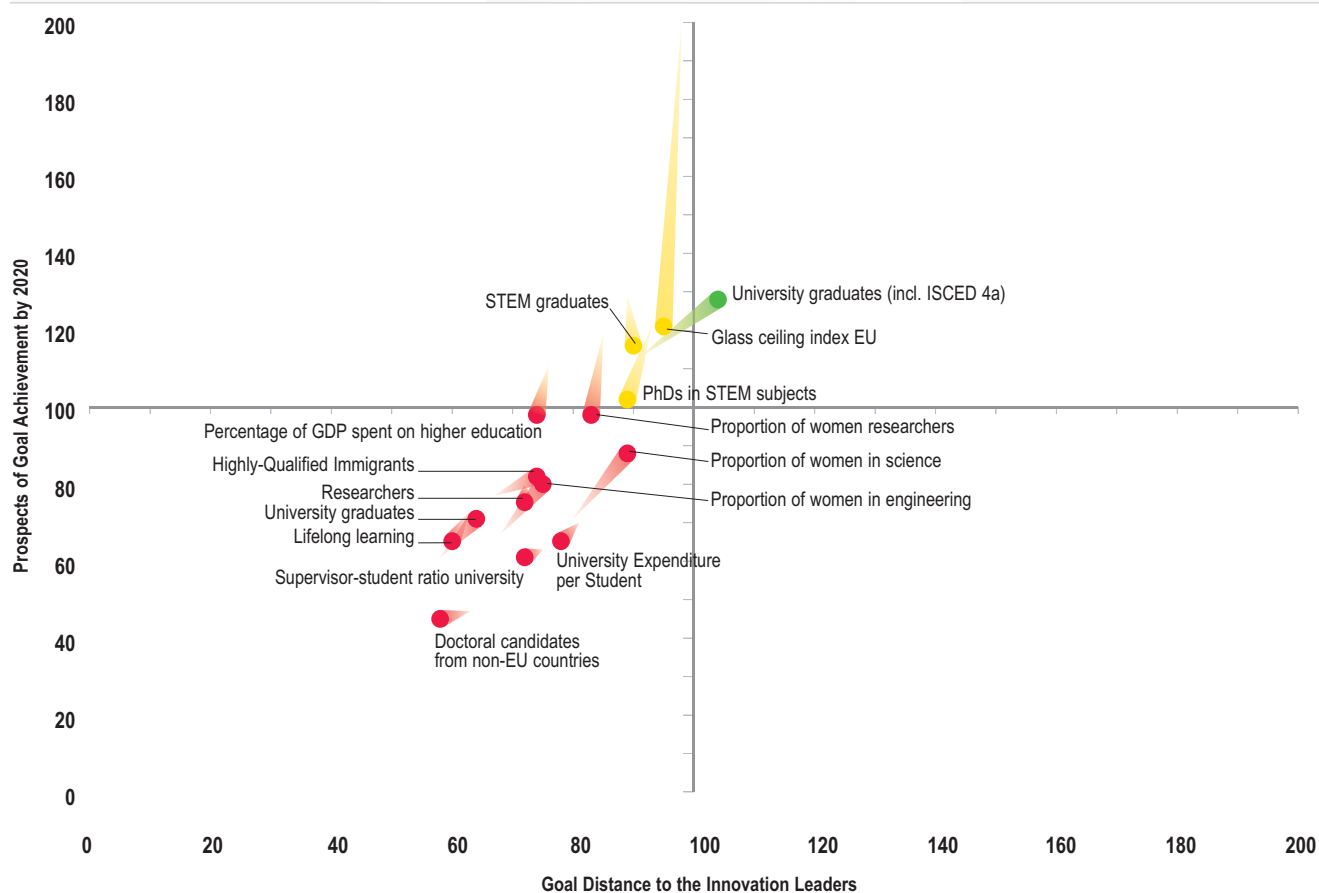
goals by 2020. In many areas, such as university financing, the number of researchers, the quality of university teaching or lifelong learning, the trend is actually negative.

With the exception of the indicator “University Graduates Including ESCED4a”, which is showing a positive trend and has consistently exceeded the target horizon since 2010, none of the indicators have registered a notable improvement in goal distance in the last five years, let alone achieved the respective goal (see Figure 11). Thus from today’s perspective, only four of the

15 indicators available for this chapter, are likely to have reached the target value of the leading innovation nations or Austria’s own national targets in 2020. In the opinion of the Austrian Council, this is far too little for Austria to advance into the group of the innovation leaders in the tertiary education sector. Considered in detail, however, certain differences in the indicator trends can be observed. Although Austria will be able to draw level with the leading countries in the indicator group

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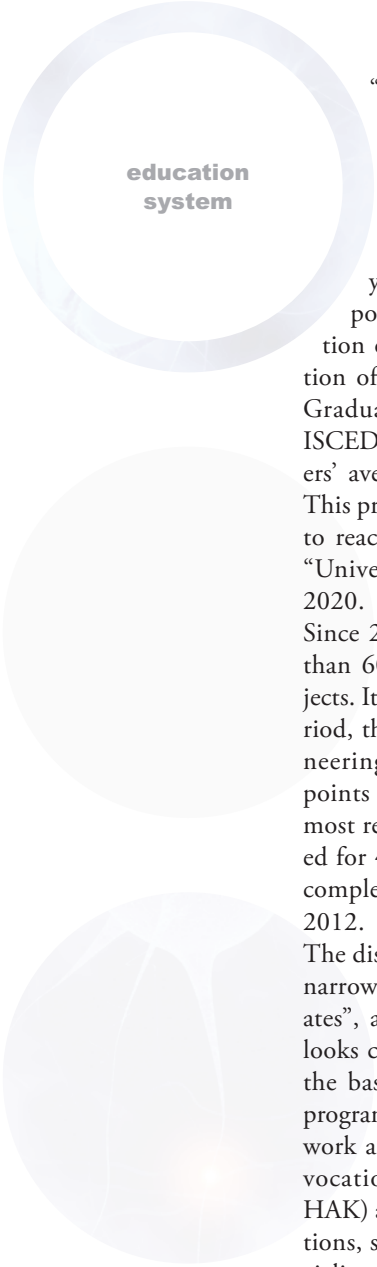
Figure 11: Goal Distance and Prospect of Goal Achievement in the Tertiary Education System, 2010-2015



Sources: see Appendix 1, WIFO presentation, Raw Data: see Appendix 2. Explanation see Appendix 3.

Note: Goal Distance=Austria’s actual value relative to the Innovation Leader’s actual value (average value most recent available year DE, DK, FI, SE);

Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders 2020.



education system

“STEM Graduates”, “Doctors in STEM Subjects” and “Glass Ceiling Index EU” if current trends persist, momentum has in some cases deteriorated significantly since 2010.

Due to the positive dynamic of the five-year trend for the indicator group “Proportion of Women in Science”, “Proportion of Women in Engineering”, “Immigration of highly-qualified persons”, “University Graduates and “University Graduates (incl. ISCED 4a)” the distance to the innovation leaders’ average value has narrowed considerably. This progress, however, is currently insufficient to reach the targets, except for the indicator “University Graduates (incl. ISCED 4a), by 2020.

Since 2003, women have accounted for more than 60 percent of graduates in science subjects. It is gratifying to note that in the same period, the share of women completing an engineering degree has risen by 7.1 percentage points to 24 percent. Thus according to the most recent available figures, women accounted for 45 percent of the 11,180 students who completed a science or engineering degree in 2012.

The distance to the innovation leaders has also narrowed in the indicator “University Graduates”, albeit at a low level. Austria’s situation looks considerably better when considered on the basis of the reclassification of education programmes by the OECD. This revised framework also includes graduates of technical and vocational schools and colleges (e.g. HTL, HAK) and post-secondary education qualifications, such as colleges or professions with specialist vocational training which guarantee access to education at a university or university of applied sciences. The value for the relevant indicator “University Graduates (incl. ISCED 4a)” is well above the level of the leading coun-

tries. At 39.63 percent, the proportion of 30 to 34-year-olds with a tertiary education qualification passed the 39 percent target set for 2020 in 2014 and the trend remains positive.

The financial situation of Austrian universities has deteriorated steadily since 2010. Spending on universities, for instance, has not kept pace with growth in student numbers. Compared to the leading countries, there has also been a slight decline in the percentage of GDP spent on universities since 2010, even though for long periods before this, the percentage had risen steadily. Between 2000 and 2012, the percentage of GDP spent on universities rose from 0.94 percent to 1.47 percent, the equivalent of an annual increase of more than 7 percent. However, since 2010, this trend has not been sustained on the same scale, as a result of which Austria has fallen back compared to the innovation leaders. From today’s perspective, it will now therefore be difficult to achieve the target reiterated in the current Government programme of spending 2 percent of GDP on the tertiary sector by 2020.³³ Meeting this target would require an annual increase in the budget of more than 300 million euros for the tertiary sector alone.³⁴ The Austrian Council therefore urgently recommends reallocating resources to make this increase possible.

Stagnating levels of spending on universities, combined with growth in student numbers in many disciplines, is also directly or indirectly having a negative impact on the development of the indicators “University Spending per Student” and “Supervisor-Student Ratio at Universities”. The statistical evaluation of the data shows that in nominal terms spending per student has been stagnating at a low level since 2005 compared to the leading innovation nations. If this trend is put in relation to the consumer price index, the budget per student has actually fallen since 2004. Despite the increased number of appointments

³³ Work Programme of the Austrian Federal Government 2013-2018, Science chapter, pp. 49-50

³⁴ Hranýai, K. / Janger, J. (2014): Forschungsquotenziele 2020: Aktualisierung 2014. Study on behalf of the Austrian Council for Research and Technology Development.

at universities, especially in 2014, there has been no improvement in the Supervisor-Student ratio compared to 2010. In the opinion of the Austrian Council there is still a strong need for action in this regard.

Specific measures to improve career perspectives in the university sector are outlined in the action plan for a competitive research area.³⁵ The intention here is to establish a career path model and sustainable personnel structure with a view to providing young scientists in particular with long-term career perspectives.

After five years, the indicator “Immigration of highly-qualified persons” shows some slight improvement; however, this is at a low level, making any prospect of achieving the goal by 2020 unrealistic. Greater efforts should therefore be made to implement a more proactive immigration policy that aims to attract highly-skilled workers to Austria.³⁶ In particular, the criteria

for the Red-White-Red Card should be revised,³⁷ both to make Austria attractive for highly-skilled workers but also to retain those foreign students who have been educated here, but who, after completing their studies, are forced to leave Austria again, leading to the loss of valuable human capital.³⁸

The “Doctoral Students from Non-EU Countries” indicator also shows that Austria is not particularly attractive for students from outside the EU. Most highly-qualified students from non-EU countries apply for structured doctoral programmes at renowned universities.³⁹ The transition away from traditional doctoral studies to structured programmes, however, is proceeding only slowly, as the indicator “Doctoral Candidates with Employment Contracts” shows (see the chapter “Research at Universities and Non-University Research Institutions”).

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Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy in the Tertiary Education System

Based on the preceding analysis of the goals of the RTI strategy and the indicator-based assessment of the extent to which these goals have been achieved, the Austrian Council recommends that particular attention be devoted to the following points:

The Austrian Council recommends that the goal reiterated in the Work Programme of the Austrian Federal Government 2013-2018, to increase to 2 percent of GDP the amount spent on universities, should be recognised as a minimum target and that the additional annual expenditure, of on average 400 million euros, that is required should be made available for the tertiary sector. The Austrian Council recommends continuing

the legal steps to implement study-place financing and to this end adapting the autonomy of the universities to current conditions with a view to capacity-oriented university access and improved conditions of study. In particular, measures to increase the number of graduates in STEM subjects should be further intensified. This also includes stepping up the relevant measures in the Action Plan of the BMWFw.

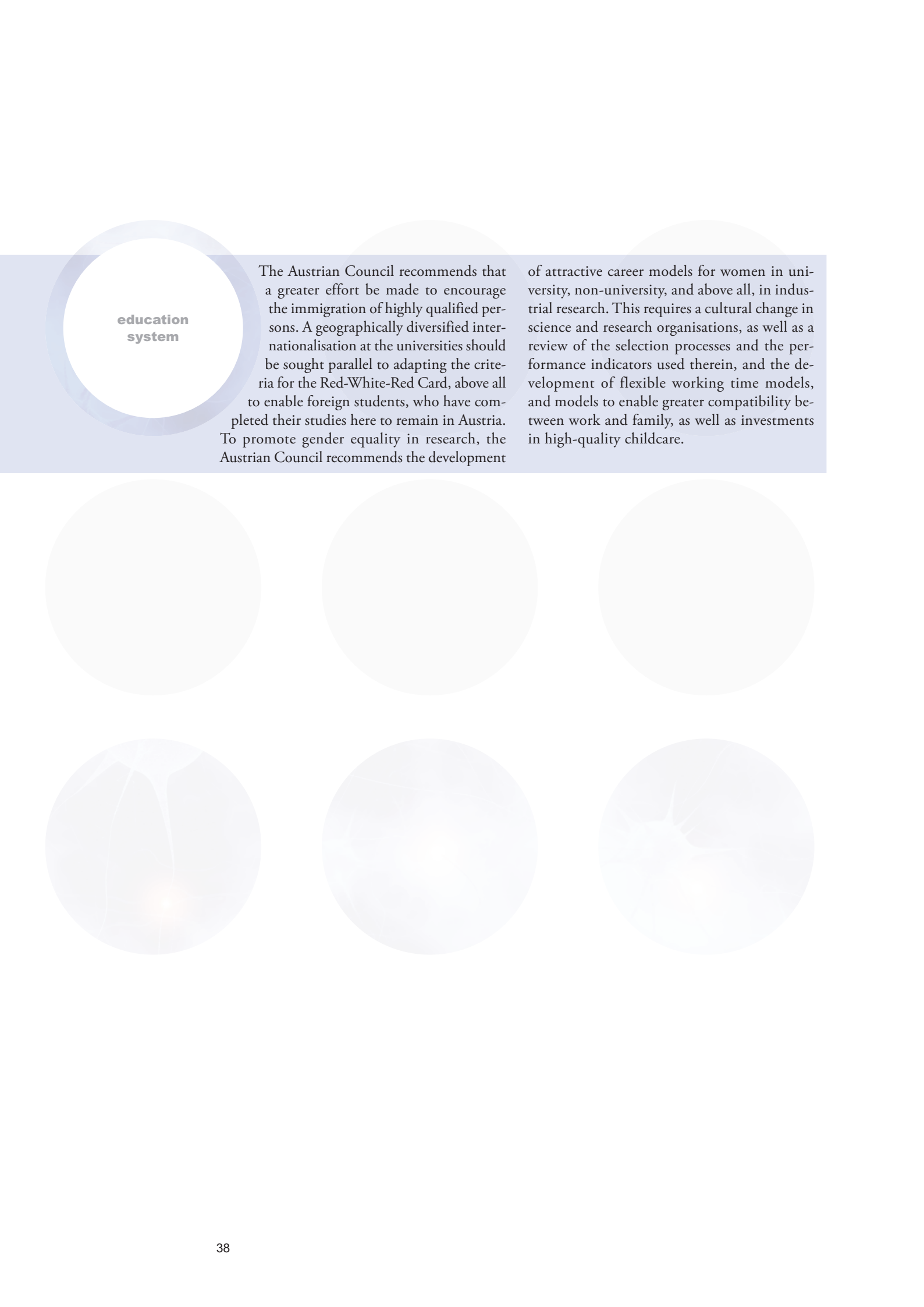
³⁵ Cf. BMWFw; Action plan for a competitive research area – Measures of the Federal Ministry of Science, Research and Economy for the Enhanced Implementation of the RTI Strategy of the Federal Government in Selected Areas 2015

³⁶ Cf. BMI; Niederlassungs- und Aufenthaltsstatistik 2013

³⁷ see also: Report on Austria's Scientific and Technological Capability 2014, p. 29 f

³⁸ OECD (2014): Recruiting Immigrant Workers: Austria.

³⁹ Cf. Janger, J. / Strauss, A. / Campbell, D. (2013): Academic careers: a cross-country perspective. In: WWWforEurope Working Paper Series, 2013, 37.



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The Austrian Council recommends that a greater effort be made to encourage the immigration of highly qualified persons. A geographically diversified internationalisation at the universities should be sought parallel to adapting the criteria for the Red-White-Red Card, above all to enable foreign students, who have completed their studies here to remain in Austria. To promote gender equality in research, the Austrian Council recommends the development

of attractive career models for women in university, non-university, and above all, in industrial research. This requires a cultural change in science and research organisations, as well as a review of the selection processes and the performance indicators used therein, and the development of flexible working time models, and models to enable greater compatibility between work and family, as well as investments in high-quality childcare.

Research at Universities and Non-University Research Institutions

Much of the basic research carried out in Austria is conducted at universities, which are the most important research establishments in the country and link research and teaching. Nowadays, universities face both an increasing plethora of tasks and more intense competition for talented researchers who demand comprehensive reforms.

On the one hand, universities in knowledge-based economies are increasingly seen as engines of economic growth, not just because of their research results but also, and in particular, because of their graduates, who are employed in companies as researchers or in other capacities. Basic research is becoming increasingly important in countries on the technological threshold. Universities are stepping up their cooperation with industry and are also encouraged to exploit research results themselves, for example by founding spin-offs or through licensing technologies. In addition to the purely economic ex-

pectations that are placed in universities, there is an increasing focus on their potential contribution to solving societal challenges.

On the other hand, international competition for talented students and excellent researchers continues to grow, accelerated in Europe not least of all by the expansion of the European Research Area. The poaching of renowned professors is becoming more frequent and talented young researchers are trying to obtain jobs at those research institutions where they find the best conditions.

The Government's RTI strategy has set a number of objectives for the areas of basic research and universities, both with regard to funding (amount and type of allocation) and with regard to structural reforms which, in view of the enormity of the challenges, should be implemented urgently.

university
research

Universities and Basic Research

Figure 12 provides an overview of the key developments with regard to the level and structure of funding as well as the quality and international linkage of research, especially basic research at universities. The most important development lies in the fact that the quality of research has greatly improved since 2010. Austria's research performance is above average, especially as measured by the number of successful applications to the European Research Council (ERC). As matters stand, there is a thoroughly realistic prospect of achieving the goals for the quality indicators "University Ranking/Research Performance" and "ERC Grants per million Inhabitants" by 2020.

The quality of research is strongly influenced by the available infrastructure, the competitive modes of funding and the transition to modern doctoral programmes.⁴⁰ The topic of research infrastructure is dealt with in detail in the section of the same name. From today's perspective, it appears rather unlikely that the goal in the two other areas will be achieved. Both indicators ("Competitive Funding" and "Doctoral Candidates with Employment Contracts", see Figure 12) have indeed improved since 2010; however, the development dynamic is far from sufficient to come even close to the level of the innovation leaders. For this reason, it is rather questionable at present whether Austria, assum-

RTI Strategy Objectives

- We want to increase investments in basic research by 2020 to the level of leading research nations.
- We want to improve basic research by implementing further structural reforms in the university system.
- The university financing model should be reformed. Research financing should become more competitive and project-based.
- University research financing, in the form of third-party funding from the Austrian Science Fund (FWF) via competitive applications, must be strengthened and given appropriate financing.
- The establishment of individual profiles of universities should be supported by creating Clusters of Excellence.
- The orientation of teaching and research topics at universities, and the collaboration with non-university research institutes, should be better aligned with an overall strategy.

⁴⁰ Cf. Keuschnigg et al. (2013): Vision Österreich 2050: Vorsprung durch Bildung, Innovation und Wandel. Study on behalf of the Austrian Council for Research and Technology Development and the Austrian Institute of Technology, Holzhausen Verlag – Vienna, p. 73ff.

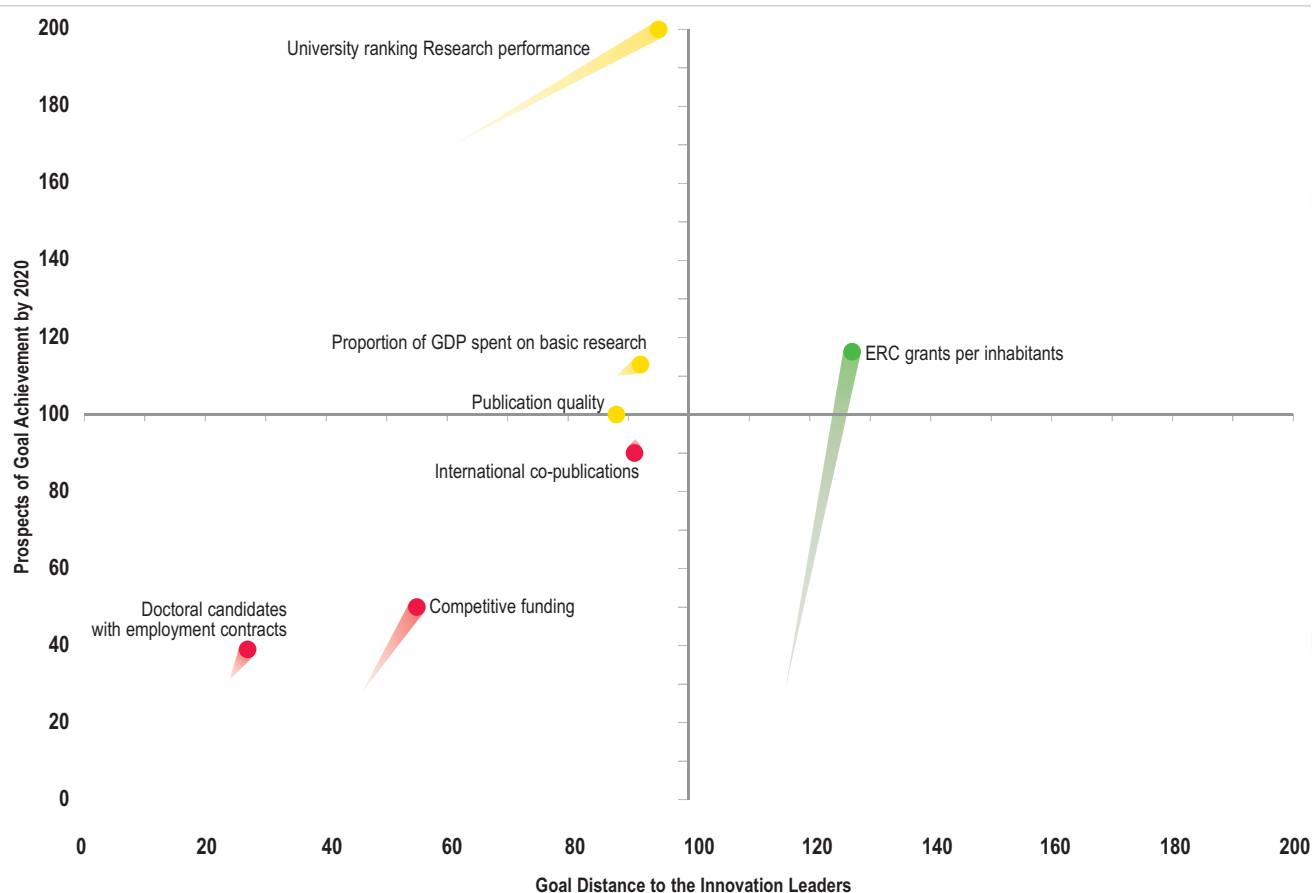


ing a consistent performance, can achieve the goal of joining the group of leading nations, even though the innovation leaders of Denmark, Germany, Finland and Sweden themselves are not amongst the top players in this area. The USA,

Switzerland, the UK and the Netherlands are clearly the benchmarks here.

However, what is positive to note is that Austria's position has improved significantly with regard to research performance in the comparison period. Eight Austrian universities⁴¹ are

Figure 12: Goal Distance and Prospect of Goal Achievement in the University Sector and in Basic Research, 2010-2015



Sources: see Appendix 1, WIFO presentation, Raw Data: see Appendix 2. Explanation see Appendix 3.

Note: Goal Distance=Austria's actual value relative to the Innovation Leader's actual value (average value most recent available year DE, DK, FI, SE); Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders 2020.

⁴¹ The University of Vienna, the Medical University of Vienna, the University of Innsbruck, the Medical University of Innsbruck, the University of Graz, the Vienna University of Technology, the Medical University of Graz and the Graz University of Technology

currently listed in the underlying ranking⁴² that records the international position of universities based on scientific performance parameters. The University of Graz is ranked 150th and the universities of Vienna and Innsbruck, the medical universities of Vienna and Innsbruck and the Vienna University of Technology are positioned between the 200th and 300th places. Not least due to the fact that rankings are gaining importance and attention at an international level, Austrian universities joined forces in a cooperation project intended to improve the position of Austrian universities in international university rankings in the long term.⁴³ The paper presents short, medium and long-term measures to optimise the data situation as well as communication and public relations work on the subject of rankings.⁴⁴ The universities consider that measures to improve Austria's ratings can most usefully be taken in those rankings that require active participation – for example the U-Multirank⁴⁵ and the Times Higher Education World University Ranking⁴⁶ (THE-TR).

It remains to be seen whether such measures will have any substantial effects on the position of Austrian universities in international league tables in the foreseeable future. For research quality rankings that are exclusively based on

the quality of publications, such as the Leiden Ranking used for this report, they will, however, play a marginal role only.

In terms of the number of ERC grants received, Austria has maintained its lead over the innovation leaders in the comparison period (see Figure 12, indicator “ERC Grants per million Inhabitants”⁴⁷). This consistently high value is an excellent measure of quality, as ERC research funding is allocated exclusively on the basis of the excellence of the project that has been submitted and of the researchers. The success of Austrian research at European level is also illustrated by the high level of participation in European Framework Programmes and by the above-average return flow ratio (see also Figure 17 in the chapter “Political Governance of the RTI System”).

The indicator “Publication Quality” offers a suitable criterion for evaluating the quality of basic research as a measurable form of scientific output. Performance in this indicator is calculated using the number of scientific publications that are amongst the top ten percent of the most cited publications worldwide in each research discipline. The performance of Austrian researchers is in line with that of the innovation leaders at a relatively high level. As a result, the

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⁴² Cf. Centre for Science and Technology Studies (CWTS) Leiden Ranking 2014 (online at: <http://www.leidenranking.com/>)

⁴³ Austrian Universities and University Rankings; Final Report in October 2014, on behalf of BMWFW, compiled by Austin BFP. The following objectives are to be pursued:

- (i) “Simplification and more efficient approach in collecting data, for example by harmonising the requirements of the national reporting system with those of the data material used for rankings”,
- (ii) “proactive, joint approach vis-à-vis key ranking providers and clarification of possible weaknesses in data collection with data providers” and
- (iii) “proactive, joint public relations on the subject of rankings to achieve objective media coverage in Austria”.

⁴⁴ Cf. See Austrian Universities and University Rankings; Final Report in October 2014, on behalf of BMWFW, compiled by Austin BFP.

⁴⁵ u-multirank; <http://www.u-multirank.eu>

⁴⁶ Times Higher Education; <http://www.timeshighereducation.co.uk/>

⁴⁷ In previous years, the indicator was calculated by measuring the number of ERC grants against the number of active researchers. Due to the limited availability of data, this calculation is now carried out based on the number of inhabitants.

indicator showed very little variation between 2004 and 2009⁴⁸.

The “International Co-Publications” indicator refers more strongly to the international network than to the quality of the publications. Although the number of international co-publications in Austria continues to grow, the indicator shows little change as this trend is also present in the countries compared. In this area, Austria is at a somewhat lower level than the comparison countries.

However, Austrian universities still have some work to do to ensure that careers are as attractive as in the leading countries, if they are to counteract the poaching of excellently qualified researchers and to recruit researchers from abroad themselves. In view of the enormous investments being made in science and research, especially in China and other Asian countries, special efforts will be required to create the ideal research conditions that will enable Austria to succeed in the global competition for the “best brains. Attractive career structures, such as a genuine “tenure track” model or the possibility of early, independent research and collaboration with renowned colleagues will – alongside a state-of-the-art research infrastructure – play a significant role in future as characteris-

tics of an attractive research location.⁴⁹ The BMWFW’s research action plan contains appropriate measures in this regard that should be implemented as quickly as possible.⁵⁰

Creating the conditions for a larger number of optimal research locations with excellent research infrastructure (see also the section “Research Infrastructure”) is not only necessary to achieve high success rates in research grant applications and to secure Austria’s position as a science and research nation.⁵¹ Research quality is rather a significant determinant of the commercialisation possibilities for university research results and also for the quality of graduates. Income from licensing technologies or from founding academic spin-offs is influenced by research quality.⁵²

The “Doctoral Candidates with Employment Contracts” indicator in principle assesses the transition away from traditional doctoral studies to modern PhD programmes, which prepare students significantly better for scientific careers and which lead to greater integration of doctoral students into university research. This transition is a slow process, and as a result implementation is not currently expected to be completed by 2020. The expansion of PhD study programmes meets the need for the increased development of scientific competence

⁴⁸ The indicator is an official Innovation Union Scoreboard (IUS) indicator. The relatively large time interval to the most recent year (2009), which is due to the customary window of five years used to calculate the citations or as a time scale for assessing the use of publications must be noted. Contrary to expectations, the values in the 2015 IUS were not updated.

⁴⁹ Cf. Janger, J. / Strauss, A. / Campbell, D. (2013): Academic careers: a cross-country perspective. In: WWWforEurope Working Paper Series, 2013, 37.

⁵⁰ BMWFW (2015): Action plan for a competitive research area: Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas, p. 13ff.

⁵¹ Keuschnigg et al. (2013): Vision Österreich 2050: Vorsprung durch Bildung, Innovation und Wandel. Study on behalf of the Austrian Council for Research and Technology Development and the Austrian Institute of Technology Holzhausen Verlag-Vienna, p. 81f.

⁵² Cf. Veugelers, R./Callaert, J./Song, X./Van Looy, B. (2012): The participation of universities in technology development: do creation and use coincide? An empirical investigation on the level of national innovation systems. In: Economics of Innovation and New Technology, 21(5-6), pp. 445–472; Di Gregorio, D./Shane, S. (2003): Why do some universities generate more start-ups than others? In: Research Policy, 32(2), pp. 209–227.

by means of appropriate support for young scientists and additional funding for establishing positions for young researchers.

The means for competitive basic research funding have decreased slightly compared to the comparative value of 2010. With a rate of 0.51% of GDP, Austria is among the innovation leaders, but a target value of approximately 0.91% of GDP (the target value for 2020 is calculated using the average values of the leading nations) can only be achieved with a massive increase in funding of more than 12% per annum until 2020. In the remaining five years, funding therefore has to almost double.

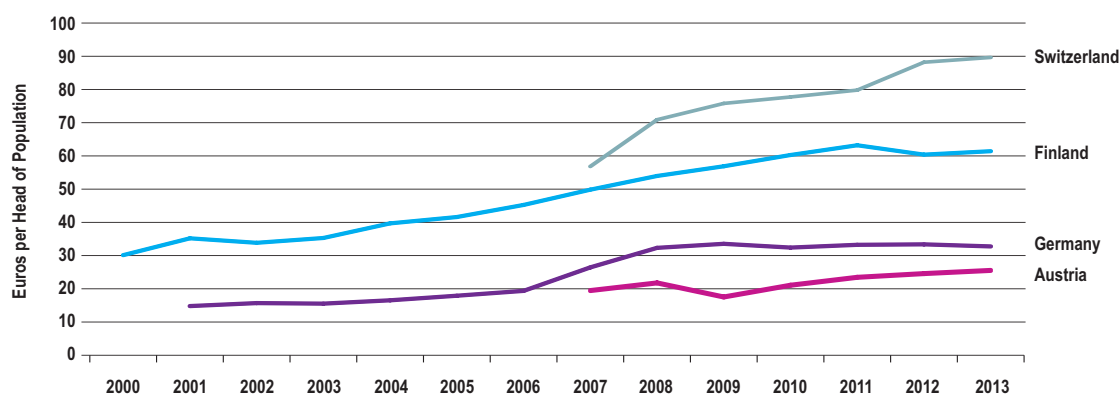
If the Austrian Science Fund (FWF) is used as the main institution for awarding competitively-allocated funds to support basic research in Austria, the budget would have to be increased from approximately 200 million euros at present to 400 million euros.

By direct comparison, the Swiss National Sci-

ence Foundation (SNF) has approximately CHF 800 million available (2012). Researchers in Switzerland can therefore receive more than three times the amount of funding per head of population from national competitive processes. At 89.60 euros per inhabitant, Switzerland thus commands a top figure, even by global comparison. In Austria the number is 25.75 euros. Figure 13 shows a comparison of the competitively-allocated research funds per inhabitant in Germany, Finland, Austria and Switzerland.

Basic research is a key pillar of highly developed economies.⁵³ In the opinion of the Austrian Council, a significant increase in competitive funding for basic research is thus advisable not only to achieve the target value of the innovation leaders, but also and in particular to strengthen Austria as a centre of innovation on a sustainable basis.

Figure 13: Funding Awarded to Basic Research on a Competitive Basis Relative to Number of Inhabitants, 2000-2013



Sources: FWF, WIFO calculations.

⁵³ Keuschnigg, C. et al. (2014): Vision Österreich 2050: Vorsprung durch Bildung, Forschung und Innovation. Study on behalf of the Austrian Council for Research and Technology Development and the Austrian Institute of Technology Holzhausen Verlag – Vienna, p. 73.

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RTI Strategy Objectives

- Develop clear role models along defined performance goals for various institutions in the non-university research sector.
- Internal research institute structures should be strengthened through reforms and adjusted to new requirements.
- The overall structure of the non-university sector should be optimised to improve coordination.

RTI Strategy Objectives

- We want to expand research infrastructures in Austria as the foundation for excellent research and to internationally position Austrian research in a coordinated manner.
- The development of research profiles of universities and non-university research institutions as hubs of research infrastructure strives to guarantee optimal coverage, synergies as well as increase existing strengths.

Non-University Research

In comparison to previous years, there have been no major changes in the area of non-university research. Those measures that are currently being implemented have already been highlighted in previous years' reports on Austria's scientific and technological capability. It is worth noting, however, that this primarily concerns reforms of the internal structures at research institutions and that thus only one of the three objectives set out in the chapter is touched upon.

Furthermore, non-university research in Austria has a highly differentiated structure and alongside large organisations such as the Austrian Academy of Sciences (ÖAW) and the Austrian Institute of Technology (AIT), there are also a large number of smaller institutes engaged in basic and applied research.

In recent years, several measures have been taken by the Federal Ministry of Science, Research and Economy and its predecessors with the aim

of bundling the sometimes small-scale structures in non-university research and promoting cooperation between universities and non-university institutions. These efforts, however, have only been partially successful. As discussed in the report entitled "Areas of strength in innovation: scientific profiling and economic synergies"⁵⁴, diversity and small-scale structures, especially in the humanities, social and cultural sciences, could only partially be reduced.

It therefore remains unclear how the measures are to contribute to achieving the other two goals of the chapter. A comprehensive strategic approach to the area of non-university research that would directly address the goals of the RTI strategy cannot be detected. In particular, the Austrian Council notes the absence of measures which would effect better coordination of the overall structure of the non-university research sector and which target the development of role models.

Research Infrastructure

State-of-the-art infrastructure for research institutions is an indispensable prerequisite for a competitive research location.⁵⁵ High levels of availability and excellent access to research infrastructure is therefore of great interest to potential users. Consequently, at least in the areas suitable for this purpose, research infrastructures should also be seen as service institutions with a suitable operational concept. The joint operation of research infrastructure centres by several research organisations can therefore be an advantage here in terms of better utilisation.

In the BMWFW's action plan for a competitive research area, public accessibility to a research infrastructure database was announced for au-

turn 2015.⁵⁶ This research infrastructure database was set up in 2011 by the Federal Ministry for Science and Research in cooperation with the universities and has since been expanded with data from non-university institutes and universities of applied sciences. This should make existing equipment at research institutions available for research and development projects run by companies and other research institutions. To this end, the RTI strategy formulated the following goals for research infrastructure:

- To expand research infrastructures in Austria in a coordinated manner as a foundation for excellent research and to position Austrian research on an international stage.

⁵⁴ AIT-IS Report, Vol. 103; on behalf of the BMWFW

⁵⁵ Keuschnigg, C. et al. (2014): Vision Österreich 2050: Vorsprung durch Bildung, Forschung und Innovation. Study on behalf of the Austrian Council for Research and Technology Development and the Austrian Institute of Technology Holzhausen Verlag – Vienna, p. 79.

⁵⁶ BMWFW (2015): Action plan for a competitive research area; Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas, p. 22ff.

- To ensure the optimal exploitation of strengths and synergy effects in the use of research infrastructures by sharpening the profiles of universities and non-university research institutions as providers of research infrastructure.

The measures necessary to achieve these goals were developed by the research infrastructure working group (RTI working group 4) and as a first step were put into concrete terms in the “Research Infrastructure Action Plan 2014-2020”⁵⁷ This was accepted by the Austrian Government in February 2014.

The new working programme of the Federal Government published in December 2013 also takes up the challenges named in the RTI strategy on the subject of research infrastructure.

For Austria to remain competitive within the European Research Area and, of course, internationally, it is necessary for Austria to put itself in a visible position and participate successfully in European initiatives. In particular, safeguarding Austrian participating interests in research infrastructure projects as part of ESFRI is an important parameter for this. The participation in European initiatives enables economies of scale that would not be feasible at

an Austrian level. This consequently increases the possibilities for Austrian researchers considerably.

Likewise, the RTI infrastructure required nationally must also be established on a long-term, calculable basis so that it may continue to ensure excellent achievement in basic and applied research.

With a view to facilitating large research infrastructure projects in particular, sufficient funding should be provided as part of a research infrastructure plan or a road map.

As in previous reports on scientific and technological capability and in a recommendation⁵⁸, the Austrian Council once again suggests that strengthened funding of research infrastructure in Austria and international participation in large research infrastructures are essential factors for the success of science in Austria, for the country’s scientific development and for overcoming the “grand challenges”. The current situation – the lack of a sufficient level of funding for smaller infrastructure units beyond basic funding – is a massive constraint for the research and development possibilities of universities as well as basic and application-oriented research institutions.

university
research

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy in the Area of Research at Universities and Non-University Research Institutions

Based on the preceding analysis of the goals of the RTI strategy and the indicator-based assessment of the extent to which these goals have been achieved, the Austrian Council recommends that particular attention be devoted to the following points:

Universities and Basic Research

The Austrian Council urgently recommends a substantial and sustainable increase in competitively allocated funds for basic research to expand the numbers of those engaged at the top of excellent research and to improve research conditions of Austria as a location for science.

This requires an increase in the numbers of locations with access to excellent infrastructure for teaching and research.

To counter the paucity of career and training positions at universities and thus to reduce the brain drain of gifted scientists and to appeal more strongly to international researchers, the

⁵⁷ Austrian research infrastructure action plan 2014-2020; prepared by the RTI working group 4 of the Task Force.

⁵⁸ Recommendation of the Austrian Council for Research and Technology Development regarding Research Infrastructure in Austria, 24 November 2011.

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Austrian Council recommends a determined effort to increase the number of suitable career positions (i.e. a genuine tenure track model) and structured doctoral programmes at universities.

Research Infrastructure

The Austrian Council again recommends that it is in Austria's scientific and economic interests to make available a level of funding sufficient to modernise and extend the necessary

research infrastructure at universities and at non-university research institutions. This requires at least a doubling of the funding volume of approximately 240 million euros allocated between 2002 and 2011 within the framework of the Research Infrastructure Programme. The guideline for a competitive allocation should promote in particular cooperation between research institutions and thus also contribute to enhancing the organisations' profile.

Research and Innovation in the Corporate Sector

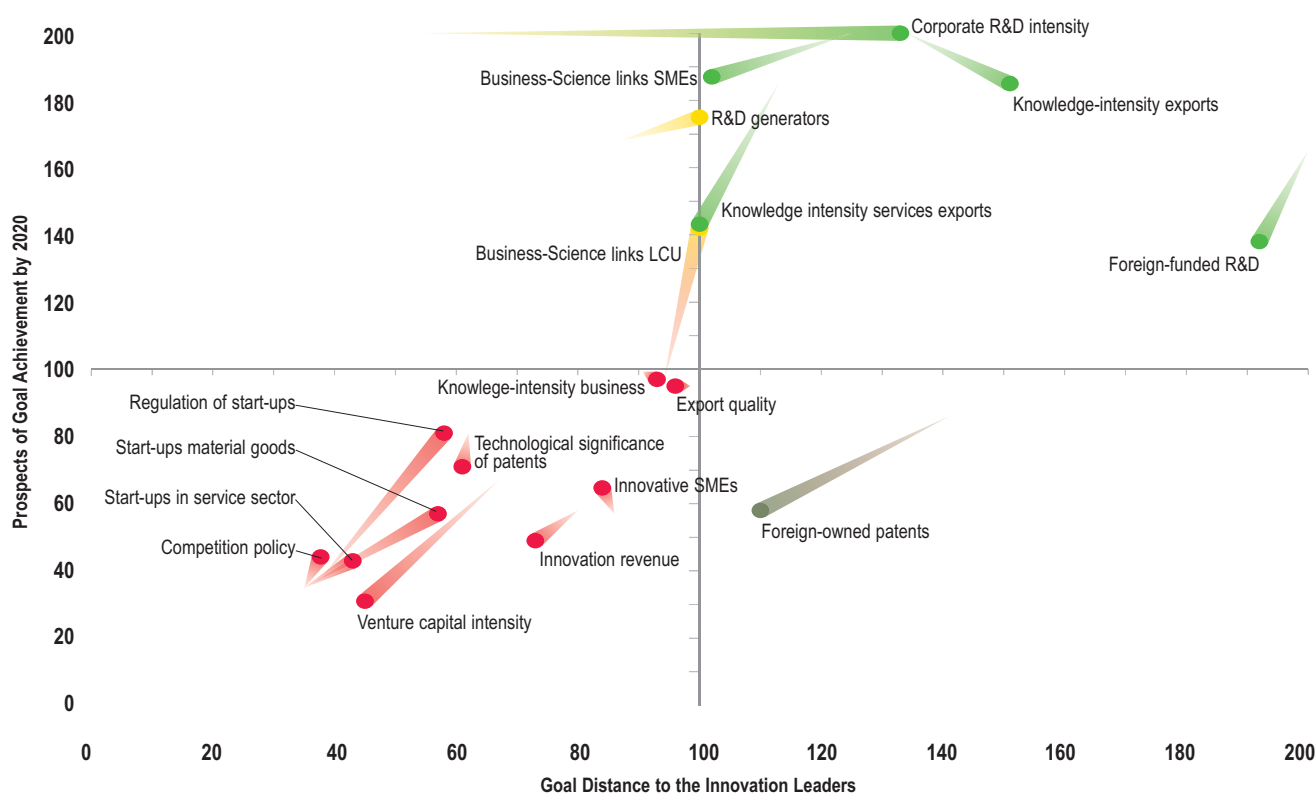
It will only be possible to increase the level of wealth in society and cope with the major social and economic challenges of the future by strengthening the Austrian economy. The transition to a knowledge-based economy and society will be driven forward by further boosting innovative performance and improving competitiveness.⁵⁹ In this context, it is important to note that an invention does not immediately consti-

tute an innovation. To qualify as such it needs to be translated into a marketable product which then caters for demand from the free market. Free competition itself encourages ideas and can frequently spark off new inventions, so providing a basis for innovation.

Figure 14 shows the variance for several input and output indicators over the past five years, based

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Figure 14: Goal Distance and Prospect of Goal Achievement in the area of Activating Innovation Potential, 2010-2015



Sources: see Appendix 1, WIFO presentation. Raw Data: see Appendix 2. Explanation: see Appendix 3.

Note: Goal Distance=Austria's actual value relative to the Innovation Leaders' actual value (average value most recent available year DE, DK, FI, SE);

Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020

⁵⁹ Keuschnigg, C. et al. (2014): Vision Österreich 2050 – Vorsprung durch Bildung, Forschung und Innovation. Holzhausen Verlag – Vienna, p. 95ff.

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on the data available for this area. Key issues are as follows:

- Funding of RTI in the corporate sector (indicator “R&D Intensity Business”)
- Attractiveness of the location (indicators “Foreign-funded R&D”, “Foreign-owned Patents”)
- Cooperation with science (indicator “Business-Science-Links”)
- Start-up dynamism and funding (indicators “Business Start-ups Manufactured Goods and Services”, “Start-up Regulation”, “Venture Capital Intensity”), competition policy
- Innovation breadth (indicators “Number of Companies with RTI Activities”, “Innovative SMEs”, “Companies Performing R&D”)
- Innovation leadership (indicators “Technological Significance of Inventions”, “Share of Revenue Generated with Innovations that are New to the Market”)
- Impact of innovation (indicators “Knowledge Intensity Business and Exports”, “Export Quality”)

Of positive note is that a third of the indicators show that the national target set for 2020 or the innovation leaders’ average has already been achieved. Thus, for example, it seems very like-

ly that it will be possible to achieve the target for cooperation intensity with science by 2020; in terms of attractiveness as a location, Austria is at present ahead of the innovation leaders, but the trend here is negative, so that by 2020 Austria may well have fallen behind the frontrunners. Some of the indicators shown in the diagram are currently only marginally removed from the target, even if the targets are unlikely to be achieved before 2020 (Innovation Impact, Innovation Breadth).

Also of note is that for a majority of the indicators, the stipulated targets have not yet been achieved and as matters stand, the trend does not yet appear to be sufficiently dynamic to achieve the targets by 2020. In particular, this applies to the known weaknesses in the area of business start-ups observed in recent years, venture capital intensity, the R&D intensity of Austrian industry, patent applications and the originality (‘radicality’) of innovation activity.

Based on the results of its mid-term review the Austrian Council concludes that both the improvements in the area of corporate research and innovation and the development dynamics are insufficient to allow Austria to join the leading group of innovation nations by 2020.

RTI Strategy Objectives

- We want to enhance domestic value creation by encouraging research intensive industries and knowledge intensive services. In the process, we want to stimulate innovations through a strong emphasis on demand-side instruments in public procurement, regulation and standardisation.
- The structure of the manufacturing and service sectors has to be improved by increasing the innovation and knowledge intensity of firms.
- The number of firms that systematically conduct research and development should be increased between 2010 and 2013 by a total of 10 percent from 2,700 and by a total of 25 percent by 2020.
- The role of internationally successful Austrian leading firms as a central pillar for the innovation system should be strengthened and the research and innovation potential of small and medium enterprises should be activated.
- Austria’s attractiveness as a location for research and technology-intensive firms has to be increased further.
- The innovation level of firms has to be raised by expanding the share of radical innovations that are new to the market.

Innovation and Corporate Research

A comparison of current performance indicators for the last five years with the above target values of the RTI strategy reveals a mixed picture for the field of corporate research and innovation.

As can be seen from Figure 14, the research intensity of Austrian industry addressed by the first item of the goals has clearly outpaced that of the innovation leaders thanks to its strong dynamic. From this it can be concluded that the measures introduced in this area are showing the desired effect.

The promotion of knowledge-intensive services as measured by the guide indicator “Knowledge Intensity in Service Exports” (i.e. the export share of services sectors with a high innovation intensity), shows a slight deterioration in its position over the last five years and is no longer above the level of the innovation leaders.

As regards the increased stimulation of innovation on the demand side also specified in the RTI strategy, one positive factor is the inter-departmental guiding concept for Public Procurement Promoting Innovation (PPPI) devised by the BMVIT and BMWFW. The concept acts as a guideline for the implementation of PPPI in Austria and includes key points for implementation designed to drive forward innovative procurement in Austria. Based on an analysis of the current situation in Austria, it identified the principal areas and used them to define the priorities in terms of measures. Implementation of this concept commenced in 2012 and was welcomed by the Austrian Council.

Since the adoption of the PPPI concept, “Innovation” has been added to the Austrian Public Procurement Act as a secondary procurement criterion. In addition, an PPPI service centre

has been set up at the Federal Procurement Agency (FPA) and existing institutions nominated to function as “PPPI centres of excellence and contact points”. A shared website⁶⁰ provides news about current activities, such as events and project competitions, and operates as an information platform. In the opinion of the Austrian Council, the priority here is above all to ensure efficient, broad-based interaction between the many different players (ministries, procurement bodies, funding agencies, industry, etc.) within an overarching PPPI governance system.

As demand from the public sector as a driver of innovation goes beyond the scope of public procurement covered by the FPA, it is necessary to consider not only the PPPI guiding concept, but also other regional and national measures which are not FPA-based. International Best Practice models in the field of Innovation-Promoting Public Procurement can offer Austria further options for action.

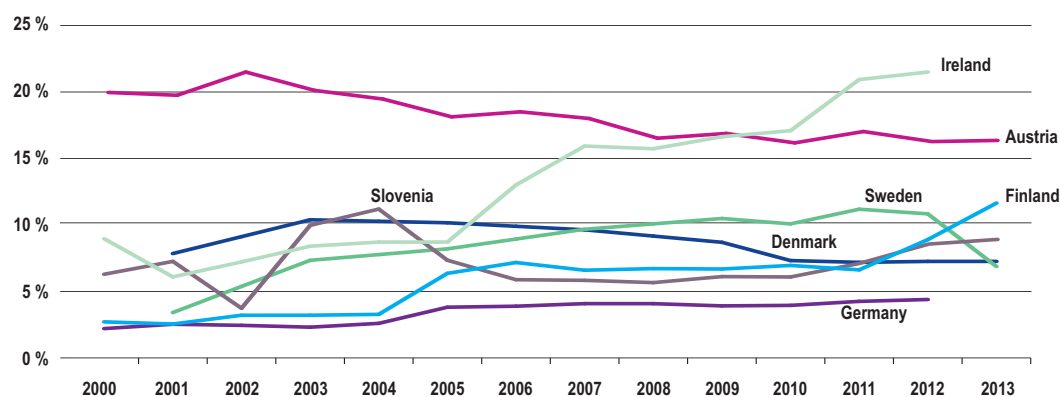
The desired improvement in product and service structure to be accomplished by stepping up the level of knowledge / innovation intensity in Austrian companies can be best illustrated by the knowledge intensity of industry (see indi-

cator “Knowledge Intensity Business”, Figure 14).

This has remained by and large unchanged over the years. In this regard, Austria continues to trail behind the average value of the innovation leaders, and the probability of achieving the target value set for 2020 remains small. It is therefore necessary to investigate the reasons behind this and to adapt national efforts accordingly.

One positive trend in comparison with the innovation leaders is the contribution made by medium and high-tech products to Austria’s balance of trade (indicator “Knowledge Intensity Exports”), even if dynamism has slowed somewhat here. When considered together with expenditure on research, which compared with other countries, enjoys above-average funding from abroad, these two indicators are important values when it comes to quantifying Austria’s quality as a centre of research and innovation. The goal of the RTI strategy to increase by around 10 percent the number of companies systematically engaged in research and development has been reached. A glance at the current

Figure 15: Foreign-Funded R&D 2000-2013 (as a Percentage of Total R&D Funding), Austria Compared to the Innovation Leaders, Ireland and Slovenia



Source: OECD MSTI.

⁶⁰ www.ioeb.at

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trend also suggests there is a good prospect of achieving the long-term objective of boosting the number of companies performing R&D by around 25 percent in total by the year 2020.

As regards motivating Austrian SMEs to step up their levels of research and innovation as addressed by the objectives, there has been no appreciable change in either goal achievement or distance-to-goal in recent years (see indicator “Innovative SMEs”, Figure 14). While Austria has fallen back somewhat in relation to the average value of the innovation leaders, there has been a slight improvement in its prospects of drawing level with them by 2020. Given the current trend however, attainment of this goal remains unlikely. It will be necessary to wait and see the extent to which the funding policy measures introduced to encourage R&D activities by Austrian SMEs have an impact in coming years.

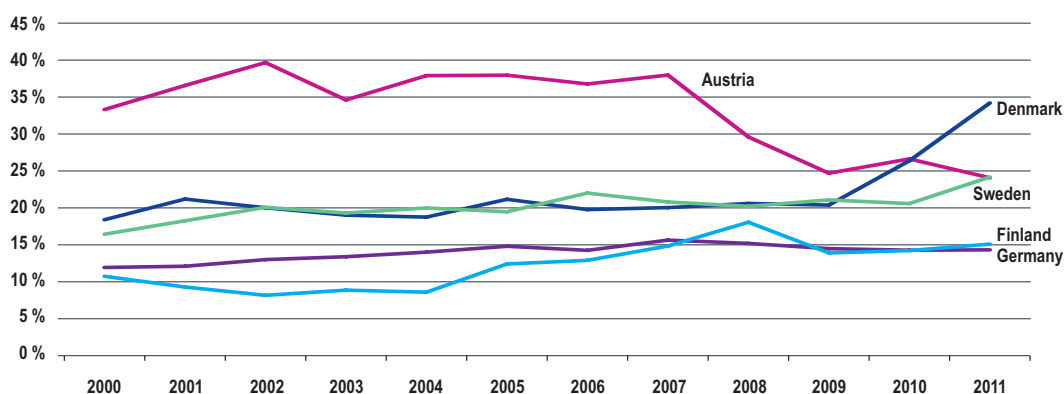
A change has been observed in relation to Austria’s attractiveness as a location for foreign companies engaged in research and development. In the past, both indicators for this objective, “Foreign-funded R&D” and “Foreign-owned Patents”, were above the average levels of the innovation leaders in terms of goal achievement,

but there has been a continuous deterioration in this position over the years. Despite the decline in the unmistakably positive trend for the level of foreign-funded R&D activities, it is still on course to exceed the average value of the innovation leaders in 2020. This is due to Austria’s slippage in this area compared with other countries, while some innovation leaders such as Finland are again showing improved tendencies in this regard (see Figure 15). Slovenia and Ireland are also of interest in this context: In Ireland, the share of foreign-funded R&D activity is greater than in all the other countries compared here, as Ireland has made specific efforts to create appropriate structures. This has served as a model to states such as Slovenia, which initiated comparable measures, although not with the same degree of success.

As regards the second measure for Austria’s attractiveness as a centre of research for international organisations – the share of inventions developed in Austria controlled by foreign players (indicator “Foreign-Owned Patents”) – Austria has clearly forfeited some of its competitive edge over the last five years and will probably have fallen back even further by 2020 (see Figure 16).

Given the long-term continuous downward

Figure 16: Percentage of Foreign-Owned EPO Patents with Participation of Inventors Residing in Austria (Foreign-Owned Patents), Austria Compared to the Innovation Leader



Sources: OECD, Regpat Database, July 2014; WIFO Calculations

trend to both indicators of attractiveness to foreign organisations (“Foreign-funded R&D” and “Foreign-owned Patents”), the Austrian Council also strongly recommends casting a critical eye on the key factors for Austria’s attractiveness as a location, e.g. first-class universities, the availability of qualified human resources or ongoing programmes to boost the level of foreign R&D, in particular the Headquarter Programme of the FFG. Greater efforts must be made to increase Austria’s appeal in this regard where appropriate. The Austrian Council also makes reference here to the process for the development of a national IP strategy addressed in the section “Cooperation Between Science and Industry”.

The increase in ‘radical’ innovations specified in the RTI strategy and advancement to the status of an innovation leader is expressed by the indicators relating to the share of revenue generated by market innovations (“Innovation Revenue”) and the technological significance of patents. The indicator “Innovation Revenue” reflects the economic importance of innovations which are not just new to the company itself, but also to the market and which are thus characterised by a particularly high degree of innovation. Over the past five years, a deterioration in Austria’s position vis-à-vis the innovation leaders has become apparent (see Figure 14). The gap to the innovation leaders’ average value has widened still further and the likelihood of achieving the 2020 target has worsened. Con-

sequently, the prospect of achieving this goal in 2020 has become even smaller. Over the last five years there has also been a slight deterioration in the indicator “Technological Significance Patents”. Here Austria remains below the average value of the innovation leaders (see Figure 14). This situation has also been described in the section “Invention Quality: Performance of RTI activities at Micro-level” in the chapter “Priority Objectives and Impact of RTI Strategy”. Given the current trend, almost no improvement is expected in coming years. Austrian industry has thus not yet managed to catch up with the innovation leaders in terms of invention quality, the precursor to radical innovation. The Austrian Council therefore takes the view that it is important to develop an overall concept with sustainable framework conditions which support a more ‘radical’ concept of innovation. In addition to the willingness of the agencies to take on greater risk when funding such high-risk ventures this includes the testing of alternative funding allocation models, which above all implies adapting the relevant criteria and mechanisms when evaluating projects.⁶¹ In addition, it is necessary to improve the relevant incentive structures at governance level⁶² At least equally important is optimisation of the fundamental drivers of radical innovation, such as university research and teaching, as well as innovation risk financing (venture capital).⁶³

Cooperation Between Science and Business

Contradictory trends can be observed in the case of the indicators associated with an increase in co-operation intensity among Austrian companies, strengthening of strategically-oriented cooperation between science and business and the disman-

tling of barriers in this area (“Business-Science Links SMEs” and “Business-Science Links LCU”) (see Figure 14).

While the level of cooperation between science and big business has risen so that it has caught up

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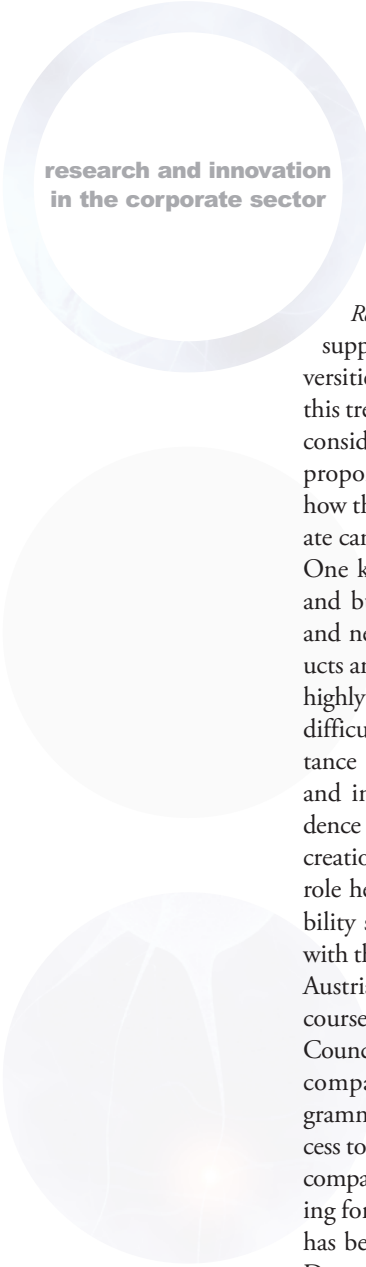
RTI Strategy Objectives

- We want to increase the co-operation intensity of Austrian firms and strengthen the strategically-oriented collaboration between science and business – with a special focus on excellence and sustainability.
- This means that we must reduce barriers and hindrances among firms, especially SMEs, for cooperating with science/research facilities, and make it easier for innovative firms to access external resources.
- This will allow more firms to expand their technology leadership and attain top positions in innovation.

⁶¹ Austrian Council Recommendation Regarding the Efficient Translation of Research Results into Innovation, 24 November 2011.

⁶² Cf. Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 21.

⁶³ Cf. Keuschnigg, C. et al. (2014): Vision Österreich 2050 – Vorsprung durch Bildung, Forschung und Innovation. Holzhausen Verlag – Vienna, p. 153ff.



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with that of the innovation leaders and will probably also manage to maintain this position, the cooperation intensity of SMEs has fallen off. (see Figure 14). It is necessary to further reinforce domestic funding instruments, such as the Christian Doppler Laboratories, COMET centres, AplusB centres, Research Studios Austria or Laura Bassi, which support research collaboration between the universities and industry, if Austria is to counteract this trend. In this context, however, it needs to be considered to what extent these instruments disproportionately favour large organisations and how the willingness of Austrian SMEs to cooperate can be increased.

One key aspect of cooperation between science and business is the translation of new findings and new business models into marketable products and services. Such transfer of technology is a highly complex affair and is frequently made more difficult by cultural specificities, such as a reluctance to take risks, or by structural weaknesses and inadequate framework conditions. As evidence of the theoretical feasibility of a venture, the creation of a proof of concept plays an important role here. This is frequently the result of a feasibility study and is in many cases also associated with the development of a prototype. A gap in the Austrian funding system was discovered in the course of a study commissioned by the Austrian Council.⁶⁴ While prototype funding is available for companies under a number of different programmes, the scientific community has only access to individual measures. What Austria lacks in comparison with other countries is a form of funding for proof of concept or proof of prototype, as has been successfully introduced for instance in Denmark in the guise of the *Proof of Concept Programme* or by the ERC under its *Proof of Concept Initiative*. On 3 December 2013, the Austrian Coun-

cil therefore put forward a detailed recommendation advocating optimised proof of concept support for knowledge transfer⁶⁵ based on the statements made in its previous recommendation relating to such transfer and start-ups.⁶⁶ Here the Austrian Council recommends developing and completing the available proof of concept support to serve as a model for implementation of the white paper on RTI governance and closing any gaps in the existing programme lines for proof of concept, regardless of programme or department responsibilities which have come into being over the years. It thus recommends entrusting new programmes or additions to the agency which is most suited to dealing with them in terms of content.

The funding programme *Knowledge Transfer Centres* and *IPR Exploitation* set up by the BMWFw in 2014 is also set to bear fruit in the foreseeable future and should be reviewed within the framework of an interim evaluation. This programme is providing a funding volume of some 20 million euros to further encourage cooperation between science and business and to cultivate a spirit of free enterprise at Austria's universities. This objective is to be accomplished via three modules: Module 1 involving three regional and one theme-based knowledge transfer centre in the field of Life Sciences, Module 2 designed to support patent applications and Module 3 for the production of prototypes.⁶⁷ The programme (specifically Modules 2 and 3 relating to patenting and prototyping) also aims to back up the tried and tested AWS patent service. It should be monitored in terms of its impact on patent activity within Austria and, where necessary, adapted accordingly. At this juncture, the Austrian Council also underlines the key significance of the process of developing a national IP strategy which commenced in 2014. It is based on the recommendation⁶⁸ put for-

⁶⁴ Fuchs, Rhomberg: Analyse typischer Barrieren bei der effizienten Umsetzung von Forschungsergebnissen in Innovationen, Brimatech, November 2011.

⁶⁵ Austrian Council Recommendation Regarding the Efficient Translation of Research Results into Innovation, 24 November 2011.

⁶⁶ Recommendation Regarding Optimised Proof of Concept Support for Knowledge Transfer, 3 December 2013.

⁶⁷ <http://wissenschaft.bmwf.at/bmwf/forschung/national/programme-schwerpunkte/wissenstransferzentren-und-ipr-verwertung/>

⁶⁸ Austrian Council Recommendation for a National Strategy for Intellectual Property, 6 June 2013

ward by the Austrian Council on 6 June 2013 and is being jointly driven forward by the BMVIT and BMFWF with the involvement of all relevant stakeholders. The development of an IP strategy for Austria should also be linked to a national open access strategy and not pursued in isolation. This should in particular include improving the

provision of information regarding the protection of property rights pertaining to Austrian knowledge-resources, as many research institutions, companies and universities have an insufficient understanding of the advantages and disadvantages of open access.

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Business Start-ups and Venture Capital

The indicators relating to business start-ups and venture capital in Austria fall well short of the expectations and endeavours described above in relation to setting the agenda in an international context. This in particular applies to venture capital intensity, i.e. the amount of venture capital that is invested in Austria. Among the 20 ranked EU member countries, Austria comes in no higher than number 17 and has thus dropped a further place since 2013. If the current trend persists, there will be almost no chance of catching up with the innovation leaders by 2020 (see indicator “Venture Capital Intensity”, Figure 14).

This could be due to a supply problem but also to a demand problem, i.e. on the one hand, there is too little venture capital available, on the other, there are too few companies seeking it.⁶⁹ The public sector is trying to counteract the supply problem with targeted measures. With the *Business Start-up Fund* and the *Business Angel Fund* two sources of aid have been set up at the AWS with the aim of helping to close the gap in early-phase funding and improving the equity capital situation of young entrepreneurs. The *Venture Capital Initiative*, which is also under the management of the AWS, is also being continued, albeit in a new form. This additionally involves the provinces by leveraging ERDF resources as well as funds of the National Foundation for Research, Technology and Development.

The funding provided by the public sector will only be able to narrow the gap between Austria and the leading venture capital markets to a limited extent. As the Austrian Council has warned several times in the past, there is an absence in particular of internationally competitive framework conditions, which would be a prerequisite for attracting institutional investors to Austria.⁷⁰ There has been little progress here since last year and there are still no plans to introduce a private equity law.

The most important new regulatory developments are the European Venture Capital Regulation (EuVECA) and the Alternative Investment Fund Manager Act (AIFMG) based on the eponymous EU directive. The intention here is to stimulate the market for raising international capital and, inter alia, to also create harmonised licensing criteria for venture capital funds throughout the EU. The AIFMG ban on marketing to retail investors that came into force at the end of the transitional period in July 2014 must be viewed critically, as it leads to inconsistencies in investor protection. This is because, under the terms of the AIFMG, private direct investments are restricted even in large funds, while EuVECA permits shares in smaller funds with a higher-risk portfolio to be marketed to retail investors. The Austrian Council therefore welcomes and supports the amend-

RTI Strategy Objectives

- We want to substantially increase the intensity of private equity and venture capital in the formation of technology-based, innovative firms.
- The number of knowledge- and research-intensive new start-ups should climb annually by an average of 3 per cent until 2020.
- Starting a business should be made much easier and relieved of cost burdens.
- The growth of innovative firms should be accelerated.

⁶⁹ Peneder, M. (2013): Von den “trockenen Tälern” der Risiko- und Wachstumsfinanzierung. In: WIFO-Monatsberichte, 2013, 86(8), pp. 637–648. The demand problem, i.e. the insufficient number of young companies that could be financed by venture capital, is also indirectly addressed by other areas with a focus on education or radical innovation. Cf. Friesenbichler, K.S. / Url, T. (2013): Standortfaktoren und Investitionspotential von Risikokapital in Österreich. In: WIFO-Monatsberichte, 2013, 86(8), pp. 673–683.

⁷⁰ Jud, T. (2013): Funktionsmodell und Rahmenbedingung der Risikokapitalfinanzierung. In: WIFO-Monatsberichte, 2013, 86(8), pp. 663–672.

ment to this law promised in the Government's work programme.⁷¹

In response to the financial crisis over the last five years, the focus has fallen on additional stabilisation of the financial sector through the introduction of a host of new regulations. Lenders are now obliged to hold even greater own equity capital and must apply even more stringent criteria when granting loans.⁷² This means that it is not just competitive framework conditions to provide the basis for attracting institutional investors to Austria that are lacking here.⁷³ Given this situation, lending frequently falls through due to an absence of reliable forecasts and security for loans, particularly in the initial phase of start-up funding. Yet it is above all in the early stages that many new and small companies need fast, straightforward (project) finance. This depends on the availability of a diversified portfolio of equity capital funding instruments, which, as in the case of venture capital, is not sufficiently developed in either Austria or Europe. The objectives are thus as follows: to increase the flow of funding to start-ups in the initial phase and to better establish equity capital financing in the early stages of developing a business while simultaneously raising awareness for this issue among the general public.

To further increase the venture capital intensity of the private sector and to compensate for the weakness of the venture capital market, other instruments should also be considered here. This might include tax concessions for investment in new companies, something that also involves improving the basic statutory provisions applicable in these areas.

It should be noted here that from 2015/2016 Horizon 2020 calls will increasingly support

measures designed to boost risk financing and to assist innovative SMEs. This concerns for example, the willingness to invest (investment readiness) and the situation on the markets (market readiness) as well as the "bankability" of companies. In addition, Horizon 2020 should be extended to include non-bank lenders (e.g. crowd-lending platforms), with technical assistance being offered to such target groups. The Austrian Council recommends that the competent authorities and agencies publicise these calls to a greater extent to increase the level of Austrian participation in such European programmes.

As regards the goal of increasing the number of start-ups involving high levels of knowledge and research by an average of 3 percent per year by 2020 specified in the RTI strategy, both indicators relating to Austrian start-up activities, "Business Start-Ups Manufactured Goods / Services", clearly remain well below this national target when judged by their average annual growth. The position has, however, improved slightly in recent years, as the distance to the innovation leaders has narrowed and there is now a greater prospect of achieving the goal by 2020. Nonetheless, the development of business start-ups in the services sector remains unsatisfactory despite a modest increase and at 3.56 percent in 2011, the most recent value currently available, even shows a negative trend.⁷⁴

The Austrian Council therefore recommends treating business start-ups as a priority and envisaging a series of supportive measures. In view of the current situation, particular attention should also be paid to the specific characteristics of service start-ups. It is gratifying to note that the Federal Government attaches great importance to start-up activities in Austria as ex-

⁷¹ Work Programme of the Austrian Federal Government 2013-2018, p. 15. Compare also the Austrian Council Recommendation for an Amendment of the Alternative Investment Fund Manager Act (AIFMG), 6 March 2014.

⁷² AVCO Positionspapier (2014). Vorschläge zur Verbesserung der gesetzlichen Rahmenbedingungen für alternative KMU-Finanzierungen.

⁷³ Jud, T. (2013): Funktionsmodell und Rahmenbedingung der Risikokapitalfinanzierung. In: WIFO-Monatsberichte, 2013, 86(8), pp. 663-672.

⁷⁴ Source: Statistik Austria

pressed in its current “Founder Country Strategy”.⁷⁵ In this context, it must be ensured that the overall funding package of AWS and FFG is completely covered and that the individual measures are coordinated to optimum effect to avoid any unnecessary duplication or overlaps. New forms of financing should be developed for start-ups in addition to bank finance, which has now reached its limits. To fund innovative young entrepreneurs and SMEs, the extensive possibilities of crowd funding, including peer-to-peer lending and crowd investing, should be encouraged as a supplementary form of financing within an efficient and effective legal framework and incorporated into a competitive overall strategy for corporate growth.⁷⁶ In this context, the Austrian Council welcomes the latest crowd funding initiatives of the BMWFW agreed at the Federal Government’s closed-door conference, in particular the Austrian Alternative Financing Act.⁷⁷ In addition to these alternative financing mechanisms, consideration should be given to introducing a tax allowance for business angels to increase equity investments and to reduce ancillary wage costs for start-ups and companies engaged in research. Furthermore, the Austrian Council backs innovative funding models, which fund guarantees in conventional early-phase programmes.⁷⁸

The portfolio of financial support measures for technology-based and innovative business start-ups was also further optimised and rounded off. The AWS young entrepreneurs programme was revamped.

The *Gründungs.Investitions.Scheck* scheme has been successfully established. The *AplusB* programme will be continued in a third round following a revision of the guidelines⁷⁹ and comprehensive

evaluation. Such detailed evaluation of these funding programmes will however only be possible once robust data monitoring of RTI-related start-ups is in place. The results of such evaluation can also form the basis for possible recommendations about improved coordination of the different levels and players involved in the funding system.

The key players in the RTI system, i.e. responsible ministries, the relevant funding agencies, the chambers of commerce and the Austrian Council of Research and Technology Development have worked together for the first time to facilitate Austria’s participation in the Global Entrepreneurship Monitor (GEM) 2014. As part of an additional RTI module under GEM 2014, a survey was carried out among a representative cross-section of the Austrian population to investigate a starting point for RTI-start-ups and spin-offs from universities and public research institutions. Improvement of the data pool is likewise a welcome step as it offers an important insight into Austrian start-up activities based on research, technology and innovation. The positive trend observed here is gratifying but should not however conceal the fact that there is undoubtedly still room for improvement if the Federal Government’s goal is to be attained. Additional possibilities for genuine data-based monitoring of RTI-related start-ups are also under discussion by the working groups Knowledge Transfer and Start-ups of the RTI Task Force.

Little success has been achieved in terms of dismantling administrative and regulatory hurdles. As regards the indicator “Start-up Regulation” Austria has lagged far behind the aver-

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⁷⁵ http://www.ots.at/presseaussendung/OTS_20150416_OTS0156/mahrer-oesterreich-soll-gruenderland-nr-1-in-europa-werden-bild

⁷⁶ Willfort, R. / Mayr, P. / Weber, C. (2015): Crowdfunding und Crowdsourcing: Potenzial für den österreichischen Innovationsstandort. Study on behalf of the Austrian Council for Research and Technology Development.

⁷⁷ http://www.bmwfw.gv.at/Presse/AktuellePresseMeldungen/Documents/Crowdfunding_Potenzial-1.pdf

http://www.bmwfw.gv.at/Presse/AktuellePresseMeldungen/Documents/Crowdfunding_Vergleich_AT_DE-1.pdf

⁷⁸ Cf. AWS Double Equity Funds – Garantieübernahme von bis zu 80 % für einen Kredit in Höhe von bis zu EUR 2,500.000,-

⁷⁹ Austrian Council Recommendation RTI-Related Start-ups, 19 November 2012

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age value of the innovation leaders in the past and has now only managed to close this gap slightly. At the same time there has been a small increase in the prospect of goal achievement, although this will not be sufficient to catch up with the innovation leaders by 2020. One particular weakness here is the time required to obtain approvals and licences. The introduction of the business portal USP as a central one-stop shop for firms can be considered a success. The Austrian Council recommends extending the powers of the WKO service centres for start-ups. They too should be authorised to enter new businesses in the commercial register, and an e-signature should replace notarisation. The clearance of entries in this register should remain the prerogative of the registration court alone.

On 1 July 2013 legislation was amended in relation to the “GmbH light”. Following further amendment in February 2014, the main relief provided by the law is a reduction in the minimum nominal capital that has to be paid in by new entrepreneurs. The initial signs in this regard seem positive. The WKO, for example, has pointed out that in 2014, the number of new businesses founded according to “GmbH light” legislation rose by 37 percent compared with 2012.⁸⁰ However, due to a lack of reliable data, the extent to which the “GmbH light”, now its final form, can contribute to stimulating RTI start-ups remains unclear. Here too the Austrian Council recommends monitoring these developments and keeping a close eye on the “GmbH light” and other legal forms of companies. In any case, it is essential to ensure a stable legislative framework and the legal cer-

tainty this provides in the sensitive area of start-up regulation.

The main reason for the renewed adjustment of the rules governing the “GmbH light” are the high taxes losses predicted due to large numbers of companies changing their legal form. As shown in last year’s Report on Austria’s Scientific and Technological Capability 2014 and the many individual recommendations made by the Austrian Council,⁸¹ this underlines the necessity to consider additional tax concessions geared specifically to the innovative content and research performance of start-ups and early-stage businesses.

In its current work programme the Federal Government has promised a number of initiatives to spark off a new wave of start-ups: Expanding the AWS measures and an adequate endowment of the Business Start-up Fund should (with regard for the needs of the market) result in the availability of more venture capital. Improved eligibility criteria as envisaged in the New Start-Up Funding Act (NeuFÖG) are designed to speed up access, i.e. instead of 15 years only five years have to be expired since the last commercial activity. In addition, a failed business will no longer represent a formal criterion for exclusion as regards a promise of funding. Moreover, the Austrian Industrial Code is to be brought into line with the changes in social framework conditions, with the expansion not just of the online business registration scheme, but also the one-stop shop at the WKO’s 90 start-up service centres.⁸² The Austrian Council welcomes and supports these initiatives and now plans to continuously monitor and evaluate their implementation.

⁸⁰ Press Conference of the Federal Chamber of Economy (WKÖ) to present the latest start-up statistics 2014 on 27 January 2015.

⁸¹ Austrian Council recommendations regarding the efficient translation of research results into innovations, the creation of suitable framework conditions for private equity in Austria, and the introduction of an investment allowance (all from 24 November 2011); Austrian Council Recommendation Regarding RTI-Related Start-ups, 19 November 2012

⁸² Cf. Work Programme of the Austrian Federal Government 2013-2018, (2014)

Promote Innovation through Competition

The indicator “Competition Policy” in Figure 14 shows Austria still trailing some distance behind the innovation leaders. Although there has been a slight improvement in this situation since 2010, above all in terms of the development dynamic, this does nothing to alter the fact that attainment of this goal by 2020 continues to look unlikely. On the whole, though, Austria has probably not exhausted the possibilities for promoting innovation through competition.⁸³

The reform of competition law on 1 March 2013 has broadened the investigative powers of the Federal Competition Authority (BWB), although the scope of authority held by the BWB still lags behind that of the European Commission.

While the possibility of competition monitoring has also been introduced, there are still indications of a lack of competition intensity in cer-

tain branches in Austria, above all in the services sector.

In each European Semester the European Commission analyses the fiscal policies of Austria and all other EU member states. In its recommendations on the national reform programme 2013, the Commission expressed serious doubts as to the justification for restrictions on access to professions in the services sector, and in particular to those known as the liberal professions.⁸⁴

According to the Commission, the financial and human resources of the BWB are still below the levels observed in economies of a similar or even smaller size. The Competition Authority is thus still too small relative to its (broader) powers and cannot therefore realise its full potential in terms of playing a positive role in competition policy and hence indirectly in innovation policy.

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RTI Strategy Objectives

- We want to stimulate innovation via an active competition policy.
- To do this, institutions that monitor competition should be strengthened.

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy in the Area of Research and Innovation in the Corporate Sector

Based on the preceding analysis of the goals of the RTI strategy and the indicator-based assessment of the extent to which these goals have been achieved, the Austrian Council recommends that particular attention be devoted to the following points:

Innovation and Corporate Research

The Austrian Council recommends that the framework conditions for research and innovation in the corporate sector be further improved by the development of a mix of funding instruments and supporting framework conditions. For the implementation, please refer to the relevant individual Austrian Council recommendations.⁸⁵

Given the negative trend in the level of foreign-funded R&D, the Austrian Council recommends taking a critical look at the ongoing programmes to attract research centres in Austria, in particular the FFG's Headquarter Programme, and to revise them where necessary. However, the main priority here is to optimise the key factors in terms of location quality. These include the calibre of graduates, the ex-

⁸³ See also Janger et al. (2014): Monitoring of Austria's Efforts within the Europe 2020 Strategy. Update 2013-14. WIFO-Monographie, July 2014.

⁸⁴ Recommendation for a Council Recommendation on Austria's 2013 National Reform Programme, European Commission, COM (2013) 370 final.

⁸⁵ Austrian Council Recommendation Regarding a National Strategy for Intellectual Property, 6 June 2013; Austrian Council Recommendation Regarding RTI-Related Start-up Activities, 19 November 2012; Austrian Council Recommendations regarding the efficient translation of research results into innovations, the creation of suitable framework conditions for private equity in Austria, and the introduction of an investment allowance (all from 24 November 2011).

cellence of university research or the efficiency and effectiveness of the IPR system and research funding (see the relevant recommendations in this regard).

The Austrian Council recommends developing an overall concept with sustainable framework conditions which support a more “radical” concept of innovation.

This includes the willingness of the agencies to take on greater risk when funding such high-risk ventures. This should include the testing of alternative funding allocation models, which implies adapting the relevant criteria and mechanisms when evaluating projects.⁸⁶ In addition, it is necessary to improve the relevant incentive structures at governance level.⁸⁷

Cooperation Between Business and Science

The Austrian Council recommends evaluating the existing funding lines for the proof of concept phase in terms of their applicability and efficiency and reviewing the responsibilities of the funding agencies for these programmes in relation to the reform of RTI governance.⁸⁸

The Austrian Council recommends monitoring the impact of the BMWWF programme *Knowledge Transfer Centres and Exploitation of IPR* (in particular Modules 2 and 3 to aid patenting and prototyping), which backs up the AWS patent service, and where necessary, adapting it accordingly.

The Austrian Council recommends swift completion of the process of developing a national IP strategy which commenced in 2014. This is based on a recommendation put forward by the Austrian Council on 6 June 2013 and is being

jointly driven forward by the BMVIT and BMWWF with the involvement of all relevant stakeholders. The development of an IP strategy for Austria should also be linked to a national open access strategy. This should in particular include improving the provision of information regarding the protection of property rights pertaining to Austrian knowledge resources.

Start-ups and Venture Capital Financing

In view of its impact on Austria’s overall performance, the Austrian Council recommends the prioritisation of this area. For the implementation, please refer to the relevant individual Austrian Council recommendations.⁸⁹ In view of the current situation, particular attention should also be paid to the specific characteristics of service start-ups.

Absolute priority must be given to building a system for the robust data-based monitoring of RTI start-ups. The positive impacts of political measures and regulation on start-up activity can only be evaluated on the basis of detailed data. In this context, the Austrian Council welcomes Austria’s participation in the Global Entrepreneurship Monitor (GEM) 2014 and above all, the introduction of an additional RTI module and discussion of the options for genuine data-based monitoring of such RTI-related start-ups within the working groups Knowledge Transfer and Start-ups of the RTI Task Force. The business start-up strategy planned by the working group cannot be implemented until the question of data has been resolved.

The goal must therefore be to increase the flow of funding to early-stage companies, and to bet-

⁸⁶ Austrian Council Recommendation Regarding the Efficient Translation of Research Results into Innovation, 24. November 2011.

⁸⁷ Cf. Austrian Council for Research and Technology Development (2013): *Weißbuch zur Steuerung von Forschung, Technologie und Innovation*, p. 21.

⁸⁸ Austrian Council Recommendation Regarding Optimised Proof of Concept Support for Knowledge Transfer, 3 December 2013; Austrian Council for Research and Technology Development, *Weißbuch zur Steuerung von Forschung, Technologie und Innovation*, p. 18 ff.

⁸⁹ Austrian Council Recommendation Regarding the Amendment of the Alternative Investment Fund Manager Act (AIFMG), 6 March 2014; Austrian Council Recommendation Regarding RTI-Related Start-up Activities, 19 November 2012, Austrian Council recommendations regarding the efficient translation of research results into innovation, the creation of suitable framework conditions for private equity in Austria, and the introduction of an investment allowance (all from 24 November 2011).

ter establish equity capital financing in the early stages of developing a company while simultaneously raising awareness for this issue among the general public.

To further increase the venture capital intensity of the private sector and to compensate for the weakness of the venture capital market, other instruments should also be considered. This might include tax concessions for investment in new companies, something that also involves improving the basic statutory provisions applicable in these areas. From 2015/2016 Horizon 2020 calls will increasingly support measures designed to boost risk financing and to assist innovative SMEs. The Austrian Council recommends that the competent authorities and agencies publicise these calls to a greater extent to increase the level of Austrian participation in such European programmes.

The Austrian Council recommends that new forms of financing should be developed for innovative young entrepreneurs and SMEs in addition to bank finance. Thus crowdfunding, including peer-to-peer lending and crowd investing should be encouraged as a supplementary form of financing within an effective and efficient legal framework and should be incorporated into a competitive overall strategy for corporate growth. In this context, the Austrian Council welcomes the latest crowdfunding initiatives of the BMFWF agreed at the Federal Government's closed-door conference, and in particular, the Alternative Financing Act. In addition, consideration should be given to introducing a tax allowance for business angels to increase equity investments and to reduce ancillary wage

costs for start-ups and companies engaged in research. In addition to this, the Austrian Council backs innovative funding models, which fund guarantees in conventional early-phase programmes.

The Austrian Council recommends extending the powers of the WKO service centres for start-ups.

The Austrian Council recommends the ongoing improvement of appropriate framework conditions to encourage start-up activity in the knowledge- and technology-intensive sector. The optimisation and further development of the "GmbH light" must be treated as a priority.

The Austrian Council again recommends examining whether international models of tax concessions can be applied to early-stage knowledge- and technology-based companies in Austria. A differentiation in the research premium with higher percentages for early-stage and small innovative companies should therefore be considered and, if and where necessary, developed and implemented in detail. Overall there is a need to consider additional tax concessions geared specifically to the innovative content and research performance of start-ups and early-stage businesses.

Promote Innovation Through Competition

The Austrian Council recommends a further strengthening of the resources of the competition authorities. In addition, the Austrian Council recommends beginning with the systematic sector-specific analyses to identify barriers to innovation announced in the RTI strategy.

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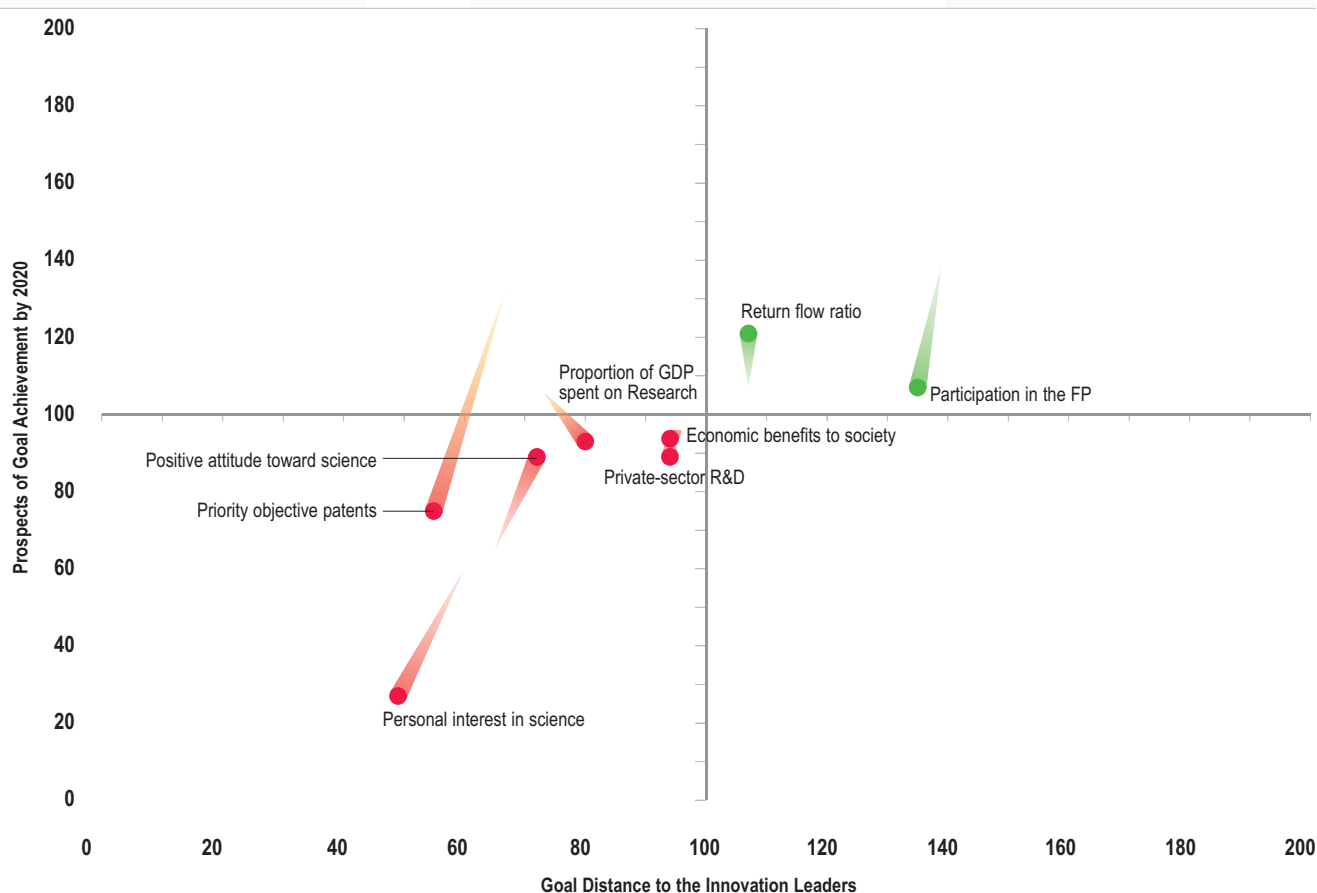
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Political Governance of the RTI System

Chapter 5 of the RTI strategy addresses a number of questions on the issues of governance, the funding system and dialogue between science and society. The strategic objectives are based on carefully considered and to some extent very critical findings, which – halfway through the time horizon for implementation – remain highly relevant. In terms of policy and administration, the ambition to catch up with the in-

novation leaders should be supported with clear mechanisms and a transparent system. Efficient and targeted governance is more important now than ever before. At the time the strategy was drawn up, the economic crisis was still palpable; there was, however, the strong conviction that significantly more financial resources would be invested in the RTI sector in the future. From today's perspective, this hope has not been realised. The current budgeting

Figure 17: Goal Distance and Prospect of Goal Achievement in the Area of Political Governance, 2010-2015



Sources: see Appendix 1, WIFO presentation. Raw Data: see Appendix 2. Explanation: see Appendix 3.

Note: Goal Distance=Austria's actual value relative to the Innovation Leaders' actual value (average value most recently available year DE, DK, FI, SE); Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020.

approach generally limits itself to an updating of budgets without significant increases. This national budget situation is unlikely to change in the near future and so little scope for increasing RTI budgets is to be expected. However, it should also be noted that private-sector R&D financing will have to make a significantly higher contribution in the future.

In this situation, an increase in output at research institutions can usually only be achieved through greater efficiency or the use of synergy effects. However, it is still possible to increase the impact of research, technology and innovation on the economy and society, even with a constant level of funding, provided support is focused solely on the best projects in companies and at universities, for example through the increased competitive allocation of funds. Efficient and effective RTI governance will therefore have to serve as a key lever for increasing output for the foreseeable future.

As only a small number of indicators are available for monitoring the extent to which the objectives in this chapter of the RTI strategy have been achieved, the assessment of goal attainment is based more strongly on quality criteria than in previous years. For those areas where indicators are available, Figure 17 provides an overview of the developments since 2010. In general terms, it is evident that the change in Austria's performance has been negligible.

Figure 17 clearly shows that both participation in

the EU Research Framework Programme and the return flow ratios have been above average for the past five years. Despite a downward trend in participation in the Framework Programmes, as matters stand it is expected that Austria will be able to retain its top position in comparison to the leading countries in 2020.

In the case of indicators associated with Austrian attitudes to science and research, however, the downward trend prevails. Despite improvements in individual areas, insufficient development momentum means there is no prospect of achieving the relevant objectives by 2020.

In the area of R&D financing, the momentum has clearly diminished, suggesting that the target for spending on research and development as a percentage of GDP cannot be achieved. R&D financing is discussed in detail in the chapter entitled "Financing of Research, Technology and Innovation".

The comparison to previous years shows that Austria's performance in relation to goal achievement in the area of political governance has remained more or less constant for the past five years. In its mid-term review, the Austrian Council therefore came to the conclusion that the RTI strategy measures are not being implemented with sufficient intensity to achieve the objectives in the area of political governance by the year 2020.

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Governance Structures

The RTI strategy points decidedly towards "compartmentalised and fragmented policy structures", which result in the unclear distribution of competences and responsibilities in the domestic RTI system.⁹⁰ The respective objectives of the RTI strategy address the problem areas outlined in the findings. In its white paper on steering research, technology and innovation in Austria, the Austrian Council presented an initial interim report on the status quo of governance structures two and

a half years after the adoption of the RTI strategy.⁹¹ In the Austrian Council's view, the suggestions included in this paper for optimising the efficiency of RTI governance in Austria remain prerequisites for achieving the innovation leadership envisaged by the Austrian Government.

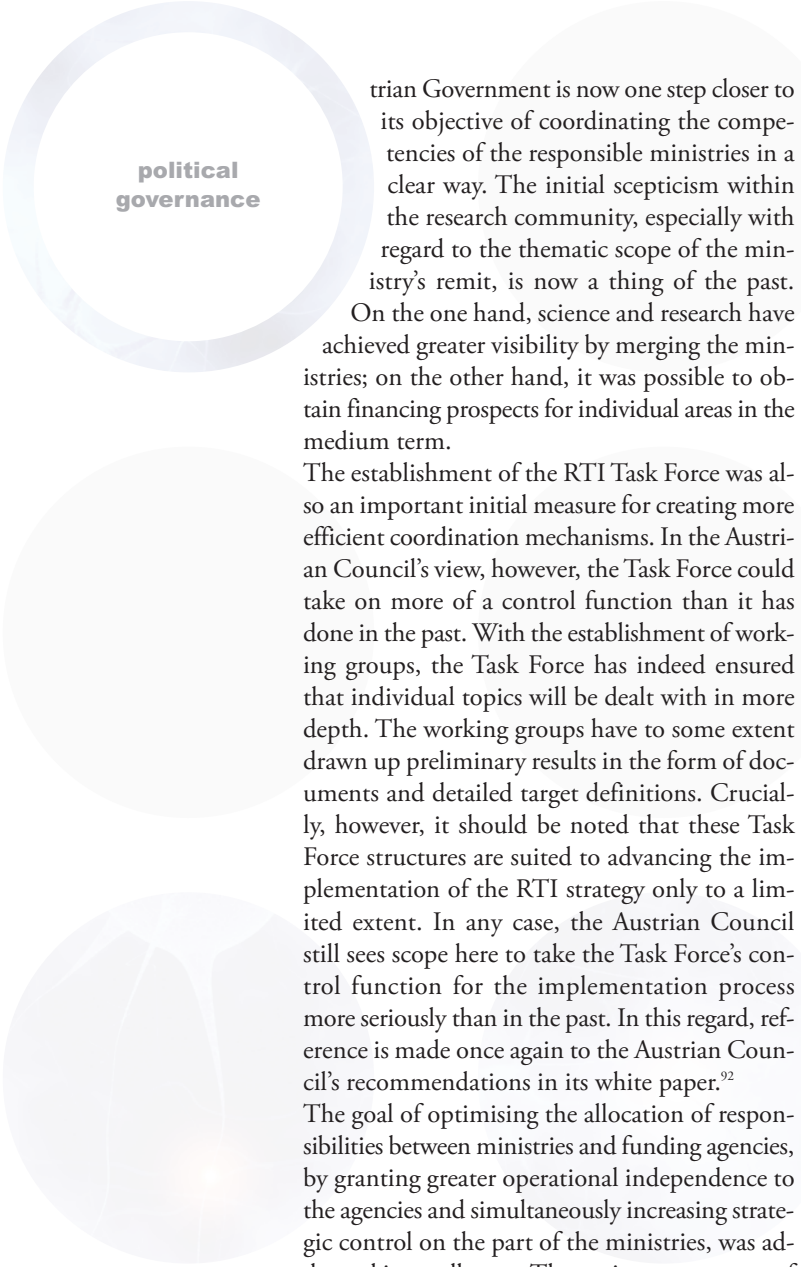
The creation of the BMWWF, which took place at the end of 2013, made it possible to bring together the areas of science, research and economic affairs in a single ministry. As a result, the Aus-

RTI Strategy Objectives

- We want to coordinate the competencies of the responsible ministries in a clear way. To do this, efficient co-ordination mechanisms should be established among the responsible ministries.
- Task distribution among the ministries and funding agencies should be optimised by granting higher operational independence to the agencies and simultaneously strengthening strategic management by the ministries.
- At the funding agency level, task administration should be tidied up to remove duplicate efforts.
- The system's effectiveness and intelligence should be increased by augmented management of objectives and outputs.

⁹⁰ RTI Strategy of the Austrian Federal Government, p. 32f.

⁹¹ Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation.



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trian Government is now one step closer to its objective of coordinating the competencies of the responsible ministries in a clear way. The initial scepticism within the research community, especially with regard to the thematic scope of the ministry's remit, is now a thing of the past.

On the one hand, science and research have achieved greater visibility by merging the ministries; on the other hand, it was possible to obtain financing prospects for individual areas in the medium term.

The establishment of the RTI Task Force was also an important initial measure for creating more efficient coordination mechanisms. In the Austrian Council's view, however, the Task Force could take on more of a control function than it has done in the past. With the establishment of working groups, the Task Force has indeed ensured that individual topics will be dealt with in more depth. The working groups have to some extent drawn up preliminary results in the form of documents and detailed target definitions. Crucially, however, it should be noted that these Task Force structures are suited to advancing the implementation of the RTI strategy only to a limited extent. In any case, the Austrian Council still sees scope here to take the Task Force's control function for the implementation process more seriously than in the past. In this regard, reference is made once again to the Austrian Council's recommendations in its white paper.⁹²

The goal of optimising the allocation of responsibilities between ministries and funding agencies, by granting greater operational independence to the agencies and simultaneously increasing strategic control on the part of the ministries, was addressed in small steps. The topic management of

the BMVIT and the FFG, made it possible for example to initiate the targeted alignment and joint development of the thematic focus. However, in the area of funding agencies the problem of unnecessary duplications persists, as individual structures are encountered multiple times, without any potential synergies being used. Particularly at the interface between innovation and market entry, a very similar target group is being addressed by both the FFG and the AWS.

The implementation of topic management will also address the objective of increasing "system effectiveness and system intelligence through increased target and output control on the part of the funding agencies within the framework of performance agreements". If one considers the historical development of the funding system, it becomes apparent that significant improvements have been made in the past. However, there is still an area of tension in respect of the competencies of the agencies and their parent ministries.⁹³ The federal administration's performance-oriented approach – which has been in place since 2013 – may hinder a joint approach by the ministries, as it brings about a fine-tuning of each ministry's own mechanisms rather than the creation of inter-departmental synergies with the aim of improving output. The Austrian Council also made concrete recommendations in this regard in its white paper on steering research, technology and innovation.⁹⁴

With regard to the Climate and Energy Fund (KLI.EN), the Austrian Council is also of the opinion that there is still a need to review the KLI.EN agenda in respect of its effectiveness.⁹⁵ There has not yet been an in-depth analysis in this regard, nor has any improvement to the current situation been attempted.

⁹² Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p.22.

⁹³ Pichler, R. (2014): Delegierte Koordination. Zur Koordinationsfunktion intermediärer Organisationen in der österreichischen Forschungsförderung; Vol. 43, No. 4, pp. 329-346.

⁹⁴ Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 18f, 20f.

⁹⁵ Cf. Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p.19.

Setting Priorities

The “Priority Objective Patents” indicator used to measure goal attainment (see Figure 17) shows that inventive activity in those areas of technology which are important for overcoming societal challenges remains well below that of the innovation leaders. The distance to the goal has increased gradually since 2010, while at the same time development momentum has deteriorated rapidly. As matters stand therefore, there is no realistic prospect of achieving the target by 2020. This is predominantly due to the fact that the number of such patent registrations in Austria has declined. A more detailed root cause analysis for the declining trend would certainly be advisable in the opinion of the Austrian Council.

As the RTI strategy explained in detail, where there is a scarcity of financial resources the focus must be placed on certain key topics. The European Union has defined these as its “Grand Challenges” and implemented them as thematic priorities in its programmes. Austria, too, is faced with the challenge of moving away from certain areas of its existing thematic spectrum, which receive little international recognition, and to succeed on an international level by specialising in niche segments. Consequently, the RTI strategy aims to promote inter-departmental cooperation.

In this respect, the relevant units in the domestic research landscape are in the first instance the responsible departments of the BMVIT and BMWWF. At present, a focused orientation of the funding supply is especially to be found in thematic programmes for applied research. The programmes of the FFG and AWS are well targeted at national and European social challenges. In the field of basic research, the FWF focus on excellence has developed a thematically open funding logic which is also well suited in this context. The activities of the ministries responsible for research (BMWWF and BMVIT), together with a cross-department prioritisation, are characterised by highly advanced coordination processes, however. Having said that, the interfaces to other ministries and strategic measures that have research relevance,

are only selectively well developed. The members represented on the Task Force profit from the cooperation, whilst the distance to other actors who are not included is increasing. However, the limitation of prioritisation to national funding agencies and to ministries responsible for research is inadequate, since relevant funding structures at regional level, which are mainly financed by European Regional Development funds – are far more extensive. Although Smart Specialisation has paved the way to a holistic view of regional innovation systems, the comprehensive alignment of all relevant strategic documents requires a much higher degree of coordination. The process of coordinating these instruments with one another is, however, developing altogether very positively – even if optimum conditions for the RTI system have not yet been achieved.

An example of stronger networking is the field of primary production, i.e. agricultural and forestry products, for which the Ministry of Agriculture holds responsibility. A series of projects has been proposed within the framework of Smart Specialisation, in which regionally focused priorities are defined as part of the partnership agreement (STRAT.AT 2020), under which the common national thematic objectives and priorities for cohesion policy and for rural development and fisheries policy have been formulated. The European Structural and Investment Funds (“ESI funds”) are:

- EAFRD/European Agricultural Fund for Rural Development
- ERDF/European Regional Development Fund,
- ESF/European Social Fund,
- EMFF/European Maritime and Fisheries Fund and CF/Cohesion Fund.

In the case of the Fund for Rural Development (EAFRD), almost 4 billion euros will flow into rural areas over the coming financing period up until 2020, of which up to five percent may be allocated for innovation. However, since no explicit objectives have been defined for this portion of the fund, this budget could also be con-

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RTI Strategy Objectives

- We want to strengthen Austria's competitiveness in a wide range of cross-cutting fields in science and technology by focussing activities on units of internationally competitive size. To do this, fields in which domestic science and business are strong should be taken into account. Special attention must be paid to the competences and potentials of Austrian firms that can help implement research results for overcoming the Grand Challenges.
- Priorities in research and technology development should be set on the basis of systematic selection and decision-making processes. While doing so we must make sure that governmental priorities are sufficiently justified to prevent market or system failure.
- The definition of new priorities for specific challenges should lead to a concerted coordination of activities in a comprehensive system approach by all concerned ministries in the context of the Research, Technology and Innovation Task Force.
- To address the great societal challenges (Grand Challenges) of the future comprehensive system priorities must be established.
- Priorities should be defined on the basis of preliminary analyses, their effects should be limited in time, and they should be monitored.



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sidered for use in innovation. That said, there is no planning certainty with regard to the scope for innovation. If we assume as a basis the unlikely event that this framework will be explored to its full potential, this would mean that around 190 million euros would flow into the innovation system by 2020. There does not appear to be any coordination with the existing climate, energy and environmental research programmes as regards content. On the basis of this example, it should be considered how the prioritisation could be handled on a cross-ministry basis, at least when it comes to the Grand Challenges of *Climate Change* (EAFRD, ERDF), *Resources* (ERDF) and *Quality of Life and Demographic Change* (ESF) referred to in the measures of the RTI strategy. This would make it pos-

International Positioning

The domestic RTI system is still well-positioned internationally, however, the framework conditions are becoming increasingly challenging. The establishment and continuation of various missions in the international environment strengthens the domestic position and represents an important bridgehead for cooperation of all kinds.

Internationalisation is a broad field of action for the implementation of the RTI strategy. Firstly, the European Union and its research policy are crucial for Austria and have a significant influence on the Austrian RTI landscape. From a global perspective though, numerous regions outside Europe have started or indeed have completed a rapid catch-up process. The developments in the Asian region in particular should be taken into account in this context. This has already been described in the RTI strategy in this form and is reflected in the Task Force in the form of two working groups (7a “Internationalisation and RTI Foreign Policy” and 7b “Austria and the European Research and Innovation Area 2020”).

The EU’s Research Framework Programme (Horizon 2020) was launched in early 2014 and will run until 2020, and is based on the same time horizon as the RTI strategy. At the time the strategy was drawn up, the content of the Euro-

sible to set priorities for research and innovation in the social sector, although this would require intensive cooperation and coordination between the research community and the BMASK during implementation.

In accordance with the objectives of the RTI strategy, the Austrian Council suggests involving representatives from other ministries and from provincial governments in regular dialogue on research needs and inter-ministerial RTI priorities. At present, there is no such coordinating body that meets on a regular basis. There are a number of dialogue platforms which have already been established in sub-areas which would lend themselves to this purpose. The Task Force should carry out an analysis to determine which ones would be suitable for this purpose.

pean programme was not yet clear. Although the strategy defined a high level of Austrian participation in the programme and a further increase in the returns ratio as goals, it did not say which specific measures might be implemented to achieve them.

In the now completed 7th Framework Programme, Austrian participants had generally been able to position themselves very well. In comparison with the leading innovation nations, Austria enjoyed above-average success measured both in terms of its participation in the Framework Programme and by the flow of return funds. In both these areas, Austria has already achieved the target of the RTI Strategy, as demonstrated in Figure 17 by the “Returns Ratio” and “Participation in the Framework Programme” indicators. With regard to the remaining period up to 2020, however, it has to be said that there is no nominal increase in funds compared to the 7th Framework Programme and the individual thematic areas receive less money. Moreover, a further improvement in the quality of funding applications from the new member states is to be expected. This will noticeably intensify competition, so that Austria will only be able to maintain its successful participation rate and returns ratio if it makes massive additional efforts.

It can be assumed that this trend will continue in years to come, something that in the foreseeable future could threaten the prospects of achieving the goal, which at present are still intact. In this context, the RTI strategy measure for developing cooperation strategies is of crucial importance. The scientific relevance of Central and Eastern European countries is very high and, in terms of optimal positioning within the European Knowledge Area, Austria may have a formative role to play. However, this requires an increased Austrian presence in the bodies at European level. In this regard there is still considerable potential for influence in many areas.⁹⁶ A structured approach to work on such bodies and the financial compensation for these services – unless performed by civil servants in the public sector – would have to be taken into account in terms of planning and budgets. As at the European level, scientific diplomacy in other regions is also hugely important for the domestic innovation system and a key success factor in the initiation of collaborations. The two offices in Washington DC and Beijing (Office of Science and Technology Austria – OSTA) are important outposts in those regions where partnerships are sought. This kind of support should also be set up in the other regions where Austria has plans for strategic cooperation (Brazil, Russia and India and in Southeast and Eastern Europe). A region's po-

tential for future cooperation should be analysed in advance and new offices prioritised on the basis of the results thereof. In this context, it is important to take existing cooperation relationships into consideration.⁹⁷ Continued progress and adequate staffing should be ensured in the long-term both for existing facilities and for newly created offices. As in past reports on Austria's scientific and technological capability, the Austrian Council clearly supports an expansion of missions, provided there is a long-term, strategic perspective for the selected target countries.

Membership in international research infrastructures is not a subject covered in the RTI strategy, even though such infrastructure plays a key role in, international cooperation and enjoys high levels of recognition amongst the general population, as demonstrated by CERN, for example. For a small country like Austria, memberships of international research infrastructures are extremely important to ensure close links with top international researchers.⁹⁸ The Austrian Council therefore recommends putting suitable structures and programmes in place to strengthen Austria's position as a research location and to make it a more attractive centre for international researchers than it is at present.

political governance

Funding System

The funding system is described in the RTI strategy as a “wide range of options” for the creation of framework conditions and incentives.⁹⁹ This finding is generally correct and the domestic funding landscape is indeed well dif-

ferentiated. However, we must also concur wholeheartedly with the further findings of the RTI strategy with regard to the “over reliance on programmes” discussed therein. The first half of the implementation period for the strategy was

RTI Strategy Objectives

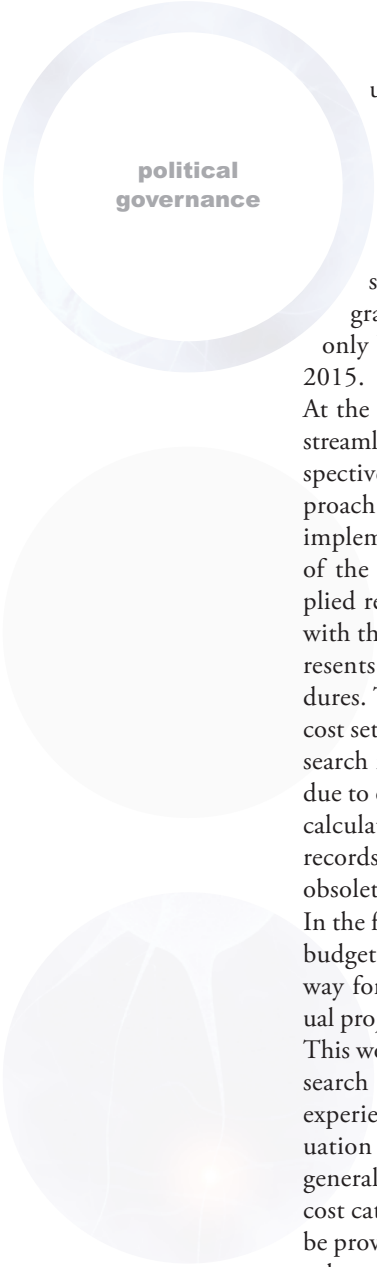
- We want to establish an overall policy approach in the funding system that applies the most efficient bundle of measures in a coordinated way in each context.
- Direct research funding should be further developed as regards the use of an adequate mix of instruments.
- The regulatory basis for research funding should be streamlined.
- The principle of competition-based allocation should be strengthened.

⁹⁶ Data available at <http://ec.europa.eu/programmes/horizon2020/en/experts>

⁹⁷ In the 1990s, the Ministry of Science began operating Austrian Science and Research Liaison Offices in the Czech Republic, Hungary, Slovakia, Bulgaria and Slovenia with a regional focus on the Western Balkans; these were gradually phased out by 2011 due to intensified bilateral and in particular multilateral cooperation relationships.

⁹⁸ See, for example, BMVIT, BMWF, BMWFJ, BMEIA (2013): Beyond Europe – Die Internationalisierung Österreichs in Forschung, Technologie und Innovation über Europa hinaus; Recommendations of the Working Group 7a to the RTI Task Force of the Austrian Federal Government, p. 12f.

⁹⁹ RTI Strategy of the Austrian Federal Government, p. 38.



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unable to bring about any significant simplifications here, despite welcome attempts in individual areas. Due to changes at the European level, in particular as a result of the adoption of the new Framework Programme and the associated adaptation of the legal basis, a gradual improvement of the situation has only been foreseeable since the beginning of 2015.

At the time of reporting, steps to significantly streamline the policies and guidelines for the respective instruments and to harmonise the approach were in preparation or just about to be implemented. The harmonisation by the FFG of the rules concerning general costs for applied research projects to bring them into line with the conditions of Horizon 2020 thus represents a substantial simplification of procedures. To what extent the elimination of a full cost settlement would bring about losses for research institutions cannot yet be clearly stated due to other adjustments. At any rate, complex calculation models and the keeping of detailed records for verification purposes will become obsolete with the new flat-rates.

In the field of basic research, however, the tense budgetary situation at the FWF is paving the way for the axing of general costs for individual projects and the PEEK funding programme. This would send a very negative signal to the research institutions, which have only recently experienced a slight easing of the financial situation as a result of the FWF reintroducing general costs for these projects. As with other cost categories, funding recipients must always be provided at the outset of the project with legal security as regards the award of the calculated costs.

As matters stand, a modern and homogeneous regulatory framework for research funding, as described in the RTI strategy, has not yet been established, all the more so, as as the involvement of the provinces and their regional funding instruments is an essential aspect for the fulfilment of the objective. Organisationally, this remains a very complex task.

The generally stagnant programme budgets are

a fundamental weakness. In the field of direct applied research funding, this also reduces the opportunities for public authorities to use targeted incentives to actively promote technology-based solutions to societal challenges such as climate change and an aging population. Moreover, this makes the prospect of achieving the 2020 target of spending 3.76 percent of GDP on research increasingly unrealistic. The private sector share of general spending on R&D has stagnated since the crisis and the public sector has been unable to compensate for this. Improvements in Foundation law and the provision of legal security for crowd-financing could bring about some improvement in conditions in the near future. The proposed change to tax incentives in the strategy has already been implemented and the recognition of research premiums by the FFG has, after initial concerns about the administrative burden, proved extremely useful. In the Austrian Council's view, in addition to tax incentives, the budget for direct applied research funding should be increased on a yearly basis, not least because inflation and GDP growth result in stagnant programme budgets, which in effect lower the percentage of GDP being spent on research and development. The subject of research funding is discussed in greater detail in the chapter entitled "Financing of Research, Technology and Innovation".

The development of "Matching Funds" is to be viewed positively. Under this scheme, project proposals which were evaluated and found to be worthy of funding, but which could not be funded for budgetary reasons, are forwarded to the applicant's home province and, where appropriate, financed there using regional funds. This process has the advantage that no further evaluation is required and applicants receive an alternative financing option relatively promptly, eliminating the need for resubmission in the next call. This model is already being implemented in cooperation with the federal funding agencies in a number of Austrian provinces and has been welcomed by all stakeholders. In its recommendations on the allocation of funds from the National Foundation, the Austrian

Council proposed allocating more Foundation funds for this purpose.¹⁰⁰ The National Foundation, however, should show a guaranteed minimum pay-out to ensure long-term predictable budgeting.

In recent years, the Austrian Council – in cooperation with other bodies at national and regional level – has closely examined the European Regional Development Fund (ERDF) with a

view to optimising the administrative burden and providing a transparent basis for project appraisals.¹⁰¹ In the past, increased awareness could only be created through dialogue. However, no structural changes which would actually have an effect on the research system, are currently envisaged.

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Research and Society

The publication of the Eurobarometer data last year painted a rather sobering picture. The already unsatisfactory result from 2010 continued to deteriorate.¹⁰² As Figure 17 shows, two of the three indicators on Austrian attitudes to science and research – “Economic Benefits of Science to Society” and “Personal Interest in Science” – are experiencing a downward trend. This finding is also corroborated by the action plan of the BMWWF, which recognised the need for a turnaround.¹⁰³ Although there is no up-to-date data for the last two years, it can be assumed from this finding that no significant change in the situation has taken place and that the measures referred to in the action plan will only take effect in the long-term. All the relevant indicators are thus well below the target set for 2020 – and current development trends are not likely to bring about any substantial turnaround in the medium term.

The relevant chapter of the RTI strategy appeals to both the scientific community to show greater willingness to participate in dialogue and to society to take on board its responsibility to engage

more with science. All findings suggest, however, that neither side has much ambition to comply with these requests. Some research institutions have indeed recognised that actively presenting their research results can deliver positive effects in terms of acceptance and awareness and can, in fact, make a valuable substantive contribution to their work. The reflection process in response to questions asked by outsiders is the easiest part of the participation. The public can also take on an active role in the form of increased involvement and by taking on research tasks. Striking examples of this include the generation and analysis of data, which it would not be possible for researchers to tackle alone due to the effort and expense involved. Highly dedicated laymen often make significant contributions in this regard, and generally without receiving anything in return. The “Citizen Science” Coordination Office announced in the BMWWF action plan for 2015 has the opportunity to make a significant contribution to stepping up these activities and will have a wide scope of activity in the current research landscape.¹⁰⁴ Platforms such as the

RTI Strategy Objectives

- *We want a culture of appreciation for research, technology, and innovation, and to promote an understanding of how this field makes an essential contribution to increasing the quality of life and societal prosperity.*
- *To do this, we must establish a stable infrastructural environment for multiple forms of dialogue between science and society, along the lines of a “scientific citizenship”.*
- *Responsibility and integrity in science should be strengthened via institutional processes.*

¹⁰⁰ Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation p. 21 as well as annual individual recommendations to the National Foundation (<http://www.rat-fte.at/einzelempfehlungen.html>)

¹⁰¹ Recommendation of the Austrian Council for Research and Technology Development Regarding the Simplification of Research Funding – in Particular Structural Funds (European Regional Development Fund), 3 December 2013

¹⁰² EU Commission (2013): Special Eurobarometer 401: Responsible Research and Innovation (RRI), Science and Technology, p. 16.

¹⁰³ BMWWF (2015): Action plan for a competitive research area: Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas, p. 25ff.

¹⁰⁴ BMWWF (2015): Action plan for a competitive research area: Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas, p. 31.

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German Sciencestarter initiative can be used for orientation.¹⁰⁵

The majority of research institutions, however, have not yet opened themselves, and dialogue takes place only within the scientific community. The reasons for this are manifold, ranging from the complex subject matter, which the institutions do not wish to inflict on laymen, through to the high time demands on staff who do not see themselves as in a position to take on even more of these tasks. According to the action plan, the Responsible Science alliance between research institutions and the BMWFW should bring about a change in culture in this regard.¹⁰⁶ The Austrian Council sees this as a welcome measure, whereby the activities to be observed at European level (RRI) should definitely be taken into account.¹⁰⁷

On the part of the population, it is evident that a small proportion of citizens already interested in research are seriously addressing the issues, and that the offer of scientific communication has been well received. It might reasonably be assumed that, as a rule, information appeals to a social stratum that is already interested in and familiar with science and research, while the majority of the population is more disinterested and is content to say, “Science is not for me”. Those who are educationally disadvantaged or who have little or no interest in research are not being addressed using low-threshold content and thus have no knowledge of what is on offer. Appealing to those who cannot be reached is difficult. A concept for reducing reservations around the subject of science and research is urgently needed. Mention can be made here of the

“culture of appreciation” for science, technology and innovation called for by the RTI strategy, for which appropriate measures need to be taken to promote dialogue more intensively and more systematically than in the past.¹⁰⁸

The huge success of the Long Night of Research and the popularity of initiatives such as “Kinderuniversität”, “Sparkling Science” and “Jugend Innovativ” show, however, that there is basically potential here. However, many of the formats for scientific communication that are well accepted among the general public have the common problem that continuous financial coverage is not provided and that the budgets must be laboriously negotiated and justified from one date to the next. The ministries should focus on ensuring optimal conditions and creating maximum awareness for these formats citing the corresponding objectives and measures set out in the RTI strategy.¹⁰⁹ Even just the rapid implementation and long-term safeguarding of the measures set out in the strategy would represent an important development and could serve as the foundation for individual activities. Existing funding instruments for the targeted support of science communication, such as the FWF’s “WissKomm” programme at the federal level or the Vienna Business Agency’s “COMMUNICATION and TECHNOLOGY-AWARENESS” programme at the regional level, are consistently successful and effective. For this reason, the Austrian Council will invite the ministries and agencies involved in these programmes to explore the options for intensifying such initiatives – for example, how such instruments could be developed and expanded under the National Foundation. In view of the sched-

¹⁰⁵ <https://www.sciencestarter.de/home.html>

¹⁰⁶ BMWFW (2015): Action plan for a competitive research area: Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas, p. 29.

¹⁰⁷ <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

¹⁰⁸ RTI Strategy of the Austrian Federal Government, p. 43.

¹⁰⁹ RTI Strategy of the Austrian Federal Government, p. 43.

ule set out in the BMWWF Action Plan, which aims to introduce a funding programme for this purpose in 2017, the timely start of preparatory activities is imperative.¹¹⁰

The Austrian Council draws attention to the important role of the media, whose commitment has steadily declined, at least in the case of the public service broadcaster. Between 2006 and 2009, science reporting on ORF – the Austrian Broadcasting Corporation – fell to nearly half its previous level, while the private channels ATV and Puls4 quadrupled their science reporting over the same period.¹¹¹

In the course of the “Draw a Scientist” project commissioned by the Austrian Council, in which children were asked to draw their image of a scientist, the majority of entries confirmed the stereotypes.¹¹² The results showed researchers

as (young) men with wiry hair – just like the image of Albert Einstein. It is therefore necessary to consider how the stereotype can be adjusted and brought back into line with reality, especially as misconceptions of research as a profession are rife even amongst the adult population. Implementing the measures laid down in the RTI strategy would contribute towards establishing research as a worthwhile career goal for a larger number of young people and towards making scientific work more attractive as a profession. The general population, on the other hand, should assume the responsibility for entering into a more intensive dialogue through scientific citizenship, and should take on an active role in research issues.

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Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy in the Area of Political Governance

Based on the preceding analysis of the goals of the RTI strategy and the indicator-based assessment of the extent to which these goals have been achieved, the Austrian Council recommends that particular attention be devoted to the following points:

Governance Structures

The Austrian Council recommends initiating an active and sweeping process of RTI policy reform with a view to moving ahead with the implementation of the strategy more decisively. This must be backed at the highest political level. To this end, the Austrian Council believes that an RTI reform agenda is required that should be led by the Federal Chancellery and implemented in co-operation with all those ministries with respon-

sibility for RTI. This agenda should be embedded in government plans and must contain politically binding, specific and quantifiable targets. These must form the basis for clear terms of reference for the RTI Task Force, which must in future play a more active role in steering the implementation of the RTI strategy.

With regard to the allocation of responsibilities between ministries and funding agencies, the

¹¹⁰ BMWWF (2015): Action plan for a competitive research area: Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas, p. 31.

¹¹¹ Woelke, J. (2010): Berichterstattung über Wissenschaft, Technologie, Forschung und Entwicklung in österreichischen Fernsehvollprogrammen. Study on behalf of the Austrian Council for Research and Technology Development.

¹¹² Thenius, C. / Gruber, S. (2014): Draw a Scientist – Wer macht Wissenschaft? Ein Science-Awareness-Projekt für Kinder. Study on behalf of the Austrian Council for Research and Technology Development.



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Austrian Council recommends further expanding topic management and reducing the duplications which continue to exist, particularly at the interface between innovation and market entry. The Austrian Council also recommends the vigorous implementation of its recommendations contained in the white paper on steering research, technology and innovation.¹¹³

Setting Priorities

The Austrian Council recommends an overarching national management of themes that has regard to the existing development potential and strengths that address the grand challenges. This should comprise a systematic and continuous procedure to evaluate existing priority areas and identify new ones, and should also include appropriate regional coordination. Overlaps and gaps should be avoided. Furthermore, there should also be coordination with other types of instruments such as open-topic and structural measures. A central aspect is the development of comprehensible criteria for identifying topics.

International Positioning

The Austrian Council recommends expanding support and consultancy activities to assist the domestic research community in connection with European programmes while also maintaining existing services. To promote networking and enable Austria to exert greater influence, suitable measures must be put in place to make working on European bodies and platforms more attractive to Austrian experts.

The Austrian Council also recommends putting international structures in place to attract shared research infrastructure with a view to strengthening Austria's position in European networks.

The Austrian Council reiterates its recommendation to selectively expand scientific missions

in countries which are of strategic importance for the domestic innovation system.

Funding System

As a supplement to the agreed rise in the research premium from 10 to 12 percent, the Austrian Council recommends that the budget for direct applied research funding should be increased on a yearly basis.

The Austrian Council recommends a detailed analysis of the thematic priorities in research funding and of funding recipients. The results of this analysis should then provide the basis for streamlining and bundling the agencies' portfolio.

The Austrian Council recommends making greater use of the National Foundation to supplement established instruments. To this end, an annual minimum payment should be defined that would permit budget planning for this purpose.

To encourage the private sector, and in particular, public benefactors to provide a greater proportion of research finance, the Austrian Council recommends an improvement in legal and fiscal framework conditions. For further information, please see the recommendations in the chapter Financing Research, Technology and Innovation.

The Austrian Council recommends that when drafting European law, the Austrian Government intervene in favour of research.

The Austrian Council reiterates the need to significantly simplify the administration of funding and in particular funding that is provided via the European Regional Development Fund (ERDF) to ensure a high level of legal certainty for applicants. The Austrian Council therefore recommends that the content of the reform agenda and the goals defined in the Government working programme be implemented as a matter of priority.

¹¹³ Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation.

Science and Society

Owing to the correlation between the extent to which people are informed about, and interested in, developments in science and research on the one hand and national innovation performance on the other, the Austrian Council recommends strengthening the dialogue between science and society. In the view of the Austrian Council, the positive effects that can be expected from this can work in both directions.

The Austrian Council recommends using young

researchers as testimonials for scientific careers and thus to combat negative clichés about science and research. Suitably practical career models are a prerequisite for achieving long-term positive changes.

The Austrian Council calls upon the media – in particular the media with a public service remit – to focus more strongly on science communication and to generate attractive, informative formats for the public.

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financing

Financing Research, Technology and Innovation

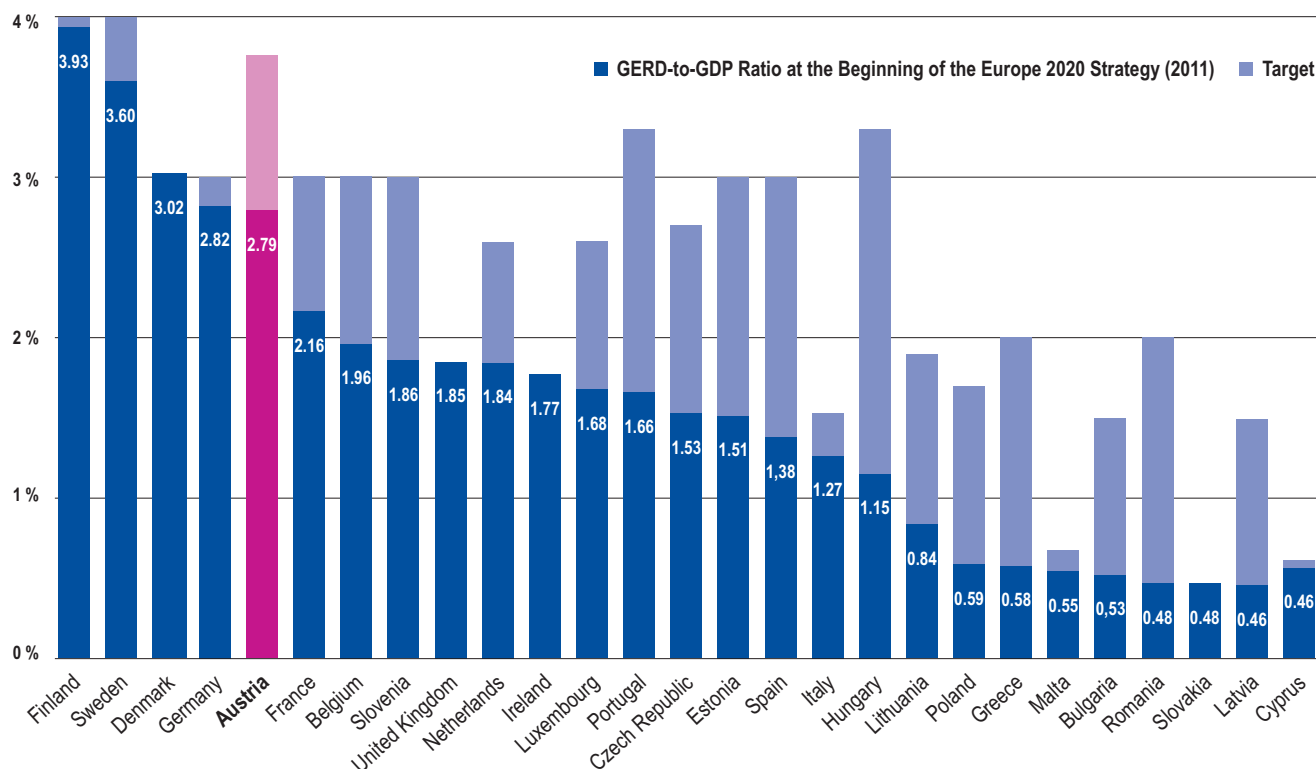
The provision of financing for research, technology and innovation is an essential prerequisite for achieving the goals defined in the RTI strategy. In this context, two targets are especially relevant: To increase the amount spent on research to 3.76 percent of GDP by 2020 (to the level of the innovation leaders) and to increase the share of private-sector funding to at least 66 percent, and if possible to 70 percent, of total R&D expenditure. As part of the Europe 2020 strategy almost all European countries have adopted national targets for spending on R&D as a percentage of GDP to be met by 2020. Figure 18 shows there was a marked divergence in levels of national ambition when these targets were set: among those coun-

tries that already spend a high percentage of GDP on R&D, Austria has committed itself to making the biggest increase, namely of one percentage point. The R&D target of 3.76 percent must therefore be regarded as ambitious. Viewed in the long term and in international comparison, the expenditure trajectory to achieve this goal has indeed been dynamic.

Figure 19 shows how spending on R&D as a percentage of GDP has developed in Austria compared to the leading innovation countries. Between 1995 and 2007 Austria boosted spending sharply. Compared to Austria, only South Korea recorded an even more marked increase in its GERD-to-GDP ratio.

This catch-up process is also reflected in the cu-

Figure 18: GERD-to-GDP Ratios 2011 and GERD-to-GDP Targets 2020 in an EU Comparison



Sources: Eurostat, WIFO Forschungsquotenziele.

mulative change in research intensity (see Figure 20), where Austria is in second place. This is an impressive development as notwithstanding rapid structural change toward knowledge-intense industries, Austria is still relatively strongly specialised in industries with medium knowledge-intensity; together with other factors, a country's industrial structure is a key determinant of its potential research intensity.¹¹⁴

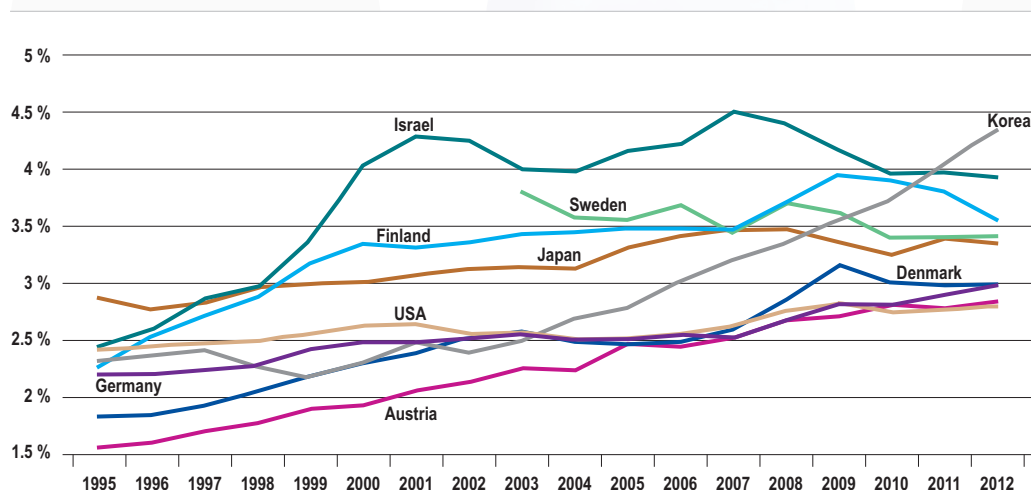
Yet as can be seen in Figure 17 (see the chapter Political Governance) the momentum for both financing indicators ("GERD-to-GDP Ratio", "private-sector R&D") has diminished when

viewed in light of the target year 2020. Although the distance to the goal of the indicator GERD-to-GDP has narrowed somewhat since 2010, the prospect of goal achievement is also significantly smaller than it was in 2010. This also becomes evident if the cumulative change in the GERD-to-GDP ratio from 1995-2012 is broken down into the sub-periods 1995-2007 and 2008-2012 (see Figure 21). While spending on R&D as a percentage of GDP grew by a very dynamic rate of 0.9 percentage points between 1995 and 2007, growth in the period

RTI Strategy Objectives

- We want to increase research intensity by one percentage point, from 2.76 percent to 3.76 percent of GDP, by 2020.
- Of this investment amount, at least 66 percent, but 70 percent if possible, should come from the private sector.
- Firms should be stimulated on a broad front (including an improved regulatory situation and sufficient incentive structures) to perform more research and innovation. The number of firms conducting research and development should be increased.
- Allocation of public funds should follow in line with the increased output and impact orientation of the innovation system.
- Innovation system actors should be guaranteed the greatest possible planning security.

Figure 19: GERD-to-GDP Ratios of Selected Countries, 1995-2012



Source: OECD.

¹¹⁴ Cf. Janger, J. (2013): Strukturwandel als Indikator für die Qualifikationsnachfrage der Wirtschaft, WIFO-Monatsberichte, 86(2), pp. 135–147; Reinstaller, A., Unterlass, F. (2012): Strukturwandel und Entwicklung der Forschungs- und Entwicklungsin-tensität im Unternehmenssektor in Österreich im internationalen Vergleich, WIFO-Monatsberichte, 85(8), pp. 641–655

¹¹⁵ The recently published Global Estimate for 2015 delivered a retrospective positive adjustment in the figures for corporate R&D financing, which grew at a faster rate than had been assumed in the global estimates for 2012-2014. As a result, and also because of significantly weaker GDP growth, spending on R&D as a percentage of GDP rose more significantly overall: based on the preliminary results, the Federal Government's target for 2010 of a GERD-to-GDP ratio of 3 percent has now been achieved in 2015. However, this improvement will not suffice to reach the 3.76 percent target in 2020. The figures should also be treated with caution, as they are based on the preliminary results of the R&D full survey for 2013 which has not yet been completed. The survey also shows that companies increasingly transferred external R&D spending (which, if abroad, is not included in the R&D survey) to internal spending. If this is the case, it is possible that R&D financing grew by less than the amount reported in the global estimate. Statistik Austria surmises that these effects might be linked to utilisation of the research premium.

financing

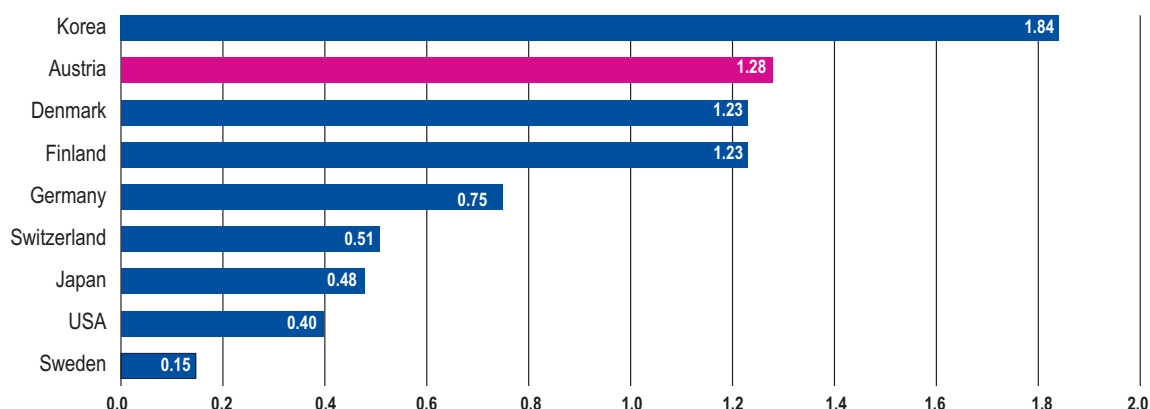
2008-2012 was almost stagnant at 0.2 percentage points.¹¹⁵

As far as the share of private-sector spending is concerned, both the distance to the goal and the prospect of achieving it are smaller than in 2010. Both indicators thus suggest that it will not be possible to achieve the objective in the RTI strategy. On the whole, this trend is a typical catching-up

phenomenon and can also be seen in developing economies: compared to advanced industrial nations, catching-up economies initially grow at faster rates; over time, however, the pace of GDP growth slows and converges with that of the highly-industrialised states.¹¹⁶

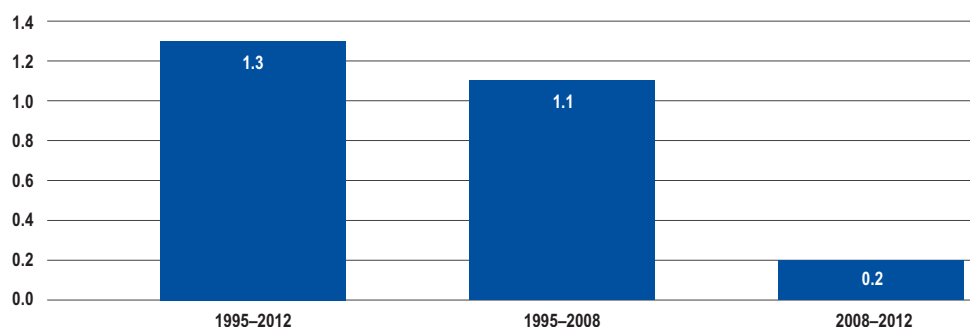
This observation is backed by the results of a recent study carried out by WIFO on behalf of the Austrian Council, in which the budget trajec-

Figure 20: Cumulative Change in the GERD-to-GDP Ratio in Percentage Points, 1995-2012



Source: OECD MSTI.

Figure 21: Change in Austria's GERD-to-GDP Ratio in Percentage Points



Source: OECD MSTI.

¹¹⁶ Cf. Keuschnigg, C. et al. (2014): Vision Österreich 2050 – Vorsprung durch Bildung, Forschung und Innovation. Holzhausen Verlag – Vienna, p. 40f.

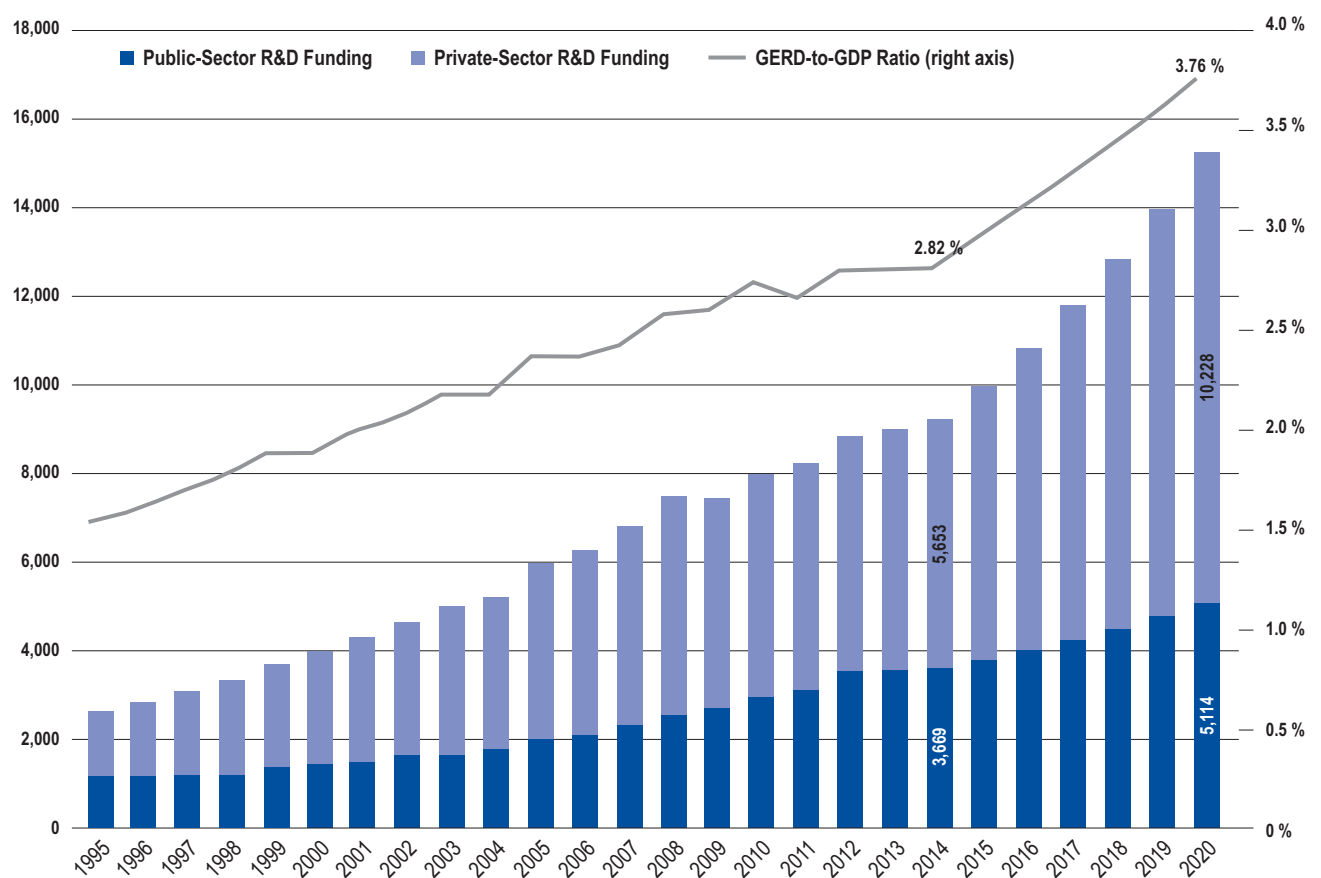
¹¹⁷ WIFO (2014): Forschungsquotenziele 2020. Study on behalf of the Austrian Council for Research and Technology Development.

ry required to achieve the 3.76 percent target was calculated in detail.¹¹⁷ As spending on R&D would have to rise from 9.32 billion euros at present to 15.34 billion euros in 2020 (see Figure 22), it is extremely unlikely that the GERD-to-GDP ratio target will be achieved by 2020. On the basis of two different scenarios (pessimistic/optimistic) WIFO concludes that in 2020 the GERD-to-GDP ratio will lie between 2.63 percent (pessimistic scenario) and 3.17 percent (optimistic scenario) (see Figure 23). The shortfall to the target figure for 2020 is put at roughly 2.4 billion euros (pessimistic scenario)

and 4.6 billion (optimistic scenario). Apart from the gap between the target and actual values in public R&D spending, it should be pointed out that first and foremost there will have to be a massive increase in the share of private-sector spending on R&D, if the 3.76 percent target is to be reached. The RTI strategy defines a target of 66 to 70 percent, as is already the case among the leading innovation nations (see Figure 24). Moreover, Figure 25 shows that in contrast to the trend in the leading innovation nations, the

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Figure 22: Trajectory of Funding to Achieve the Target GERD-to-GDP Ratio of 3.76 Percent in 2020 (in € mn.)



Source: WIFO Forschungsquotenziele 2020.

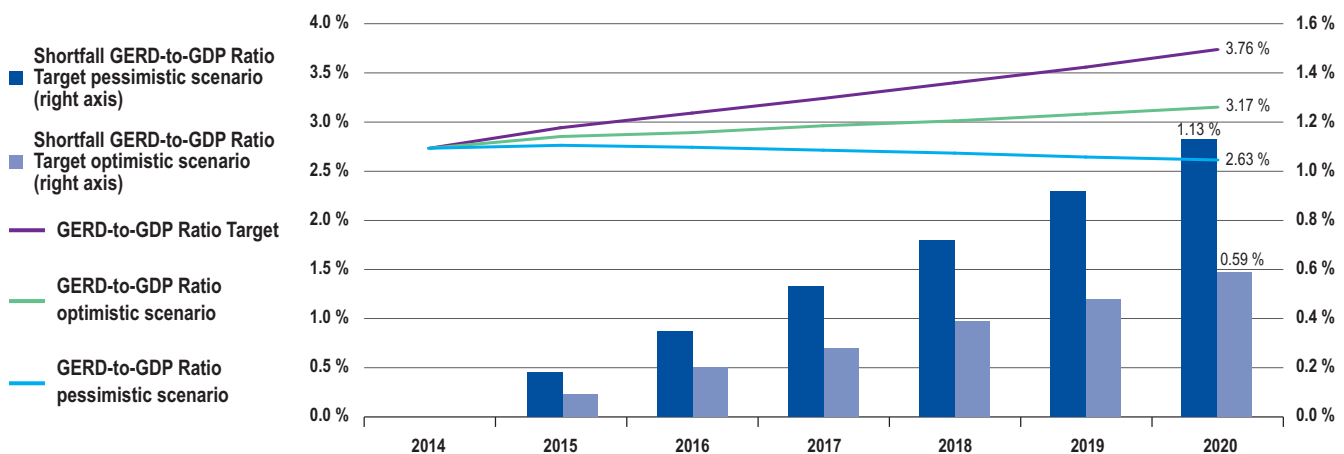
financing

share of private-sector R&D financing in Austria is declining steadily.

A key question, therefore, is what can be done to increase the proportion of private-sector R&D funding. An increase in the percentage of private-sector R&D spending can also serve as a measure of the success, or otherwise, of the many efforts to increase the productivity and leverage effect of public sector financing and the innovation system

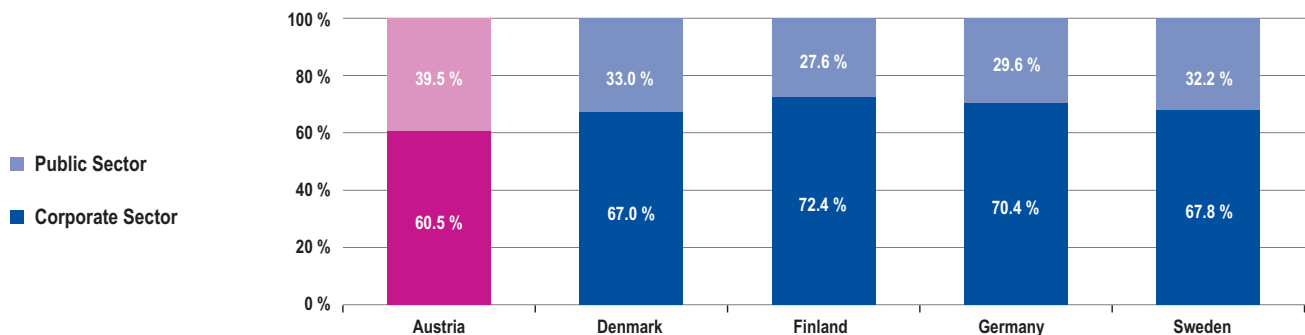
under strong public control (e.g. universities). Greater efforts to stimulate private-sector R&D funding must also include initiatives to increase philanthropic donations of the kind which play such an important role in the USA. In countries with a strong philanthropic culture, donors both large and small, non-profit foundations and businesses are the main actors, whereas in Austria none of these segments is overly well developed. Although there is a significant willingness among

Figure 23: Gap to Target GERD-to-GDP Ratio up to 2020



Source: WIFO Forschungsquotenziele 2020.

Figure 24: Public and Private-Sector Contribution as a Percentage of Total Research Expenditure

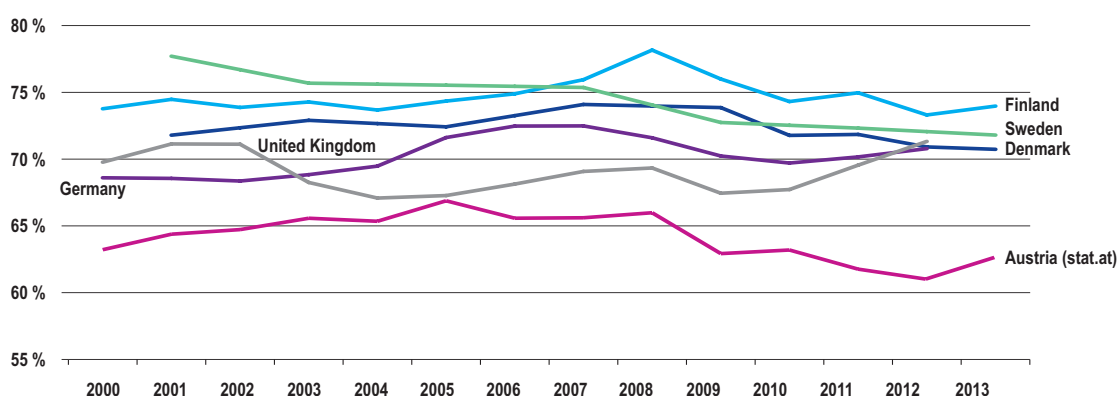


Source: OECD, MSTI.

Austrians to donate, the volume of donations is quite low.¹¹⁸ In this context, it would be particularly important to reform the fiscal framework.¹¹⁹ The Austrian Council therefore welcomes the announcement in the Government programme¹²⁰ and in the BMFWF's action plan,¹²¹ to make improvements in this regard. The Austrian Council also welcomes the initiatives agreed at the Government's closed-door conference to increase the share of private-sector funding. Special mention should be made here of the crowd-funding initiatives of the BMFWF, in particular the Alternative Financing Act on the one hand and the non-profit package on the other, which together should

contribute to increasing the proportion of private-sector funding. The increase in the research premium from 10 to 12 percent that was also agreed at the closed-door conference should also be mentioned in this context. It should be noted, however, that the volume of the research premium has risen sharply in recent years and in 2014 amounted to an estimated 375 million euros. Given this now substantial volume, the Austrian Council recommends conducting a detailed evaluation of the impacts of the research premium. This evaluation should be based on existing (micro) data and should follow a micro-econometric approach.¹²²

Figure 25: Development of the Private-Sector Contribution to R&D Funding (as a Percentage of Total R&D Spending)



Sources: OECD MSTI, Statistik Austria.

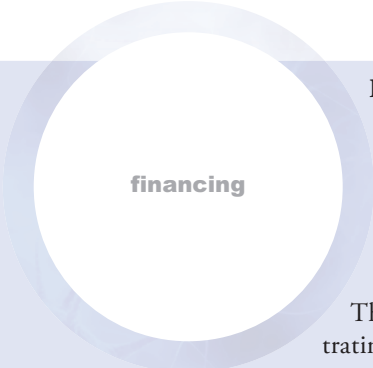
¹¹⁸ See Neumayr, M. / Schober, C. (2009): Spendenstudie 2008: Ergebnisse einer repräsentativen Bevölkerungsbefragung zum Spendenverhalten in Österreich. NPO Institut, WU; cf. Fundraising Verband Austria (2010): Spendenstudie 2010.

¹¹⁹ The Austrian Council has therefore drawn up a proposal for a reform that could, and must, be incorporated into existing tax law, see Leitner&Leitner (2012): Gesetzesinitiative zur steuerlichen Entlastung von Stiftungen, Expert opinion on behalf of the Austrian Council for Research and Technology Development.

¹²⁰ Work Programme of the Austrian Federal Government 2013-2018, p. 6

¹²¹ BMFWF (2015): Action plan for a competitive research area: Measures of the Federal Ministry of Science, Research and Economy for the enhanced implementation of the RTI strategy of the Federal Government in selected areas p. 36.

¹²² See Janger et al (2010): Forschungs- und Innovationspolitik nach der Wirtschaftskrise, WIFO Monatsberichte 8/2010, 682 and Streicher, G., (2007), Additionality of FFG funding, InTeReg Working Paper 49-2007



financing

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy with Regard to RTI Financing

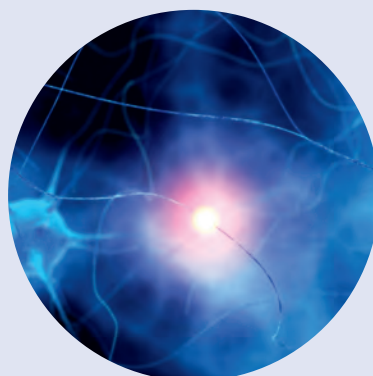
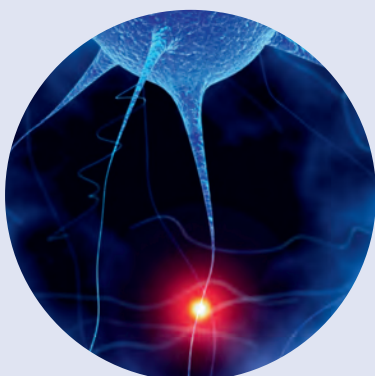
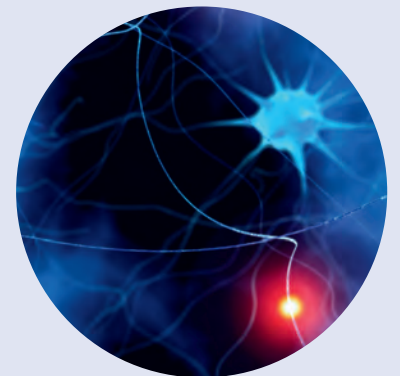
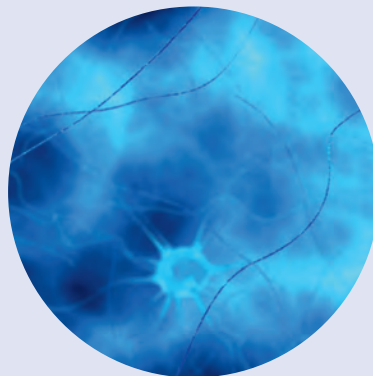
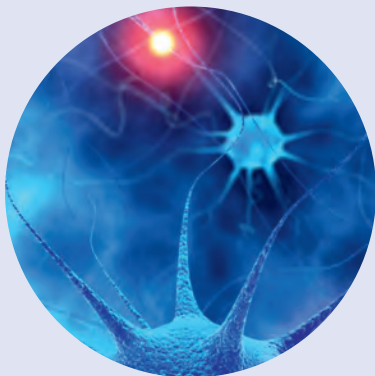
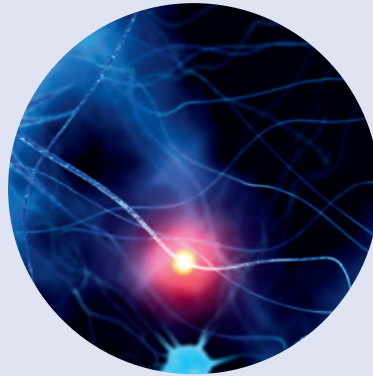
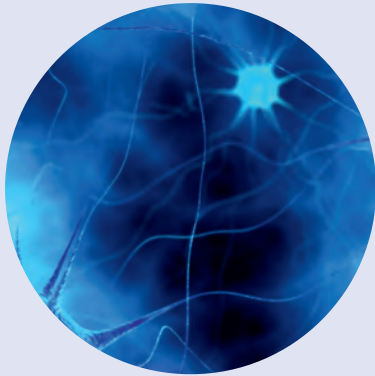
Based on the preceding analysis of the goals of the RTI strategy and the indicator-based assessment of the extent to which these goals have been achieved, the Austrian Council recommends that particular attention be devoted to the following points:

The Austrian Council recommends concentrating the use of public-sector funds and instruments in a way that strengthens their leverage effect with a view to increasing incentives for private-sector R&D spending and increasing the share of financing provided by the private sector. The Austrian Council therefore recommends that the relevant initiatives adopted at the Government's closed-door conference, such as the non-profit package or the crowd-funding initiative be vigorously implemented. In this context, the Austrian Council recommends that special consideration be given to amending tax law to strengthen non-profit foundations.¹²³

Given the substantial increase in the volume of the research premium, the Austrian Council also recommends conducting a detailed evaluation of its impacts. This evaluation should be based on existing (micro) data and should follow a micro-econometric approach.

The Austrian Council recommends the prompt implementation of the measures that have been announced and which are necessary to achieve the two spending targets – 2 percent of GDP for the tertiary sector respectively 3.76 of GDP on research in general by 2020. This is necessary as only a sustained increase in spending can guarantee the growth of science and research in the long term.

¹²³ For details see Leitner&Leitner (2012): Gesetzesinitiative zur steuerlichen Entlastung von Stiftungen, Expert opinion on behalf of the Austrian Council for Research and Technology Development.



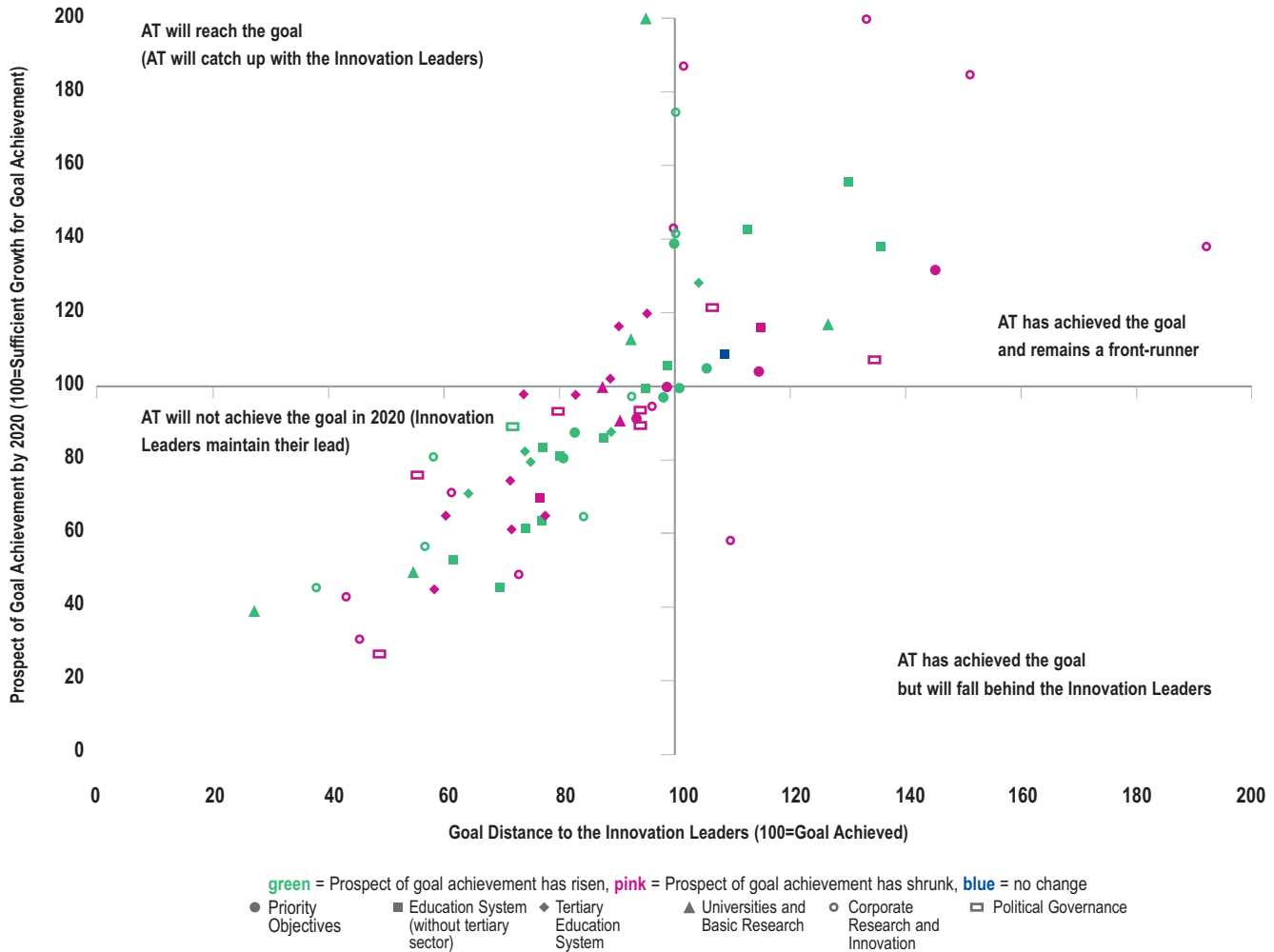
priority fields of action

Summary and Priority Fields of Action

The indicator-based analysis and evaluation of the Austrian RTI system in Figures 26 and 27 and Table 4 provides a summary of the results of the mid-term review of the implementation of the RTI

strategy. It offers a good overview of Austria's performance in all areas of the RTI strategy and its position relative to the leading countries. It shows those areas in which the RTI strategy goals have already been achieved and in which

Figure 26: Overview of Austria's Performance in all Areas of the RTI Strategy Relative to that of the Innovation Leaders



Sources: see Appendix 1, WIFO presentation. Raw Data: see Appendix 2. Explanation: see Appendix 3.

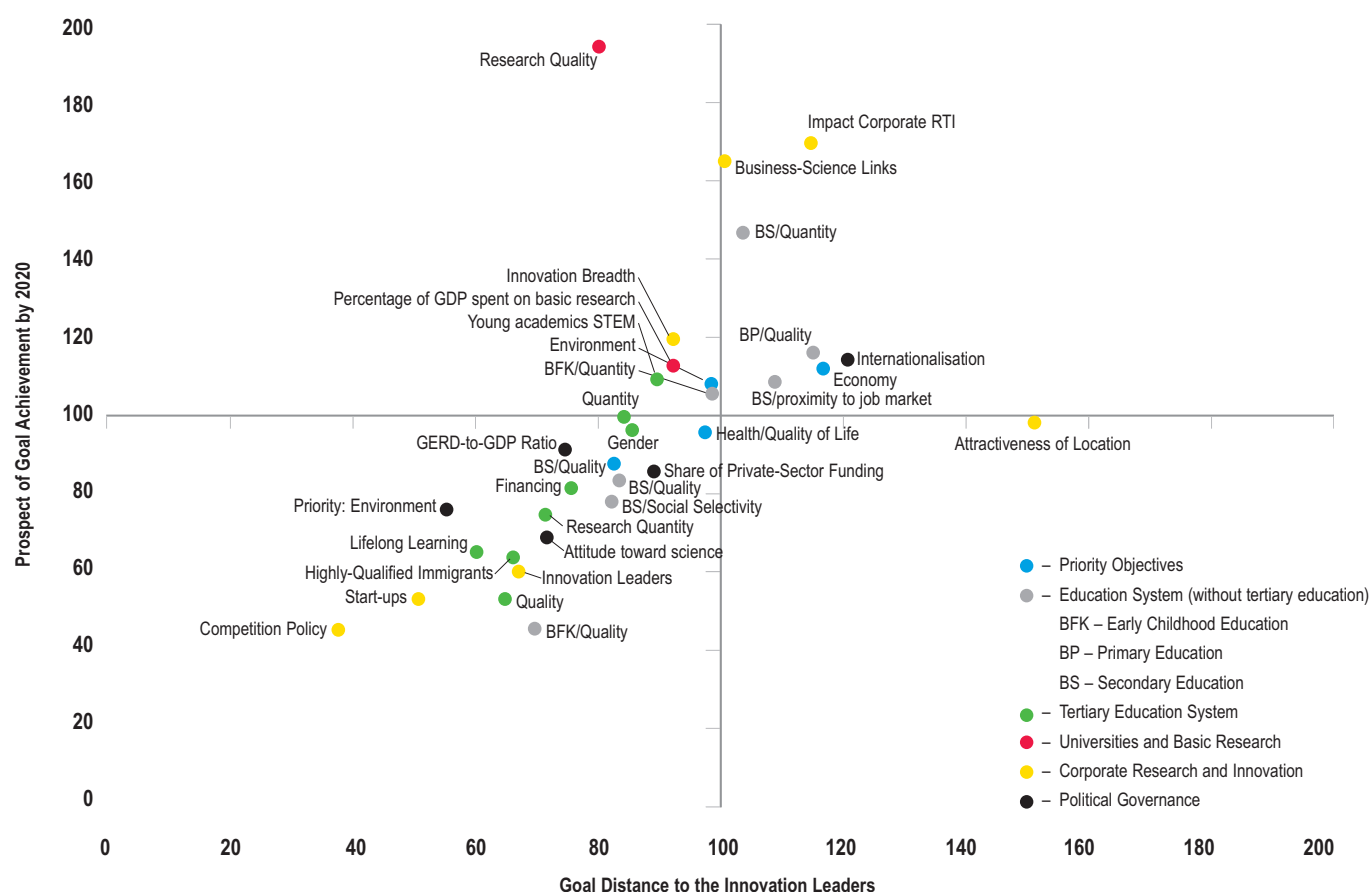
Note: Goal Distance=Austria's actual value relative to the Innovation Leaders' actual value (average value most recently available year DE, DK, FI, SE); Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020.

Austria out-performs the innovation leaders. Yet it also shows the areas in which Austria trails behind the leading nations and how good the prospect is of achieving the goal. If we consider the overall dynamics of development, we find that most of the indicators are still located in the lower left quadrant of Figure 26, signifying that the catch-up process as a whole is still not dynamic enough for Austria to achieve the objectives of the RTI strategy and

draw level with the innovation leaders. Targets, which as matters stand will not be achieved by 2020, are predominantly those for areas of the Austrian innovation system, where problems are already well known, for instance, aspects of education from early childhood education to the tertiary sector, inadequate start-up dynamics and innovation leadership (radical innovation) as well as financing aspects

priority fields of action

Figure 27: Overview of Austria's Performance in the Thematically Aggregated Areas of the RTI Strategy Relative to the Innovation Leaders



Sources: see Appendix 1, WIFO presentation. Raw Data: see Appendix 2. Explanation: see Appendix 3.

Note: Goal Distance=Austria's actual value relative to the Innovation Leaders' actual value (average value most recently available year DE, DK, FI, SE);

Prospect of Goal Achievement =Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020.

priority fields of action

concerning university spending, R&D expenditure and private-sector financing. This can be seen in Figure 27, in which the indicators are aggregated by topic.

The overview in Table 4 illustrates this lack of progress even more clearly: Overall, positive trends can only be seen for half the targets, with barely 50 percent of indicators showing an improvement in goal distance

and goal achievement prospects compared to 2010 (see the ranking of Indicators in Appendix 5). This contrasts with deterioration in performance in 45 percent of cases. The average goal distance to the innovation leaders (=100) across all areas remains almost unchanged compared to 2010 at 87 and short of the momentum needed to achieve the target. It is therefore clear that the pace of progress is still too slow across all indicators and that there is still some

Table 4: Overview of Average Goal Distances and Prospects of Goal Achievement and Changes Compared to 2010

	Average Goal Distance GD (max. 200)	Average Prospect of Goal Achievement PGA (max. 200)	Increase in PGA or GD in %	PGA or GD Shrunk in %	Average Change in GD (max. 200) in Percentage Points	Average Change in GD (max. 200) in Percentage Points
Total	87	95	49	45	1	-2
Priority Objectives	102	104	60	40	-1	1
Education System (without tertiary sector)	93	100	73	20	9	20
Tertiary Education	79	86	31	63	1	-7
Universities & Basic Research	69	87	83	17	-4	7
Corporate Research & Innovation	91	104	35	55	3	-11
Political Governance	86	87	11	78	-2	-24

Sources: see Appendix 1, Raw Data see Appendix 2, Average Innovation Leaders=100

catching up to do in respect of Austria's overall innovation performance.

Positive developments can be observed above all in respect of "Universities and Basic Research" and "Education System (Without the Tertiary Sector)" and with regard to the priority objectives. In these areas, the goal distance or the prospects of goal achievement have risen since 2010 in 83, 73 and 60 percent of the indicators. However, the enormous increase in the area "Universities and Basic Research" should not blind us to the fact that Austria still trails a long way behind the leading countries and that the pace of progress is still too slow for the goals to be achieved by 2020.

The only area in which both the goal distance

and the prospect of goal achievement exceeds the average level of the innovation leaders is that of the priority objectives. The sole area in which a performance deficit vis-à-vis the leading innovation nations can be observed is in respect of the environmental indicators and, to a lesser extent, with regard to life expectancy and quality of life. Austria's economic performance benefits from special factors such as close economic ties with Germany and tourism.

Developments in the "Education System (Without the Tertiary Sector)" were altogether positive so that overall goal achievement can be considered to be within reach by 2020. Here, it is predominantly the quantity indicators that have improved, while performance in the qual-

ity indicators, which is so hugely important for innovation, is in some cases still well below the level of the leading countries – even allowing for the fact that qualitative and quantitative indicators cannot readily be strictly separated. The area “Tertiary Education System”, however, falls well short of the goals and in two thirds of the indicators the trend is actually negative.

The area “Universities and Basic Research” has seen the greatest reduction in goal distance compared to 2010. However, it should be noted that, together with the “Tertiary Education System”, it shows the worst performance in terms of goal distance. As progress toward reducing goal distance in the tertiary education sector is also stagnating, there will be no realistic prospect of achieving the target if the current trend persists. Although the quality of research performance has improved in “Universities and Basic Research”, this positive trend is threatened by the uncertain financial outlook. As a result, from today’s perspective, there is no prospect of achieving the goal.

The area “Corporate Research and Innovation” has the third-smallest distance-to-goal and, together with the priority objectives, has the greatest prospect of goal achievement. Together with

the area “Education System (Without the Tertiary Sector)” overall goal achievement is deemed to be within reach by 2020 – provided the trends continue to develop as they have in the past. However, many indicators, such as “Attractiveness of Location” are negative, so it is by no means certain that the goal can be achieved. Furthermore, performance in key sub-areas, such as start-up dynamics and growth of innovation-intensive early-stage businesses, remains extremely weak in comparison with the leading nations

Measured by the change in goal distance compared to the first year of strategy implementation, the area “Political Governance” emerges as the clear loser with a performance that was negative in every respect. Furthermore, with 78 per cent of the cases, it has the most indicators where the goal distance has widened and the prospect of goal achievement has fallen. However, it must be pointed out that indicators are not available for every aspect of this area. Moreover, it should be remembered that the negative performance in this area is largely due to strong downward trends of individual indicators, such as the low level of public interest in science and research.

priority fields
of action

Key Results and Conclusion of the Mid-Term Review

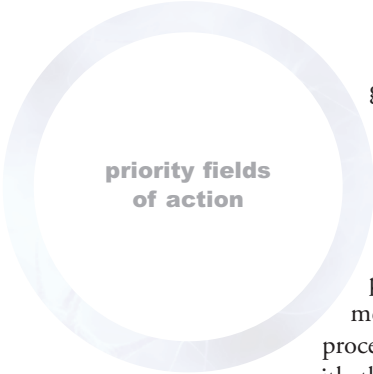
To sum up, the findings of the Austrian Council’s mid-term review are sobering: As matters stand, the RTI strategy has not been implemented with sufficient intensity in recent years to enable the Federal Government to achieve its higher overall strategic objective of positioning Austria among the leading innovation nations by 2020. In its previous reports on Austria’s scientific and technological capability, the Austrian Council has repeatedly emphasised that the measures in the strategy must be implemented with greater rigour in order to achieve the ambitious goals by 2020.

The Austrian Council considers that a new phase of policy-making is definitely needed to achieve

the goal of becoming an innovation leader: Instead of the previously fragmented individual measures, a package of reforms must be successfully implemented, which must be adapted to suit the entire RTI system. However, this requires a stronger political commitment and a greater degree of political willpower.

The key question posed in the Austrian Council’s mid-term review, and previously in its white paper on steering research, technology and innovation in Austria,¹²⁴ is therefore: How serious is the ambition formulated in the RTI strategy to become an innovation leader? If this ambition is to be taken seriously, policymakers must give much greater priority to education, research, technolo-

¹²⁴ Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 23.



priority fields of action

gy and innovation – as key factors for Austria's future – than they have in the past. While the Federal Government's RTI strategy is ambitious, it does not set out binding targets in respect of individual measures; it is more of an orientation paper. The Austrian Council again recommends initiating an active and sweeping process of RTI policy reform to move ahead with the implementation of the strategy more decisively.¹²⁵ This must be backed at the highest political level. To this end, the Austrian Council

believes that an RTI reform agenda is required that should be led by the Federal Chancellery and implemented in cooperation with all those ministries with responsibility for RTI. This agenda must be set out in the Government programme and must contain binding political targets and clear mandates for the RTI Task Force. If there is no increased focus on the key issues education, research, technology and innovation, the Austrian Council believes that the goal of establishing Austria as a leading innovation nation by 2020 will clearly not be achieved.

Priority Fields of Action and Recommendations

On the strength of the indicator-based analysis and evaluation of the capability of the Austrian RTI system, the Austrian Council has identified five priority fields of action:

- The education system (including the tertiary sector)
- Basic research
- Start-ups and growth of innovative early-stage companies

- Governance structures
- Private-sector R&D financing

In some cases, no progress has been made in these areas for many years. Due to their importance for the RTI system, the Austrian Council takes the view that greater efforts are needed in these areas in particular, in order to improve the performance of the Austrian innovation system as a whole.

Recommendations of the Austrian Council Regarding Priority Fields of Action

Intensify the Reform of the Education System

The Austrian Council recommends further reforms to modernise the structures of the education system, in particular by implementing specific measures to strengthen school autonomy and streamline the division of competences between the Federal Government and the provinces. The Austrian Council once more recommends that to overcome early-age selection in the education system, there be a commitment to, and implementation of, comprehensive all-day schooling in secondary education first stage, alongside ability differentiation and talent development.

Furthermore, the Austrian Council considers that there is an urgent need to increase early-

childhood education (by means of a second year of kindergarten and the promotion of German and other first-language skills), to increase the number of multi-lingual educators (including in particular Turkish speakers) and to provide schools facing special challenges (especially in terms of the socio-economic background of the pupils) with increased financial and human resources.

The Austrian Council recommends that the goal set out in the Work Programme of the Austrian Federal Government, to increase to 2 percent of GDP the amount spent on universities, should be recognised as a minimum target and that the additional annual expenditure, of on average EUR 400 million, that is required

¹²⁵ Austrian Council for Research and Technology Development (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 22.

should be made available for the tertiary sector. Furthermore, the Austrian Council recommends that when taking the necessary legal steps to implement study-place financing, emphasis should be given above all to measures to improve study conditions and in particular to increase the number of graduates in STEM subjects. Further reforms of university career models can contribute to making Austrian universities more competitive in an international context.

Increase Competitively Allocated Financing for Basic Research

The Austrian Council urgently recommends a substantial and sustainable increase in competitively allocated funds for basic research to expand the numbers of those engaged at the top of excellent research and to improve research conditions of Austria as a location for science. Failing this, both the improved quality of research performance and Austria's attractiveness as a location for science are seriously endangered.

Further Optimisation of Legal and Financial Framework Conditions for Business Start-ups and Growth

The Austrian Council recommends implementing innovative concepts and supporting funding models with the goal of optimising framework conditions to encourage start-up activity in the knowledge- and technology-intensive sector. The Austrian Council again recommends examining whether international models of tax concessions can be applied to early-stage and small knowledge- and technology-based companies in Austria. A differentiation in the research premium with higher percentages for early-stage and small innovative companies should therefore be considered and, if and where necessary, developed and implemented in detail.

The Austrian Council also recommends developing financing opportunities for innovative young entrepreneurs and SMEs. Crowdfunding, including peer-to-peer lending and crowd investing, should be encouraged by an effective and efficient legal framework and should be incorporated into a competitive overall strategy for corporate growth. In this context, the Austrian Council welcomes the latest crowdfunding initiatives of the BMFWF agreed at the Federal Government's closed-door conference, and in particular, the Alternative Financing Act.¹²⁶

Furthermore, consideration should also be given to introducing a tax allowance for business angels to increase equity investments and to reduce ancillary wage costs for start-ups and companies engaged in research. In addition to this, the Austrian Council backs innovative funding models, which fund guarantees in conventional early-phase programmes.

Improve Governance Structures for the Implementation of the RTI Strategy

The Austrian Council recommends initiating an active and sweeping process of RTI policy reform with a view to moving ahead with the implementation of the strategy more decisively. This must be backed at the highest political level. To this end, the Austrian Council believes that an RTI reform agenda is required that should be led by the Federal Chancellery and implemented in cooperation with all those ministries with responsibility for RTI. This agenda should be embedded in government plans and must contain politically binding, specific and quantifiable targets. These must form the basis for clear terms of reference for the RTI Task Force, which must in future play a more active role in steering the implementation of the RTI strategy.

**priority fields
of action**

¹²⁶ http://www.bmwf.at/Presse/AktuellePresseMeldungen/Documents/Crowdfunding_Potenzial-1.pdf,

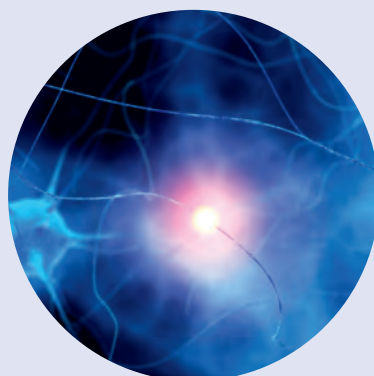
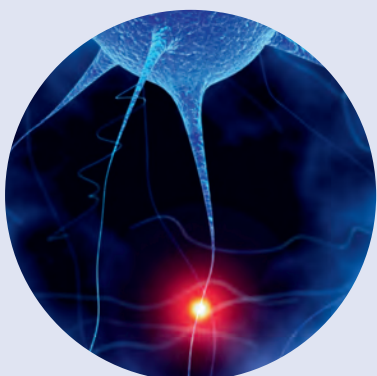
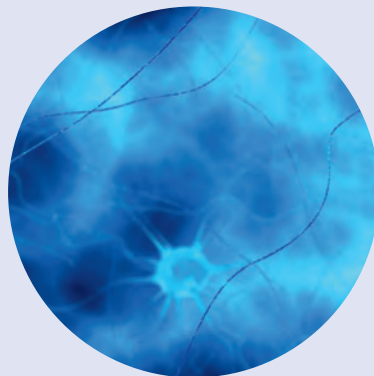
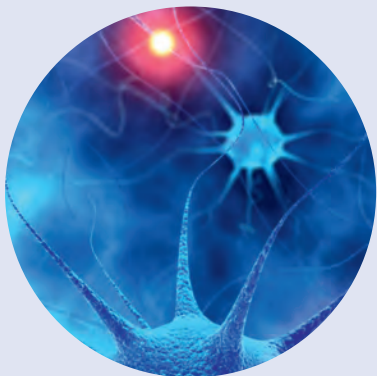
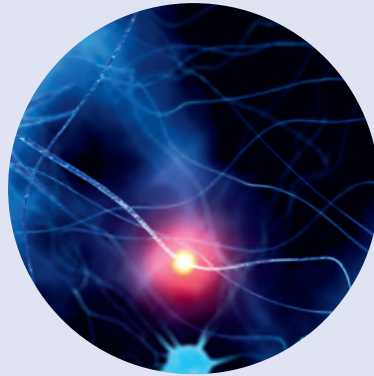
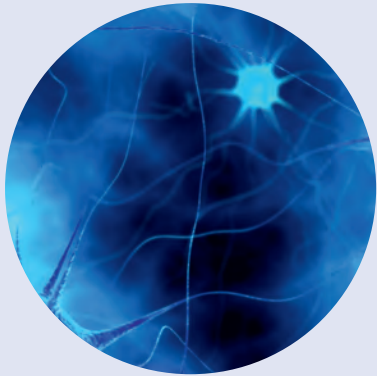
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**priority fields
of action**

**Promote Measures to Increase
the Private-Sector Share
of R&D Funding**

The Austrian Council recommends focusing on measures to increase the proportion of private-sector R&D funding. This can be done, for example, by improving framework conditions for philanthropic gifts and donations, for foundations and for private venture capital funding. In this context, it is essential to concentrate the use of public-sector funds in a way that strengthens their leverage effect with a view to increasing incen-

tives for private sector R&D spending and increasing the share of financing provided by the private sector. The Austrian Council therefore recommends that the relevant initiatives adopted at the Government's closed-door conference, such as the non-profit package or the crowd-funding initiative be vigorously implemented. Given the substantial increase in the volume of the research premium, the Austrian Council also recommends conducting a detailed evaluation of its impacts. This evaluation should be based on existing (micro) data and should follow a micro-econometric approach.



Global Innovation Monitor

Based on the indicators used in the Report on Austria's Scientific and Technological Capability, the Global Innovation Monitor compares the development of selected countries (China, Israel, the Netherlands, Switzerland, South Korea and the USA) with that of Austria in the areas of economic performance, society, the environment, education, university research and corporate research. Such a comparison with the leading innovation nations framed not just in European – as in the first part of the report – but also in global terms of reference, should help shed light on Austria's position in the context of worldwide trends.

The comparison countries for the Global Innovation Monitor were chosen for a number of reasons: Firstly, they were defined as the target countries for Priorities 1 and 2 in the recommendations of the working group 7a to the RTI Task Force.¹²⁷ Secondly, the selected countries are – with the exception of China – deemed to be global innovation leaders that can serve as benchmarks due to their successful performance. China was included in the list, because it has faster growth rates for spending on research,

publications, patents etc. than any other country. Thirdly, members of the Austrian Council who took part in official visits to these countries were given deeper insights into the RTI systems there. Finally, organisations such as the OECD regularly collect, update and publish data sets on indicators for all selected nations (see the Indicator Set in Appendix 6). A guide to interpreting the diagrams can be found in Appendix 7.

The most innovative countries in the world – by which we mean the innovation leaders cited as benchmarks in the first part of this report Denmark, Germany, Finland and Sweden, and then above all, the USA, Switzerland, South Korea and the Netherlands – recognised a long time ago that only increased efforts in the areas of education, research and innovation can put us on the path to overcoming the global grand challenges. It is for this reason that these countries have – even during the economic crisis – massively increased their investments in research and development (R&D) and in education. These investments also bring benefits in the form of improved economic performance and greater societal well-being.

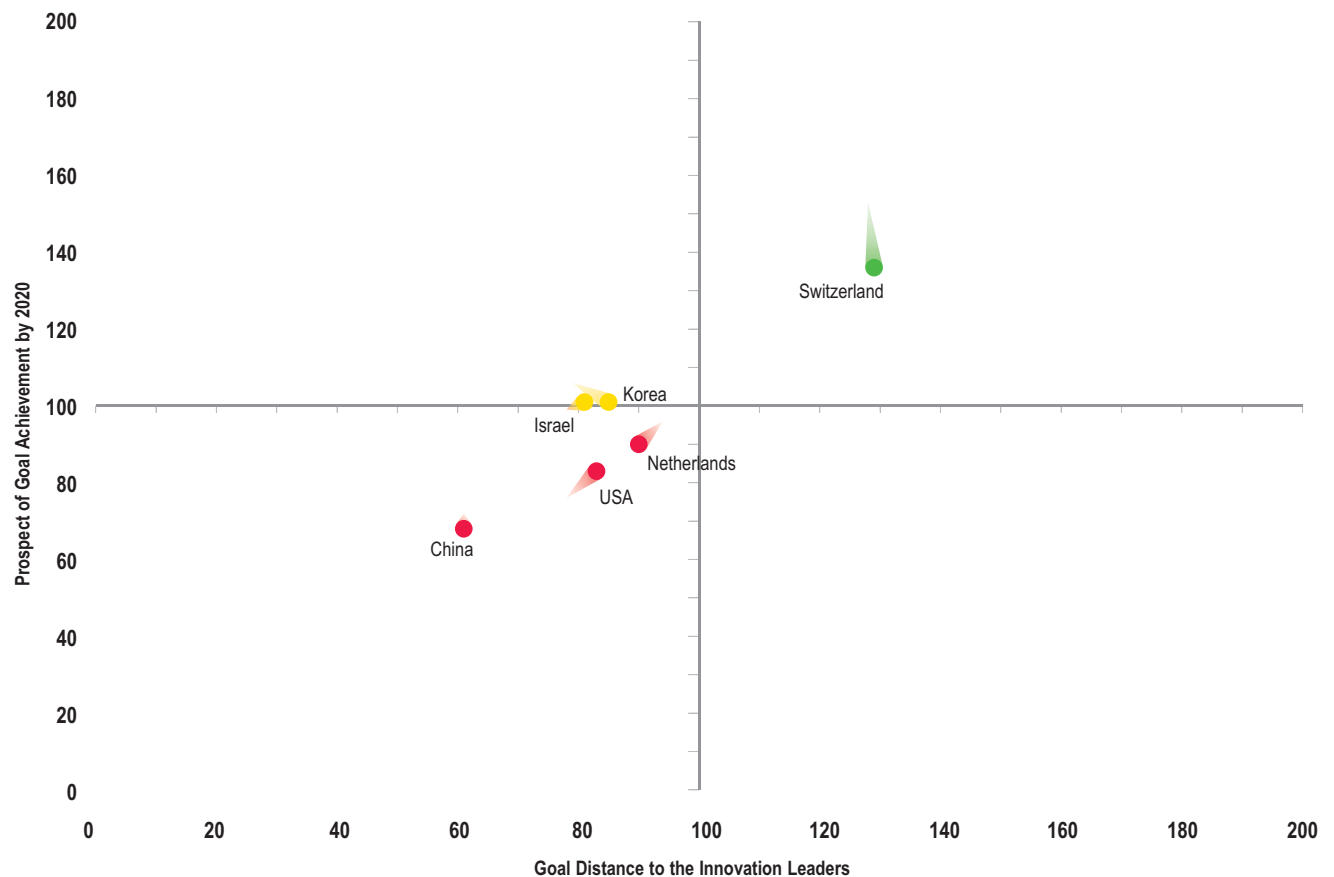
¹²⁷ BMVIT, BMWF, BMWFJ, BMEIA (2013): Beyond Europe: Die Internationalisierung Österreichs in Forschung, Technologie und Innovation über Europa hinaus. Recommendations of Working Group 7a to the RTI Task Force of the Austrian Federal Government, p. 7.

Economy, Society and Environment

Figure 28 shows that Austria is relatively well positioned in respect of the economic, societal and environmental indicators. Only Switzerland is better placed in terms of its economic development, social well-being and environmental situation and only Korea and Israel have a development dynamic that more or less equals that of Austria. The performance of the USA,

the Netherlands and China is too weak to enable these countries to overtake Austria by 2020. The trend in China viewed in terms of the prospect of overtaking Austria by 2020 is even slightly negative. However, China's growth momentum should not be underestimated just because of this performance deficit vis-à-vis Austria.

Figure 28: Economy, Society and Environment in an International Comparison



Sources: see Appendix 6, Explanation see Appendix 7.

Education

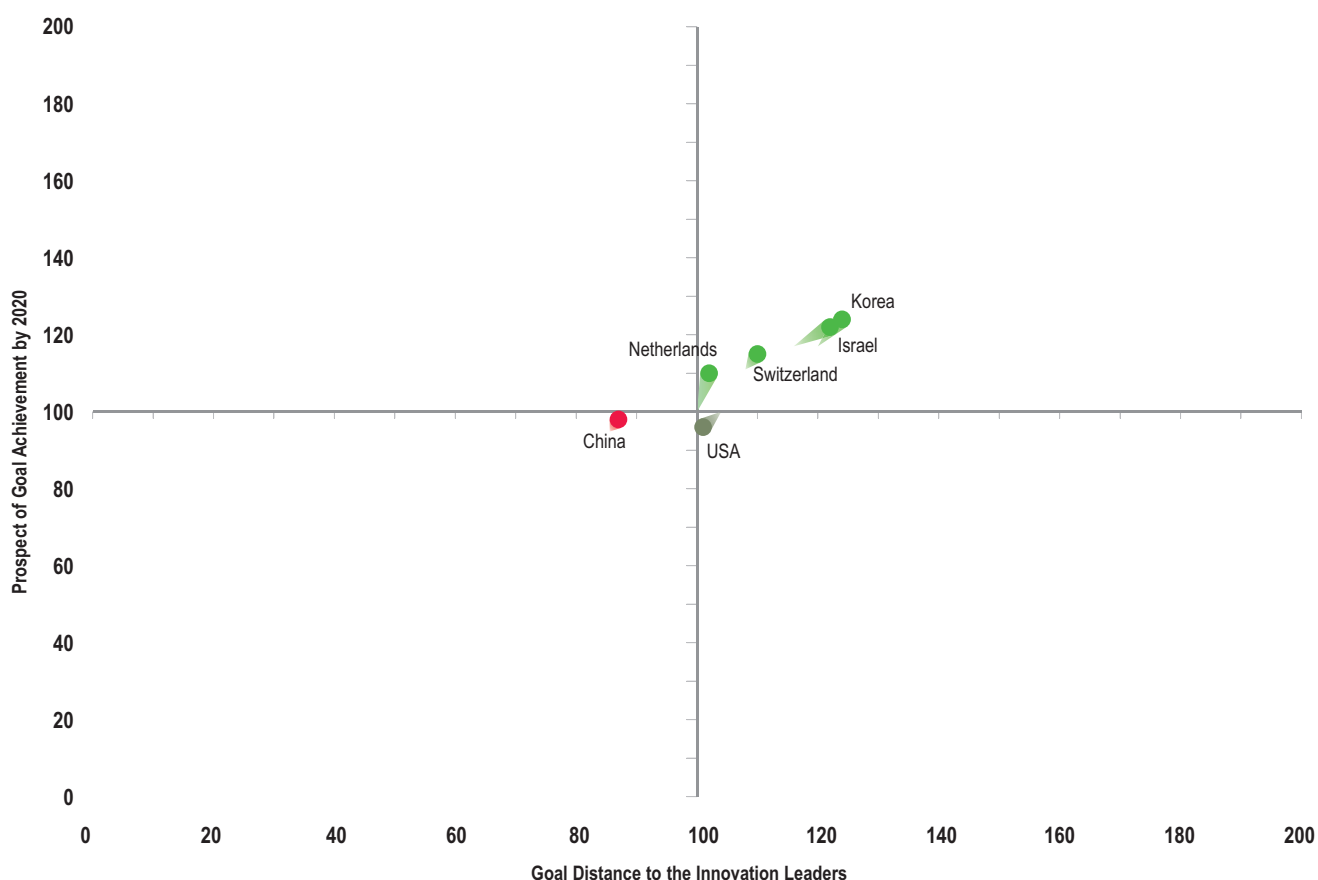
The evaluation of the education system presents the results of the PISA surveys as output components and spending in the tertiary education sector on students as input components in aggregate form.

If one compares the current evaluations (values for 2012), Austria's education performance is currently ahead of China's, but behind that of the USA, the Netherlands, Israel, Korea and Switzerland (see Figure 20).

The Netherlands, Switzerland, Korea and Israel are all, to a greater or lesser extent, clearly ahead

of Austria both with regard to goal distance and the strength of the development dynamic. Austria and the USA are roughly on par with one another. China still lags behind somewhat and at current growth rates will not be able to catch up with Austria by 2020. The diagram also shows that all the countries considered boasted a high level of momentum over the entire period. A continuous improvement in the quality of schooling and greater financial inputs, especially in the tertiary education sector, will therefore remain an essential factor for education policy in Austria.

Figure 29: Education in an International Comparison



Sources: see Appendix 6, Explanation see Appendix 7.

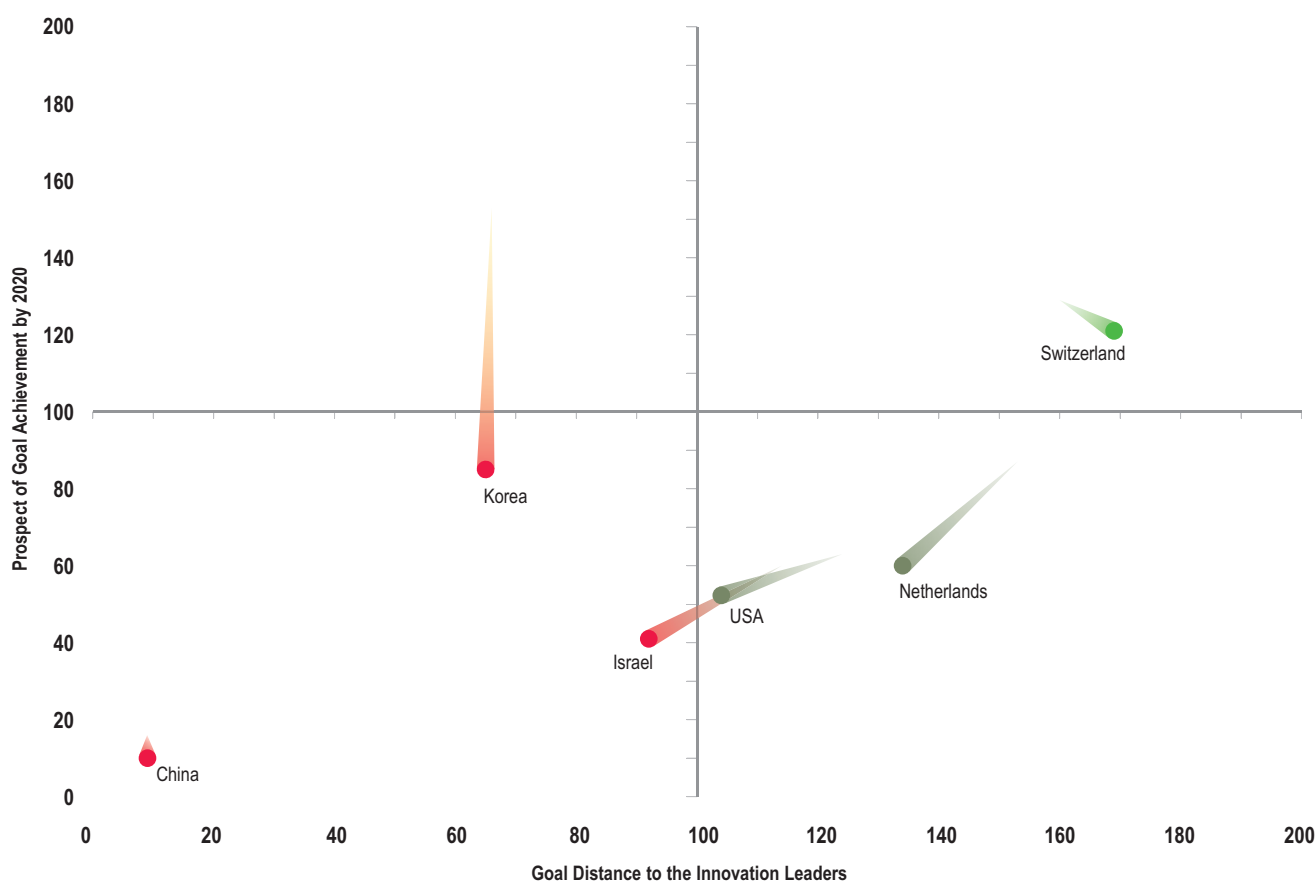
University Research

The trend in the area of university research is rather similar to that in the field of education. Based on the aggregate individual indicators “University Ranking”, “Spending on Basic Research” and “Spending on Tertiary Education, Research and Development Relative to Population”, Austria trails behind Switzerland, Israel, the Netherlands and the USA. However, Austria could draw level with Israel, the USA and the Netherlands by 2020 (see Figure 30).

China, Israel and Korea lag behind Austria and at the present pace of development are unlikely to catch up with Austria by 2020. Although the Netherlands and the USA are still ahead of Austria, if current momentum persists Austria

will be able to draw level with them by 2020. Only the gap to Switzerland is still comparatively wide at present. That China lags so far behind is due to its large population and the very heterogeneous trends in this country. In absolute terms, however, China provides an enormous amount of funding for university research and tertiary education, which in global terms is leading to a marked shift in the availability of highly trained researchers. Equally remarkable is the rapid pace of development in Switzerland, which in recent years has shown continuous growth in all the indicators used for this sector.

Figure 30: University Research in an International Comparison



Sources: see Appendix 6, Explanation see Appendix 7.

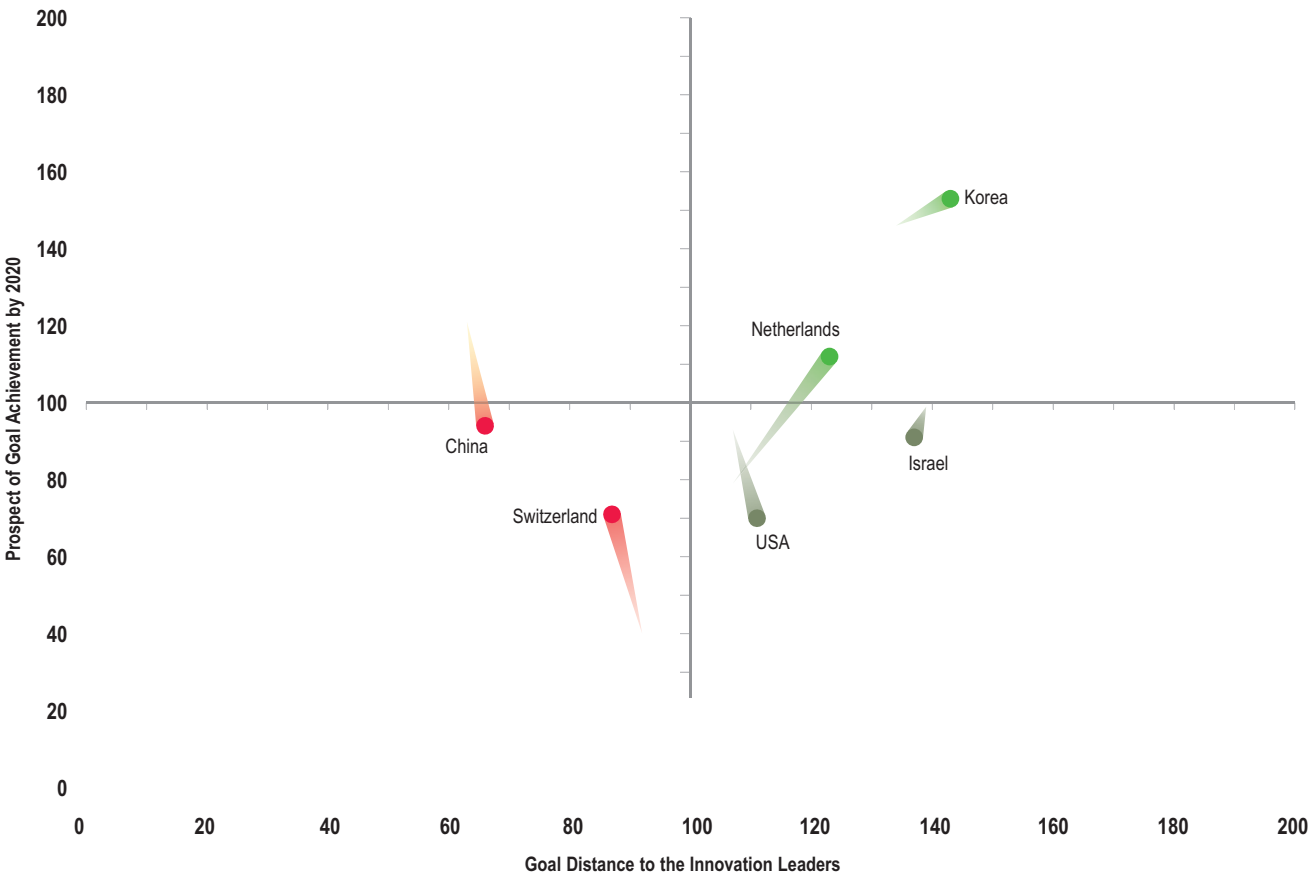


Corporate Research

As can be seen from Figure 31, Austria still has some catching up to do in respect of performance in the indicators for corporate research and innovation, which have been combined for the purposes of this presentation. With the exception of China and Switzerland, all the

comparison countries are ahead of Austria and thanks to their strong momentum, two of them – Korea and the Netherlands – will be able to extend their lead over Austria. If the current trend persists, Austria will be able to close the gap on the USA and Israel.

Figure 31: Corporate Research in an International Comparison



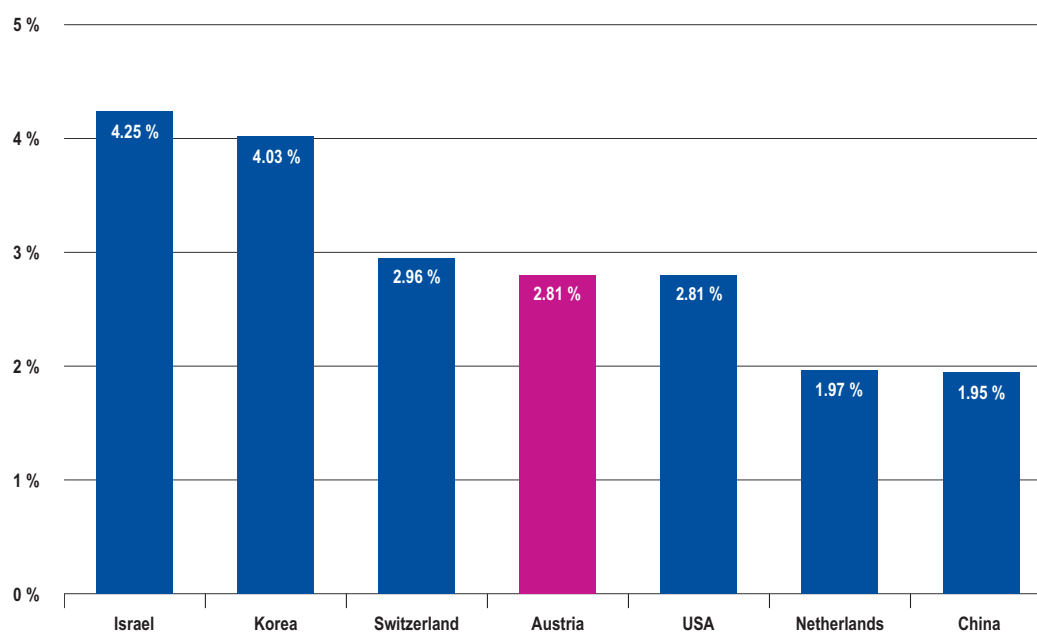
Sources: see Appendix 6, Explanation see Appendix 7

R&D Financing

Figure 32 compares spending on R&D as a percentage of GDP in the countries in the Global Innovation Monitor. The clear leaders here are Korea and Israel; Switzerland and the USA are virtually on a par with Austria. In terms of total volume, China is already in second place with a total volume of more than 208 billion US dollars – behind the USA (415 billion dollars). By way of comparison, Austria holds an

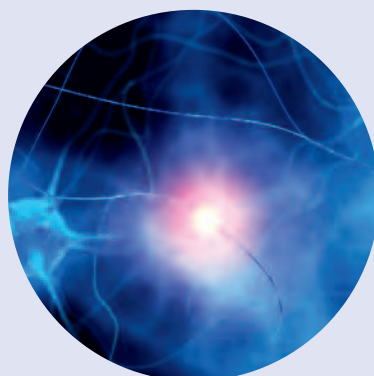
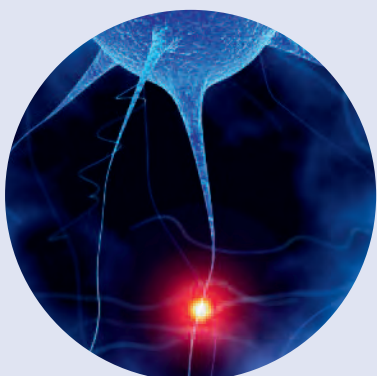
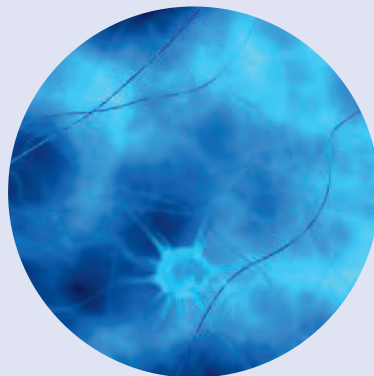
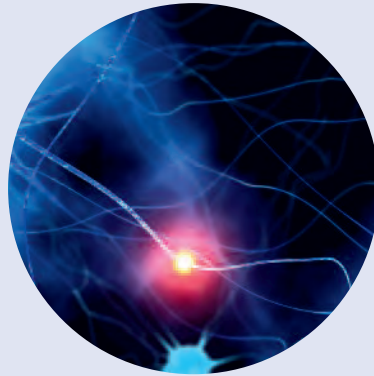
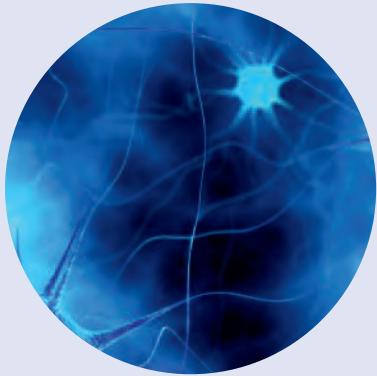
impressive 20th place in the global country rankings, spending roughly 10 billion US dollars (adjusted for purchasing power) on R&D in 2012. Relative to GDP, this is the equivalent of a GERD-to-GDP ratio of approximately 2.8 percent, putting Austria in 12th place in current global rankings.

Figure 32: GERD-to-GDP Ratios of Selected Countries in 2012



Source: OECD MSTI.





Appendix 1: Indicator Set

Strategic Objectives	Indicator to track target achievement	Abbreviation	Numerator
Priority Objectives			
Vision: In 2020 Austria is an Innovation Leader. Objective: We want to further develop the potentials of science, research, technology and innovation in Austria to make our country one of the most innovative in the EU ...	IUS Innovation Index (Summary Innovation Indicator)	Innovation Performance (IUS)	Innovation index value (normalized 0–1)
... and thus strengthen the competitiveness of our economy and increase the wealth of our society ...	GDP per capita at purchasing power standards (PPS)	GDP/per capita	Gross domestic product (GDP) at purchasing power standards
	Employment-to-population ratio	Employment rate	Employed (20-64 years)
	Unemployment rate	Unemployment rate	Unemployed (15-74 years)
... and overcome the big social and economic challenges of the future.	OECD Better Life Index	Better Life	Better Life Index– value (0–10)
	Healthy life years: Number of years a person of a certain age can expect to live without illness/disability.	HLY (F)	Years without chronic illness/ activity limitation
		HLY (M)	
	Reduction of greenhouse gas emissions in %	Greenhouse gases	Emissions of greenhouse gases, base year 1990 Index (1990=100)
	Efficiency increase: energy intensity	Energy intensity	Gross Domestic Energy Consumption (kg. oil equivalents)
	Efficiency increase: productivity of resources	Resource productivity	GDP

Denominator		Short Explanation of Indicator	Source	Calculation Information	ID No.
	n. a.	The innovation index of the IUS should make the innovation performance of EU member states comparable. It comprises 25 unweighted individual indicators, which refer to various innovation-relevant areas (i.e. human resources, research spending, patents, structural change).	IUS Innovation Union Scoreboard		1
	Total population	Gross Domestic Product (GDP) per capita is a measure of a country's total economic output. It is defined as the value of all newly-created goods and services, minus the value of all goods and services consumed as inputs. The underlying figures are expressed in PPS, a common currency, which balances price level differences between countries and allows significant GDP volume comparisons.	Eurostat		2
	Working-age population (20-64 years)	The employment rate complements GDP per capita as a measurement of a country's economic development. The working population comprises people who during the reference week worked in gainful employment for at least one hour or who did not work, but had a work place and were only temporarily absent.	Eurostat		3
	Persons in Employment (15-74 years)	The unemployment rate complements GDP per capita as a measure of a country's economic development. The unemployment rate is the number of people unemployed as a percentage of the labour force. The labour force is the total number of people employed plus unemployed. The figure is seasonally adjusted.	Eurostat	Inverted	4
	n. a.	The indicator measures wealth and quality of life across a wide range of factors. It covers several areas but as income, education and health overlap with other areas these are not included. The remaining areas are work-life balance, integration in social networks, participation in social/political events, personal security, environmental quality, housing and life satisfaction.	OECD Better Life Index	Report 2013: PGA calculated as GD	5
	Life expectancy	This indicator reflects the challenges of ageing populations. The number of healthy life years an individual will enjoy can be influenced by medical and technological progress and by social innovations such as new preventative healthcare models at the workplace.	Eurostat		6
					7
	n. a.	This indicator is one of Austria's Europe-2020 goals and reflects the fact that climate change can only be efficiently stemmed by a reduction in absolute terms of greenhouse gases. The target aims for a reduction and not an increase.	Eurostat; Austrian Federal Environment Agency	Inverted; national target	8
	GDP (in 1,000 €)	This indicator shows the development of energy efficiency; i.e. energy consumption required for Austria's annual economic output.	Eurostat; Statistik Austria	Inverted	9
	Domestic material consumption (kg)	This indicator measures the total amount of physical resources directly used in Austria's annual economic output.	Eurostat; Statistik Austria		10

Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Educational System – Pre-Primary and Primary Education			
The educational system as a whole needs to be optimised, starting with the early childhood phase. Vision 2020: age-based, early childhood educational support has been established.	Participation in early childhood education	Early childhood care	Children (4–primary level) in institutional childcare facilities
	Ratio of students to teaching staff	Student-teacher ratio early childhood	Number of children (4–5) in institutional childcare facilities
	Ratio of students to teaching staff in primary education	Student-teacher ratio in primary education	Number of students in primary education
Educational System – Secondary Education			
The proportion of early school leavers should be reduced to 9.5% by 2020.	Percentage of early school leavers	Early school leavers	People aged 18-24 with lower secondary educational attainment or less
The proportion of pupils graduating with a secondary school-leaving certificate within an age cohort should be increased to 55% by 2020	Percentage of secondary school graduates	Secondary school graduates	Passed final school leaving examination
The number of students with a first language other than German, who complete the upper secondary level should increase from 40% at present to 60%. Better integration of immigrants	Number of students with a first language other than German who have completed the second level of secondary school	Early school leavers immigrants	Number of students with a first language other than German who have completed the upper secondary level of education (AHS, BHS, 3-year technical school, apprenticeship)
The reforms aim at mitigating social selectivity.	Influence of socio-economic background on reading competence	Inheritance of education 1	Influence of PISA Index for the socio-economic background on reading competence (increase in socio-economic gradient)

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	Population 4–5 for Austria, for other countries depending on the age at which children start school (4–6)	The percentage of the population between the age of 4 and the age at which children start school who are participating in early childhood education. This indicator is used to measure progress toward the primary goal set out in the Strategy "General and Vocational Education" of increasing the proportion of children (between the age of 4 and the age at which compulsory primary education starts) who participate in preschool education to at least 95% by 2020.	Eurostat	National target	11
	Number of qualified teachers without teaching assistants	The ratio of students to teaching staff compares the number of students (full-time equivalent) to the number of teachers (full-time equivalent and not teaching assistants) at a given level of education and in similar types of institutions.	OECD, Education at a glance	Inverted	12
	Number of teachers (full time-equivalents) at primary level	The ratio of students to teaching staff compares the number of students (full-time equivalent) to the number of teachers (full-time equivalent) at a given level of education and in similar types of institutions.	Eurostat	Inverted	13
	Total population between 18-24	This is a core target within the framework of the Europe 2020 strategy. "Early leavers from education and training" are people aged 18 to 24, who fulfill the following conditions: the highest level of education or training attained is ISCED 0,1,2 or 3c short – i.e. lower secondary level – respondents should not have received any education or training in the four weeks preceding the survey.	Eurostat	Inverted	14
	Age cohort 18-19 years	Final examination rate: students who passed final school-leaving examinations (without second or subsequent qualifications), as measured by the arithmetic mean of the population aged 18 to 19.	Statistik Austria	National target	15
	Age cohort 18-19 years with a first language other than German	The indicator shows the share of students with a first language other than German, who have attained upper secondary educational attainment level (final school leaving examination, apprenticeship, intermediate technical schools).	Statistik Austria	National target; Report 2013: PGA calculated as GD	16
	n. a.	The average difference in students' reading attainment which indicates a one unit increase in the PISA index of economic, social and cultural status is defined as an increase in the socio-economic gradient. The wider the average attainment gap, the greater the impact of students' socio-economic background on their reading skills. The socio-economic background is measured by the PISA-index of economic, social and cultural status and is based on information provided by the students on their parents' education level and occupational status and household possessions, such as a writing desk for studying and the number of books. Statistical fluctuations are taken into consideration in the assessment.	OECD PISA	Inverted	17

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Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Education System – Secondary Level			
The reforms aim at continuously increasing quality in education (secondary level).	Share of students with poor performance in basic skills (literacy, numeracy, science) Target: 15% at most	Inheritance of education 2	Influence of the PISA Index for the Socio-Economic Background on Reading Skills (strength of correlation–share of the declared variance)
		PISA risk students – reading	Students who at best achieve competence level 1 of the relevant PISA scale
		PISA risk students – mathematics	
		PISA risk students – science	
	Share of students who reach at least competence level 5 (in literacy, numeracy, science)	PISA top students – reading	Students who reach the competence level 5 or higher
		PISA top students – mathematics	
		PISA top students – science	
Optimum qualification for economic activity (...)	Share of graduates in employment aged 20 to 34)	Skill Mismatch	Individuals between the ages of 20 and 34 who are in employment and who graduated from an educational programme of at least secondary level II and who left the general education and vocational education system no more than three years before the reference year.

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	n. a.	The strength of the relationship between reading performance and socio-economic background is measured by the percentage of the variance of students' performances, which can be explained by the differences in students' socio-economic background. The higher the share of the declared variance, the greater the influence of the socio-economic background.	OECD PISA	Inverted	18
	Total number of students participating in OECD PISA	This indicator provides information about the number of students as a percentage of the total population who on the basis of their test results at best attain proficiency level 1 on the relevant PISA scale. It can be assumed that low proficiency levels in these three basic skills results in significant disadvantages in personal and social life.	OECD PISA	Inverted; National target	19
				Inverted; National target	20
				Inverted; National target	21
	Total number of students participating in OECD PISA	This indicator shows the distribution of school performance upwards, i.e. the share of students with very good results.	OECD PISA		22
					23
					24
	All individuals between the ages of 20 and 34 who graduated from an educational programme of at least secondary level II and who left the general education and vocational education system no more than three years before the reference year	This indicator attempts to reflect the mismatch between training/education and the demands of the job market. It is an official target of the European Education and Training Strategy.	Eurostat	National target; as no time series is available, the prospect of goal achievement was calculated with the goal distance.	25

Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Educational System – Tertiary Education			
38% of 30 to 34-year-olds have a university degree in 2020	Share of 30 to 34-year-old university graduates in the 30 to 34-year age cohort.	University graduates	Number of 30 to 34-year-olds with an ISCED level of 4a (only Austria, Germany), 5 or 6
		University graduates (incl. ISCED 4a)	
The conditions of study at universities should be fundamentally improved, which will require establishing new financing models for higher education.	Student-to-Staff ratio	Staff-Student ratio university	Number of students
Vision: universities, universities of applied sciences and non-university research institutions work within excellent framework conditions and are sufficiently financed to optimally perform their tasks in research and teaching.	Percentage of GDP spent on higher education	Percentage of GDP spent on higher education	Expenditure for the whole tertiary sector
	University expenditure per student	University expenditure per student	Expenditure for the whole tertiary sector
This is to guarantee universities, research institutions and companies a sufficient supply of highly-qualified researchers.	Number of researchers per 1,000 employees	Researchers	Researchers according to OECD Frascati definition
	Doctors in STEM subjects per 1,000 of the population	Doctors in STEM subjects	Doctors in STEM subjects
	STEM graduates per 1,000 of the population	STEM graduates	Graduates STEM fields
The reforms are aimed at balancing the gender imbalances in research.	Women researchers as a percentage of total researchers	Percentage of female researchers	Number of female researchers (OECD Frascati definition)
	Percentage of women in Science, Technology, Engineering and Mathematics (STEM)	Share of women in science	Number of female graduates in science
		Share of women in engineering	Number of female graduates in engineering
	Glass Ceiling Index (percentage of female professors relative to the percentage of female scientific and artistic staff)	Glass Ceiling Index EU	Percentage of female professors

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	30 to 34-year-olds	This is an Austrian Europe 2020 core indicator and reflects successful participation in tertiary education; in Austria secondary technical and vocational schools and colleges are included (ISCED 4a).	Eurostat, Statistik Austria Mikrozensus		26
				National target	27
	Academic staff at universities	The indicator shows the staff-to-student ratio at universities. It is calculated, wherever possible, on the basis of full-time equivalents.	OECD, Education at a Glance	Inverted	28
	GDP	Share of expenditure on tertiary education as a percentage of GDP as a measure for funding in an international comparison. The Federal Government has set a goal of 2% in the Government programme.	OECD, Education at a Glance	National target	29
	Number of students (ISCED5a,5b,6)	The indicator university expenditure per student complements the GDP rate by considering different dimensions of the tertiary sector in different countries. A tertiary sector with a 50 % graduation rate will ceteris paribus require considerably more funds than a sector with a 25% graduation rate.	OECD, Education at a Glance		30
	Total employment	The indicator shows the number of researchers relative to total employment, i.e. the researcher-intensity in employment.	OECD MSTI		31
	25 to 34-year-olds/1,000	Tertiary degrees ISCED 6 in the sciences and technological disciplines per 1,000 of the population aged 25 to 34	Eurostat		32
	20 to 29-year-olds/1,000	Tertiary degrees in the sciences and technological disciplines (ISCED 5,6) per 1,000 of the population aged 20 to 29	Eurostat		33
	Number of female researchers (OECD Frascati definition)	This indicator measures the number of women as a percentage of research staff	OECD MSTI		34
	STEM graduates science in total	This indicator measures the number of women as a percentage of total STEM graduates, who are often involved in technological innovation processes.	Eurostat		35
	STEM graduates engineering in total	This indicator measures the number of women as a percentage of STEM graduates, who are often involved in technological innovation processes.	Eurostat		36
	Percentage of women among scientific staff	The indicator shows how likely it is that a woman makes the leap from scientific staff to a top position at university.	European Commission	Inverted; PGA in the Fig. capped at 200	37

Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Education System – Further Education/Skill Structure Migration			
Vision: The immigration of highly-skilled people will be encouraged and utilised.	Highly-qualified immigrants as a percentage of the foreign-born population	Highly-qualified immigrants	Foreign-born, highly-qualified workers residing in Austria
	Doctoral students from non-EU countries	Number of Doctoral candidates non-EU	Doctoral students from non-EU countries
To do this, the entire education system must be optimised – to models of lifelong learning.	Participation in lifelong learning	Lifelong-learning	Participants in measures for further education aged 25 to 64
Research at Universities and Non-University Research Institutions – Basic Research and Universities			
Increase investments in basic research by 2020 to the level of leading research nations.	Basic research expenditure as a percentage of GDP	Basic research expenditure as a percentage of GDP	Expenditure on basic research as defined by the OECD Frascati Manual
Strengthening of basic research through further structural reforms of the university system. Vision: Austria is a top location for research, technology and innovation, which offers optimum working conditions and career opportunities for excellent scientists. Excellent research is a matter of course in Austria.	Publication quality	Publication quality	Number of publications among the 10% most cited publications worldwide
	International co-publications	International co-publications	Number of scientific publications with at least one foreign co-author
	ERC Grants per inhabitants in million	ERC Grants per inhabitants	ERC Grants (Starting, Advanced and Consolidator Grants)
	Positioning of Austrian universities in international research rankings.	University ranking research performance	Number of Austrian universities in broad ranking groups (1-500) of international comparisons of research performance, weighted by ranking groups and relative to the population (currently only Leiden Ranking)

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	All foreign-born people residing in Austria	The indicator reflects the qualification structure of immigration. It comprises foreign-born people with residence permit and at least three-month duration of stay. A university degree is the qualification criterion.	OECD		38
	All doctoral students	Doctoral students from non-EU countries as a percentage of total doctoral students.	IUS Innovation Union Scoreboard		39
	Total population 25 to 64	Participation in lifelong learning is an official target of the ET 2020 Strategy (general and vocational learning)	Eurostat		40
	GDP	The Innovation Leaders are not used for comparative purposes, as only Denmark collects data on basic research. In this case, the reference countries are the five OECD countries with the highest level of basic research expenditure as a percentage of GDP for which data is available (most recent available year: 2010: Switzerland, South Korea, Denmark, France, USA)	OECD MSTI		41
	Total number of scientific publications	The indicator is a measure for the quality of scientific publications, i.e. the quality of research.	IUS Innovation Union Scoreboard		42
	Total population	International scientific co-publications can be interpreted as an indication of the quality of scientific research, since international co-operation normally increases scientific productivity.	IUS Innovation Union Scoreboard		43
	Total population in million	The indicator reflects the success in obtaining ERC funds, which are awarded only for international top research following a strict evaluation process. The indicator is calculated on the basis of the data published annually by the ERC.	ERC or OECD MSTI		44
	n. a.	The indicator shows how Austrian universities position themselves in terms of international research performance. It shows the number of Austrian universities in broad ranking groups (1-50, 51-100, 101-200, 201-300) in international university comparisons (currently only Leiden Ranking) relative to the size of the country (number of universities per 10 million inhabitants); the number of universities is weighted with the ranking groups (the better the ranking group, the higher the weighting). This indicator also shows whether a country has only a single leading institution or a broader range.	Leiden Ranking	Report 2013: PGA calculated as GD	45

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Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Research at Universities and Non-University Research Institutions – Basic Research and Universities			
Reform university funding (more competitive and project-related, incl. cost coverage). The funding of university research through competitive external funding from the FWF needs to be reinforced.	Budget for funds to support basic research per academic researcher	Competitive funding	Budget for funds to support basic research per academic researcher
Vision: attractive scientific careers based on international models are a common standard at Austrian universities.	Percentage of doctoral students employed at university (uni:data)	Employed doctoral candidates	Doctoral students with an employment contract at university
Research and Innovation in the Corporate Sector – Innovation and Corporate Research			
Enhance domestic value creation by encouraging research intensive industries and knowledge intensive services.	Share of knowledge-intensive sectors in employment	Knowledge-intensity economy	Employment in knowledge-intensive sectors (sectors in which more than 33 % of the employed labour force have completed tertiary education)
	Contribution of medium and high-technology products to the trade balance	Knowledge-intensity exports	Contribution of medium and high-technology products to the trade balance (for the exact calculation see IUS 2013)
	Innovation-intensive sectors as a share of total services exports	Knowledge-intensity service export	Export innovation-intensive service sectors
The structure of the manufacturing and service sectors has to be improved by increasing the innovation and knowledge-intensity of firms.	R&D quota in the corporate sector, adjusted by industry structure	R&D intensity business	Corporate-sector R&D spending, adjusted by the industry-specific R&D intensities
	Export quality in technology-orientated industries	Export quality	Exports of technology-orientated industries of material goods in the highest and middle price segment

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	Number of researchers in the university sector according to research statistics	As a rule, funds to finance basic research allocate their resources on a project basis following a competitive procedure. The budget per academic researcher is thus an indicator of the structure of university funding.	OECD MSTI, FWF		46
	Number of doctoral students	An employment contract while studying for a doctorate is standard international practice to ensure the attractiveness of careers in science. Doctoral programmes in science can last 3 to 6 years; during this period students who have not enrolled in a doctoral programme are already working. Without employment, careers in science are therefore hardly an attractive option compared to a career in industry.	Uni:Data	National target was used	47
	Total employment	The indicator shows the weight of employment in sectors, which employ many university graduates in an international comparison and are thus regarded as particularly knowledge-intensive.	IUS Innovation Union Scoreboard		48
	Total value of all exports	The indicator measures the contribution of medium and high technology products to the trade balance and can thus also be seen as a measure of the knowledge intensity of the export structure.	IUS Innovation Union Scoreboard	PGA in the Fig. capped at 200	49
	Total exports of services without tourism	The indicator shows the export weight of service sectors with high innovation intensity and can thus also be seen as a measure of the knowledge intensity of the export structure. Due to the specific characteristics of Austria (Alps, cultural cities) tourism accounts for a far higher share of services exports in an international comparison. Thus this sector is not taken into consideration.	EBOP, WIFO-calculations		50
	Value creation in the corporate sector	The R&D intensity can be interpreted as a measure of knowledge intensity. However, the average R&D intensities vary greatly depending on the sector and an adjustment of the industry structure is necessary in order to make an internationally comparable statement on the R&D intensity of the corporate sector.	OECD, WIFO-calculations		51
	Total export of technology-orientated industries for material goods	Export quality can be interpreted as a measure to improve the product structure.	Eurostat, WIFO-Calculations		52

Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Research and Innovation in the Corporate-Sector – Innovation and corporate research			
The number of firms that systematically conduct research and development should be increased between 2010 and 2013 by a total of 10% from 2,700 and by a total of 25% by 2020.	Increase in the number of companies conducting systematic research and development	R&D Performers	Number of companies in Austria conducting systematic research and development
Mobilise SMEs in research and innovation performance	Share of innovative SMEs	Innovative SMEs	SMEs with product or process innovation
Further increase Austria's attractiveness as a location for research and technology intensive firms.	Foreign-funded R&D	Foreign-funded R&D	R&D funding from abroad
	Share of foreign owners (applicants) of EPO patents with the participation of inventors residing in Austria	Foreign-owned patents	Number of patents with purely foreign applicants and at least one domestic inventor
Sustainable increase in the level of innovation in companies by increasing the share of innovations, which are new to the market	Share of innovations, which are new to the market as measured by the revenue they generate	Innovation revenue	Revenue produced by innovations, which are new to the market
Research and Innovation in the Corporate Sector – Cooperation between Science and Business			
We want to increase the co-operation intensity of Austrian firms and strengthen strategically-orientated collaboration between science and business (focus on excellence and sustainability).	Share of companies with innovation co-operation with universities/research institutions	Business-Science Links LCU	Companies with innovation co-operation with universities/research institutions
Reduce barriers to, and companies' (SMEs) fears about, co-operation with science/research	Share of SMEs with innovation co-operation with universities/research institutions	Business-ScienceLinks SMEs	SMEs with innovation co-operation universities/research institutions
More firms should expand their technology leadership and attain top positions in innovation	PCT applications relative to GDP	Technological significance of patents	Number of patents applications filed under the PCT, at international phase, designating the European Patent Office (EPO).

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	n. a.	Survey units engaged in R&D, by performance sector (co-operative research and in-house research subsumed)	Statistik Austria	National target	53
	Total number of SMEs	The indicator describes the share of SMEs with innovation activity, i.e. a measure of innovation breadth.	IUS Innovation Union Scoreboard		54
	Gross domestic expenditure on R&D	A disproportionately large share of research spending in Austria is financed from abroad. While this is an indication of Austria's quality as a location for research, it also increases the fragility of research activity in Austria. Thus, there is no need for continued growth in the share of foreign funding, at the same, however, a dramatic fall is also undesirable.	OECD MSTI	capped in the Fig. at 200	55
	Number of all patents with the participation of at least one domestic inventor	This indicator shows the control of foreign entities over inventions made by inventors living in Austria. Consequently it demonstrates the share of patents with at least one domestic inventor and where all applicants live abroad as a percentage of total patents owned by national inventors.	OECD, REGPAT Database		56
	Companies' revenues	The indicator reflects the economic significance of innovations, which are not only new to the company, but also new to the market and are therefore particularly innovative. It is thus an impact indicator for innovation	Eurostat		57
	Total population of companies	This indicator reflects the intensity of co-operation between companies and science and research	Eurostat		58
	Total population of SMEs	This indicator reflects the co-operation intensity of SMEs with science and research	Eurostat	PGA in the Fig. capped at 200	59
	GDP at PPS	The number of patent applications can be understood as an indicator of the number of innovations	IUS Innovation Union Scoreboard		60

Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Research and Innovation in the Corporate Sector – Start-Ups and Venture Capital Financing			
Substantially increase the intensity of private equity and venture capital in the formation of technology-based, innovative firms.	Venture capital intensity (market statistics)	Venture capital intensity	Venture capital invested in Austria (also through foreign funds)
Number of knowledge- and research-intensive new start-ups should climb annually by an average of 3% until 2020.	Average annual growth in the number of knowledge and research-intensive start-ups.	Start-ups material goods	Number of knowledge and research-intensive business start-up (material goods)
		Start-ups services	Number of knowledge and research-intensive start-ups (services)
Starting a business should be made much easier and relieved of cost burdens.	Ranking with respect to start-up regulations in Doing Business	Start-up regulation	Ranking with respect to start-up regulations in Doing Business
Research and Innovation in the Corporate Sector – Innovation and Competition			
Stimulate innovation via an active competition policy. To do this, institutions that monitor competition should be strengthened.	OECD indicator Competition policy	Competition policy	OECD indicator Competition policy
Political Governance of the RTI System – Setting Priorities			
Strengthen Austria's competitiveness in a wide range of cross-cutting fields in science and technology by focusing activities on units of internationally competitive size. To do this, fields in which domestic science and business are strong should be taken into account. Special attention must be paid to the competences and potentials of Austrian firms that can help implement research results for overcoming the Grand Challenges.	PCT patent applications in fields of technology that are particularly important for societal challenges	Priority: Patents	PCT patent applications in selected technological fields (climate change mitigation and health)
Political Governance of the RTI System – Funding System and International Positioning			
Increased Austrian participation in European funding programmes, for example in the Research Framework Programmes or the European Structural Funds.	Returns ratio	Returns ratio	Austria's share of grants from the 7th Framework Programme (core programme)
	"Utilised capacity" (participation in Framework Programme based on researchers per country)	Participation in Framework Programme	Austrian participations as a share of total participations (EU 27) in the respective Framework Programme.

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	GDP	This indicator measures venture capital intensity on the basis of the total sums invested in Austria, also by foreign funds (market statistics).	AVCO, EVCA		61
	n. a.	This indicator measures start-up activity in knowledge and research-intensive sectors of the material goods industry.	Statistik Austria	National target; PGA in the Fig. capped at 200. Report 2013: PGA calculated as GD	62
	n. a.	This indicator measures start-up activity in knowledge and research-intensive industries within the service sector.	Statistik Austria	National target; Report 2013: PGA calculated as GD	63
	n. a.	The indicator compares the regulatory framework for founding an LLC (GmbH) in the different countries based on the following four criteria: number of necessary administrative steps, time, costs (% GDP per capita) and minimum capital (% GDP per capita).	World Bank	Inverted	64
	n. a.	The indicator classifies a number of rules governing competition in terms of their propensity to facilitate competition.	OECD	Inverted, normalised, break in time series (2013); Report 2013: PGA calculated as GD	65
	GDP in PPS	This indicator measures inventive activity in fields of technology that make an important contribution to overcoming two societal challenges (climate change and the ageing population, and health).	IUS Innovation Union Scoreboard		66
	Austria's contribution to the EU budget.	The indicator shows Austria's success at obtaining EU funding relative to its total EU budget contribution, i.e. whether Austria obtains an above or below-average return in research. An above-average return indicates that Austria receives a high proportion of European grants.	PROVISO	Report 2013: PGA calculated as GD	67
	Researchers/country as a share of total researchers EU 27	This indicator shows whether a country's involvement in the FP is above or below its theoretically available capacity (potential). The indicator is calculated over the period of the relevant Framework Programme as of the census date).	PROVISO	Report 2013: PGA calculated as GD	68

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Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Political Governance of the RTI System – To Society Research and Society			
A culture of appreciation for research, technology, and innovation, and an understanding of how this field makes an essential contribution to increasing the quality of life and societal prosperity	Attitude towards science (personal interest, economic benefits)	Personal interest in science	Share of people with a high to medium appreciation of science in different areas
		Economic benefits of science	
		Positive attitude toward science	
Financing Research, Technology and Innovation			
Increase research intensity by one percentage point, from 2.76% today to 3.76% in 2020.	R&D intensity	R&D intensity	Gross domestic expenditure on research and development
Of this investment amount, at least 66%, but 70% if possible, should come from the private-sector. To this end, firms should be stimulated on a broad front (including an improved regulatory situation and sufficient incentive structures) to perform more research and innovation. The number of firms conducting research and development should be increased.	Share of research funding provided by the private-sector	Private-sector R&D	R&D financing from non-governmental sources

	Denominator	Short explanation of indicator	Source	Calculation Information	ID No.
	All respondents	This indicator shows the public perception of science. The questions in the Special Eurobarometer were divided into two groups. One set of questions addressed the personal benefits of, or interest in, science and technology, the other, the benefits of science and technology for the economy.	Euro-barometer	Report 2013: PGA calculated as GD	69
				Report 2013: PGA calculated as GD	70
				Report 2013: PGA calculated as GD	71
	GDP	R&D Intensity: Gross domestic expenditure as a percentage of GDP	OECD MSTI, Statistik Austria	National target	72
	Total expenditure on R&D	The share of private-sector research funding is the share of total R&D spend that is financed by business enterprises.	OECD MSTI, Statistik Austria	National target	73

Appendix 2: Indicators' Raw Data

Indicator	Current Value AT	Inno. Lead.	Goal Distance	Growth AT	Inno. Lead.	Productive Growth	Prospect of Goal Achievement	Time Series	ID
Innovation Performance	0.59	0.71	83	1.59	0.87	3.86	88	2006 – 2014	1
GDP/per capita	129.00	121.95	106	-0.19	-0.12	-0.90	105	2000 – 2013	2
Employment-to-Population Ratio	75.50	76.45	99	0.43	0.26	0.44	100	2000 – 2013	3
Unemployment rate	4.90	7.13	145	2.40	0.53	6.52	132	2000 – 2013	4
Better Life	7.52	8.05	93	0.15	0.28	1.68	91	2012 – 2014	5
Healthy Life Years (F)	74.70	74.03	101	0.20	0.29	0.27	99	2004 – 2012	6
Healthy Life Years (M)	76.80	78.28	98	0.08	0.12	0.45	97	2004 – 2012	7
Greenhouse gases	104.02	84.00	81	0.02	-1.32	-2.64	81	2000 – 2012	8
Energy Intensity	5.19	5.95	115	-0.30	-1.50	0.22	104	2000 – 2012	9
Resource Productivity	1.54	1.54	100	2.03	-23.83	-2.10	139	2000 – 2012	10
Early childhood care	93.80	95.00	99	0.86	1.32	0.16	106	2000 – 2012	11
Student-teacher ratio early childhood	13.95	9.73	70	-2.64	-4.50	-11.79	45	2002 – 2012	12
Student-teacher ratio in primary education	12.00	13.80	115	-1.58	-1.41	0.28	116	2001 – 2012	13
Early school leavers	7.30	9.50	130	-2.54	-1.45	3.83	156	2000 – 2013	14
Secondary School Graduates	42.40	55.00	77	1.16	n.a.	3.79	84	2000 – 2013	15
Early school-leavers migrants	81.46	60.00	136	0.24	n.a.	-4.27	138	2011 – 2013	16
Inheritance of Education 1	42.01	36.90	88	-0.44	-0.72	-2.26	86	2000 – 2012	17
Inheritance of Education 2	15.29	11.71	77	-0.69	-1.84	-5.07	70	2000 – 2012	18
PISA Risk – Reading	19.49	15.00	77	2.42	0.97	-3.22	64	2000 – 2012	19
PISA Risk – Mathematics	18.65	15.00	80	-0.07	2.70	-2.69	81	2003 – 2012	20
PISA Risk – Science	15.78	15.00	95	-0.58	2.73	-0.63	100	2006 – 2012	21
PISA Risk – Reading	5.52	8.94	62	-3.84	-2.15	4.09	53	2000 – 2012	22
PISA Top Students – Mathematics	14.29	12.67	113	0.00	-4.03	-4.35	143	2003 – 2012	23
PISA Top Students – Science	7.85	10.58	74	-3.90	-1.62	2.10	62	2006 – 2012	24
Skill Mismatch	89.20	82.00	109	n.a.	n.a.	-0.76	na	2009	25
University Graduates	27.30	42.48	64	3.65	2.11	8.83	71	2005 – 2013	26
University Graduates (incl. ISCED 4a)	39.63	38.00	104	3.01	-23.47	-0.60	128	2004 – 2013	27
Supervisor-Student Ratio	17.14	12.30	72	2.83	0.79	-3.28	61	2002 – 2012	28
Percentage of GDP spent on Higher Education	1.48	2.00	74	3.20	0.88	3.43	98	2000 – 2011	29
University Expenditure per Student	1.4894.90	19199.15	78	2.92	4.91	7.98	65	2000 – 2011	30
Researchers	9.37	13.10	72	3.55	2.71	7.99	75	2002 – 2013	31
Doctorate Holders STEM	1.00	1.13	89	4.35	2.48	4.06	102	2000 – 2012	32
STEM graduates	16.40	18.15	90	7.10	3.78	5.08	116	2000 – 2012	33
Share of female researchers	28.99	34.95	83	3.81	1.24	4.08	98	2002 – 2011	34
Share of women in science	35.73	40.09	89	0.13	0.29	1.75	88	2000 – 2012	35
Share of women in engineering	20.03	26.68	75	2.50	1.50	5.45	80	2000 – 2012	36
Glass Ceiling Index EU	1.90	1.81	95	-3.75	-1.89	-1.99	120	2004 – 2010	37

Indicator	Current Value AT	Inno. Lead.	Goal Distance	Growth AT	Inno. Lead.	Productive Growth	Prospect of Goal Achievement	Time Series	ID
Highly-qualified Immigrants	19.22	25.93	74	2.58	0.93	5.47	82	2000 – 2013	38
Doctoral Candidates Non-EU	9.00	15.42	58	2.32	5.18	13.08	45	2004 – 2012	39
Lifelong Learning	13.90	23.05	60	4.05	2.93	10.65	65	2000 – 2013	40
Basic research (expenditure as a percentage of GDP)	0.51	0.55	92	3.90	-17.33	2.51	113	2002 – 2011	41
Publication Quality	11.05	12.62	88	1.89	0.56	1.89	100	2002 – 2009	42
International Co-Publications	1313.61	1451.02	91	6.91	6.69	8.21	91	2004 – 2012	43
ERC Grants per inhabitants in million	2.73	2.16	127	12.90	12.65	10.40	117	2009 – 2013	44
University Ranking Research Performance	23.60	24.85	95	28.54	-7.24	-3.99	771	2011 – 2013	45
Competitive Funding	25.75	47.08	55	4.58	6.25	15.62	50	2007 – 2013	46
Doctoral Candidates with Employment Contracts	27.09	100.00	27	5.38	n.a.	20.51	39	2010 – 2013	47
Knowledge Intensity Business	14.60	15.75	93	1.13	0.36	1.50	97	2008 – 2013	48
Knowledge Intensity Exports	3.40	2.25	151	5.49	-1.75	-3.37	185	2005 – 2013	49
Knowledge-Intensity Services Exports	69.93	69.79	100	1.65	1.08	-3.30	142	2004 – 2013	50
R&D Intensity Industry	0.66	0.50	133	19.43	-70.42	2.83	331	2009 – 2012	51
Export Quality	88.61	92.17	96	-0.28	-0.06	0.51	95	1999 – 2013	52
R&D Performers	3384	3375	100	6.36	n.a.	-0.03	175	2002 – 2011	53
Innovative SMEs	37.46	44.48	84	-3.39	-0.33	2.01	65	2004 – 2012	54
Foreign-Funded R&D	16.36	8.51	192	-1.48	-20.65	-5.94	138	2000 – 2013	55
Foreign-Owned Patents	24.07	21.95	110	-2.91	3.54	3.08	58	2000 – 2011	56
Innovation revenue	7.30	10.00	73	0.60	-1.48	9.94	49	2004 – 2012	57
Business-Science Links LCU	50.60	50.67	100	4.29	-0.30	-0.29	143	2004 – 2012	58
Business-Science Links SMEs	25.20	24.80	102	7.81	0.22	-0.32	187	2004 – 2012	59
Technological Significance Patents	4.96	8.09	61	0.93	-0.83	4.78	71	2004 – 2011	60
Venture Capital Intensity	0.17	0.38	45	-10.26	-10.95	5.86	31	2007 – 2013	61
Start-Ups Material Goods	1.70	3.00	57	24.16	n.a.	7.35	57	2010 – 2012	62
Start-Ups Services	-9.20	3.00	43	60.73	n.a.	11.13	43	2010 – 2012	63
Start-Up Regulation	101.00	58.75	58	3.96	14.61	0.40	81	2006 – 2014	64
Competition Policy	0.35	0.13	38	-10.00	-6.51	-19.57	45	2003 – 2013	65
Priority Objective Patents	1.09	1.97	55	3.69	0.20	6.90	76	2003 – 2011	66
Returns Ratio	125.00	117.25	107	1.69	-0.49	-1.10	121	2002 – 2013	67
Participation in FP	127.00	94.25	135	-3.05	0.11	-4.02	107	2012 – 2013	68
Personal Interest Science to Society	9.20	18.81	49	-24.06	-19.17	-8.61	27	2010 – 2013	69
Economic Benefits of Science	63.63	67.62	94	-2.16	-1.55	-0.59	89	2010 – 2013	70
Positive Attitude to Science	44.52	61.90	72	2.37	-0.70	4.06	89	2010 – 2013	71
GERD-to-GDP Ratio	2.83	3.76	75	2.93	0.66	4.85	89	2000 – 2014	72
Private-Sector R&D	60.64	66.00	92	-0.30	n.a.	1.42	90	2000 – 2014	73

Goal Distance = actual value AT /actual value Innovation Leaders or actual value AT/target AT

Prospect of Goal Achievement = Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020

Appendix 3: Methodology and Explanatory Notes for Interpreting the Figures and Indicators

All the indicators used in this report are based on the explicit targets set out in the Austrian Government's RTI strategy. The indicators are depicted in Figures 1, 10, 11, 12, 14 and 17 according to their distance to the goal (**goal distance**) and their **goal achievement prospect**.

The goal distance on the horizontal axis indicates the Austrian actual value. It shows the relationship or the distance of the latest available Austrian value to the national goal set by the RTI strategy or the Education and Training 2020 Strategy.¹²⁸ If there is no national goal, the latest available average value of the current four innovation leaders Germany, Finland, Denmark and Sweden ("innovation leaders, actual value") is used.¹²⁹ This is because catching up with the innovation leaders has been defined as a priority objective in the RTI strategy.

All indicators are to be interpreted in the same way, i.e. values above 100 indicate that a goal has been achieved, values below 100 the distance to the goal. Values are normed as follows: The Austrian value is divided by the respective target value and multiplied by 100. If performance improvements are accompanied by a decline in the indicator values, e.g. the unemployment rate, the values are inverted, (i.e. target value in the numerator, Austrian value in the denominator) to maintain the interpretation "greater than or equal to 100 = goal achievement". The relevant indicators are shown in the List of indicators under the heading "calculation information". Values over 200 are capped at 200 in the diagrams. The goal distance provides information

about the distance to the goal (i.e. about Austria's current performance) but not about the changes or the dynamics that are necessary for the goal to be achieved. Thus an indicator, which is currently just slightly below target, can deteriorate again as the result of a negative dynamic. In other words, it is not possible to predict the likelihood that a goal will be achieved by comparing goal distances only.

For this reason, the **goal achievement prospect** depicted on the vertical axis, was chosen as a second dimension of the indicator-based presentation. Depicting the value projected for Austria in 2020 – based on the average annual growth rates of the past statistical series (see Appendix 2) – relative to the target value for 2020, shows whether previous growth achieved for an indicator will suffice for target attainment. If no national target has been set, the projected value for 2020 (calculated on the basis of the average past growth rates)¹³⁰ is used instead of the innovation leaders' actual value.

A goal achievement prospect of over 100 signifies that the rate of growth achieved in the past was higher than would have been necessary to achieve the goal. The likelihood of achieving the goal in 2020 is therefore correspondingly high. If the value is below 100, the past dynamic indicates that the goal is unlikely to be achieved. Values over 200 are again capped at 200 in the diagrams.

It is important to stress that these calculations are based on past average growth rates. They are not therefore forecasts based on assumptions, but illustrate how the trend will develop in future, as-

¹²⁸ At the suggestion of the then BMUKK, target values from the independent Education and Training 2020 Strategy were adopted for a number of indicators for the education system.

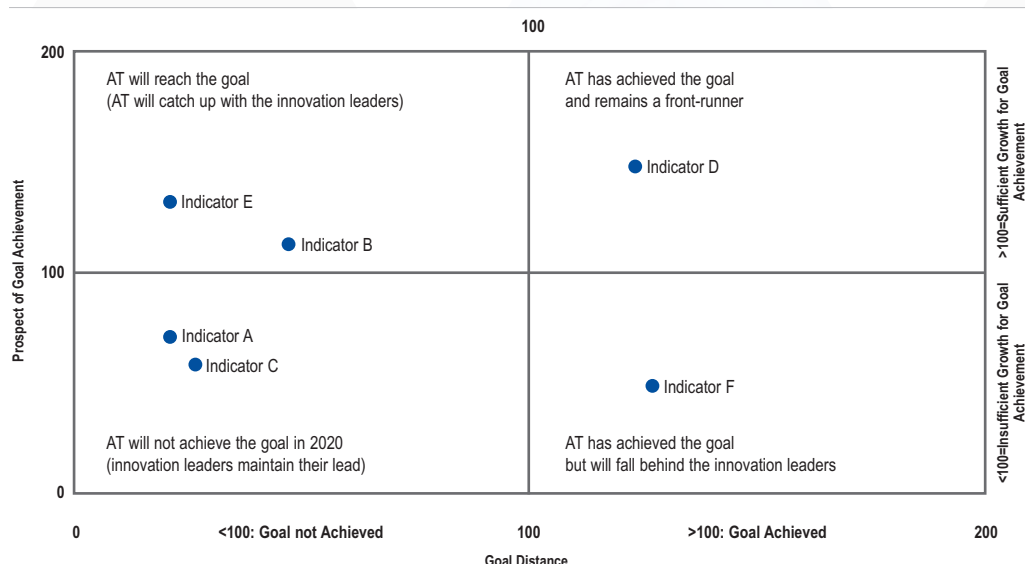
¹²⁹ The term innovation leader refers to the countries in the EU classified as the innovation leaders by the Innovation Union Scoreboard (IUS) of the European Commission.

¹³⁰ The underlying argument is that it is unlikely that the innovation leaders will stagnate at their current levels. Thus Austria's rank in the Innovation Union Scoreboard is always relative to that of other countries, i.e. it always takes into account the growth of all the other countries. Thus setting the target value at the innovation leaders' actual value would lead to excessively optimistic goal achievement prospects and might distort the assessment of which measures should be accorded priority.

suming that things continue as in the past. The results will change in line with the rate of growth over the coming years and will be incorporated into the regular updates of the depictions. Like all calculations, they should be interpreted with caution, but they do at least provide a rough picture of the dynamics of the individual targets from which conclusions can be drawn regarding the priority fields of action. The combination of goal distance and goal achievement prospect translates into a diagram

comprising four areas, each with different implications (see Figure 33) If an indicator is located in one of the two quadrants on the left, it means that the relevant goal has not yet been achieved. For indicators in the bottom-left quadrant this could remain the case due to low growth and a failure to take additional measures or intensify existing ones. Measures that are likely to improve indicator values in this area should therefore be accorded

Figure 33: Sample Illustration to Explain the Interpretation of the Indicators



Sources: see Appendix 1. Note: Goal Distance=Austria's actual value relative to the target value defined in the RTI Strategy or to the Innovation Leaders' actual value (average value most recent available year DE, DK, FI, SE); Prospect of Goal Achievement=Value projected for Austria in 2020 relative to the target value. Values over 200 cut off. Raw Data: see Appendix 2.

special priority. In the upper-left quadrant, continued development at the same rate as in the past could lead to the achievement of the goal, i.e. no further measures would be necessary, assuming that the trend continues to move in the same direction.¹³¹ Indicators in the two right-hand quadrants show that the relevant goals have already been achieved. Indicators in the upper-right quadrant

will in all probability remain there due to the specific indicator's high level of growth, provided that the innovation leaders' growth remains within the expected limits. In the bottom-right quadrant, Austria's growth will not suffice to maintain its lead over the innovation leaders in the long term. The trends should therefore be monitored very closely so that timely counter measures can be taken if necessary.

¹³¹ As the indicator sets are updated every year, changes in trends are captured in almost real time.

Appendix 4: Details of the Innovation Output Indicators in Figure 6

appendix

Indicator	Definition	Source
Export Quality	See Indicator 52	Eurostat, WIFO calculations
Corporate R&D Intensity	See Indicator 51	OECD, WIFO calculations
Proportion of Revenues Generated by Innovation	See IUS Indicator 3.2.4.	IUS Innovation Union Scoreboard
Innovative SMEs	See Indicator 54	IUS Innovation Union Scoreboard
Innovation at the Firm Level	See IUS composite indicator "Innovators"	IUS Innovation Union Scoreboard
Knowledge-Intensity Services Exports WIFO	See Indicator 50	EBOP, WIFO calculations
Knowledge Intensive Services Exports IUS		IUS Innovation Union Scoreboard
Technology-Orientated Exports to the BRIC Countries	Shares of exports to BRIC in total manufacturing as percent according to factor inputs	WIFO
Manufacturing Exports (high und medium-high tech)	See Indicator 49	Eurostat, WIFO calculations (similar to IUS)
Employment in Knowledge-Intensive Sectors	See Indicator 48	Eurostat, WIFO calculations (similar to IUS)
Economic Effects of Innovation	See IUS composite indicator "Economic effects"	IUS Innovation Union Scoreboard
Economic Effects of Innovation WIFO		Eurostat, WIFO calculations (similar to IUS)

Appendix 5: Ranking of Indicators after Change in Goal Distance (GD) and Prospect of Goal Achievement (PGA)

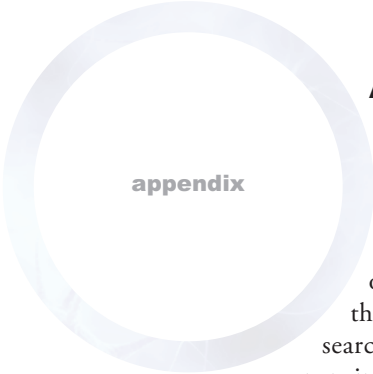
ID	Indicator	Change in Value for RB 2015-2010 GD	ID	Indicator	Change in Value for RB 2015-2010 PGA
51	Intensity of Corporate R&D	78.86	45	University Ranking Research Performance	100.00
45	University Ranking Research Performance	33.79	44	ERC grants per inhabitants in million	88.14
23	PISA top students – mathematics	29.80	21	PISA risk students – science	70.68
21	PISA risk students – science	23.40	23	PISA top students – mathematics	60.80
19	PISA risk students – reading	22.57	10	Resource productivity	48.75
64	Regulation of start-ups	20.97	50	Knowledge-intensity services exports	47.87
62	Start-ups material goods	19.92	64	Regulation of start-ups	45.41
49	Knowledge-intensity exports	17.22	19	PISA risk students – reading	38.49
20	PISA risk students – mathematics	15.86	20	PISA risk students – mathematics	37.22
14	Early school leavers	15.68	24	PISA top students – science	29.37
27	University graduates (incl. ISCED 4a)	13.31	46	Competitive funding	21.64
53	R&D generators	12.98	62	Start-ups material goods	19.92
44	ERC grants per inhabitants in million	10.31	35	Proportion of women in science	17.31
46	Competitive funding	8.75	22	PISA top students-reading	17.15
35	Proportion of women in science	8.71	17	Inheritance of education 1	16.36
10	Resource productivity	8.37	27	University graduates (incl. ISCED 4a)	15.31
63	Start-ups in service sector	7.81	14	Early school leavers	15.16
17	Inheritance of education 1	7.32	36	Proportion of women in engineering	12.64
38	Highly-qualified immigrants	7.10	6	Healthy life expectancy (F)	12.16
22	PISA top students-reading	7.06	26	University graduates	10.47
36	Proportion of women in engineering	7.03	8	Greenhouse gases	8.58

ID	Indicator	Change in Value for RB 2015-2010 GD	ID	Indicator	Change in Value for RB 2015-2010 PGA
72	GERD-to-GDP ratio	6.93	7	Healthy life expectancy (M)	8.36
71	Positive attitude toward science	6.52	63	Start-ups in service sector	7.81
26	University graduates	6.25	54	Innovative SMEs	7.71
50	Knowledge Intensity Services Exports	5.91	47	Doctoral candidates with employment contracts	7.68
24	PISA top students – science	4.92	53	R&D generators	6.70
13	Student-staff ratio primary level	4.55	38	Highly-qualified immigrants	5.70
15	Secondary school graduates	4.54	12	Teacher-child ratio early childhood	5.30
8	Greenhouse gases	4.39	15	Secondary school graduates	4.26
6	Healthy life expectancy (F)	4.17	2	Per capita GDP	3.34
1	Innovation Performance (IUS)	3.83	1	Innovation Performance (IUS)	2.82
47	Doctoral candidates with employment contracts	3.22	41	Proportion of GDP spent on basic research	2.50
7	Healthy life expectancy (M)	2.88	11	Early childhood care	0.23
41	Proportion of GDP spent on basic research	2.63	42	Publication quality	0.00
65	Competition policy	2.48	9	Energy intensity	-0.10
12	Teacher-child ratio early childhood	1.97	52	Export quality	-0.76
11	Early childhood care	1.79	43	International co-publications	-1.20
48	Knowledge-intensity business	1.56	16	Early school-leavers immigrants	-1.67
2	Per capita GDP	1.47	28	Supervisor-student ratio university	-1.87
33	STEM graduates	1.15	48	Knowledge-intensity business	-1.99
16	Early school-leavers. immigrants	0.15	3	Employment-to-Population Ratio	-2.09
42	Publication quality	0.00	73	Private-sector R&D	-2.20
67	Return flow ratio	-0.17	39	Doctoral candidates from non-EU countries	-2.31
43	International co-publications	-0.22	13	Student-staff ratio primary level	-2.94
3	Employment-to-Population Ratio	-0.51	18	Inheritance of education 2	-3.43
31	Researchers	-0.82	30	University Expenditure per Student	-4.80
52	Export quality	-1.04	31	Researchers	-4.94
60	Technological significance of patents	-1.10	40	Lifelong learning	-8.14
54	Innovative SMEs	-1.50	57	Innovation revenue	-9.02
34	Proportion of women researchers	-1.61	60	Technological significance of patents	-9.54
73	Private-sector R&D	-1.67	33	STEM graduates	-12.51
70	Economic benefits to society	-1.75	72	GERD-to-GDP ratio	-12.63
29	Percentage of GDP spent on higher education	-2.19	29	Percentage of GDP spent on higher education	-12.66
37	Glass ceiling index EU	-2.24	5	Better life	-15.04
40	Lifelong learning	-2.25	32	PhDs in STEM subjects	-18.89
5	Better life	-2.41	34	Proportion of women researchers	-20.94
9	Energy intensity	-2.72	55	Foreign-funded R&D	-26.94
28	Supervisor-student ratio university	-3.19	56	Foreign-owned patents	-27.22
30	University Expenditure per Student	-3.90	61	Venture capital intensity	-35.90
32	PhDs in STEM subjects	-4.13	58	Business-Science Links LCU	-42.23
68	Participation in the FP	-4.24	4	Unemployment rate	-53.21
18	Inheritance of education 2	-4.34	66	Priority objective patents	-57.43
39	Doctoral candidates from non-EU countries	-4.57	49	Knowledge-intensity exports	-69.90
57	Innovation revenue	-7.24	37	Glass ceiling index EUQ	-91.74
69	Personal interest in science	-11.23	59	Business-science links SMEs	-100.00
66	Priority objective patents	-11.43	51	Intensity of Corporate R&D	-100.00
58	Business-Science Links LCU	-13.33	67	Return flow ratio	n.a.
61	Venture capital intensity	-21.20	71	Positive attitude toward science	n.a.
59	Business-science links SMEs	-23.20	69	Personal interest in science	n.a.
56	Foreign-owned patents	-31.45	68	Participation in the FP	n.a.
4	Unemployment rate	-34.14	65	Competition policy	n.a.
55	Foreign-funded R&D	-75.88	70	Economic benefits to society	n.a.
25	Skill mismatch	n.a.	25	Skill Mismatch	n.a.

Appendix 6: Indicators for the Global Innovation Monitor Including Raw Data

	Indicator	Available Time Series	
		Austria	
Economy, Society and Environment	Per capita GDP at Purchasing Power Standards (PPS)	2000-2013	
	Employment-to-Population Ratio	2000-2013	
	Unemployment Rate	2000-2013	
	Life Expectancy at Birth	2000-2012	
	Efficiency Increase: Resource Productivity	2000-2012	
	Efficiency Increase: Energy Intensity	2000-2012	
Education	Teacher-Child Ratio Early Childhood	2002-2012	
	University Expenditure per Student	2000-2011	
	PISA Average Score Reading	2000-2012	
	PISA Average Score Mathematics	2000-2012	
	PISA Average Score Science	2000-2012	
	PISA Inheritance of Education	2000-2012	
	University Graduates (Age Cohorts 25-34 Years)	2000-2012	
	STEM Graduates	2000-2012	
	STEM Graduates – Women	2000-2012	
University Research	University Ranking Research Performance	2011-2013	
	University Expenditure for R&D/Population	2002-2013	
	Proportion of GDP Spent on Basic Research	2002-2011	
Corporate Research	GERD-to-GDP Ratio	2000-2014	
	Proportion of Private-Sector Research Funding	2000-2013	
	Number of Researchers per 1,000 Employees	2002-2013	
	PCT Applications Relative to GDP	2000-2011	
	Regulation of Start-Ups	2006-2014	

	Available Time Series						
	China	Israel	Korea	Netherlands	USA	Switzerland	Source
	2000-2012	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	OECD
	2000-2012	2000-2013	2000-2013	2000-2013	2000-2013	2005-2013	OECD, World Bank (Data for China)
	2000-2012	2000-2013	2000-2013	2000-2013	2000-2013	2010-2013	OECD, World Bank (Data for China)
	2000-2012	2000-2012	2000-2012	2000-2012	2000-2011	2000-2012	OECD
	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	IEA, Energy Balances, 2014 ed.
	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	IEA, Energy Balances, 2014 ed.
	2002-2011	2004-2012	2002-2012	2011-2012	2002-2012	2004-2010	OECD Education at a glance
	2007-2008	2000-2011	2000-2011	2000-2011	2000-2011	2000-2011	OECD Education at a glance
	2003-2012	2006-2012	2000-2012	2003-2012	2000-2012	2000-2012	OECD PISA
	2003-2012	2006-2012	2000-2012	2003-2012	2000-2012	2000-2012	OECD PISA
	2003-2012	2006-2012	2000-2012	2003-2012	2000-2012	2000-2012	OECD PISA
	2000-2012	2006-2012	2000-2012	2003-2012	2000-2012	2000-2012	OECD PISA
	2010-2010	2003-2012	2000-2012	2000-2012	2000-2012	2000-2012	OECD EAG
	2003-2006	2000-2000	2000-2012	2000-2012	2000-2012	2000-2011	UNESCO
	2003-2006	2000-2000	2000-2012	2000-2012	2000-2012	2000-2011	UNESCO
	2011-2013	2011-2013	2011-2013	2011-2013	2011-2013	2011-2013	CWTS Leiden Ranking, WIFO Calculation
	2001-2013	2000-2013	2000-2013	2001-2013	2000-2012	2000-2012	OECD MSTI, World Bank
	2000-2013	2000-2013	2000-2012	2011-2012	2000-2012	2000-2012	OECD MSTI
	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2008	OECD MSTI
	2000-2012	2000-2012	2000-2013	2001-2013	2010-2012	2000-2012	OECD MSTI, WIFO Calculation
	2000-2013	2011-2012	2000-2013	2000-2013	2000-2011	2000-2012	OECD MSTI
	2000-2011	2000-2011	2000-2011	2000-2011	2000-2011	2000-2011	OECD
	2006-2014	2006-2014	2006-2014	2006-2014	2006-2014	2006-2014	World Bank



appendix

Appendix 7: Methodology and Notes for Interpreting the Figures and Indicators from the Global Innovation Monitor

The diagrams in the Global Innovation Monitor provide an overview of the trends in selected countries in the areas of economic performance, society and the environment, education, university research, corporate research and research financing. In each case, Austria (AT) is used as the reference point. The calculation of the dis-

tance to AT (x-axis) and the development dynamic (y-axis) are normed to Austria (=100). Those countries that currently have a better rating than Austria are shown to the right of 100. Those countries with a y-axis value >100 are developing more dynamically than Austria and are thus reducing their distance to Austria or cannot be overtaken by Austria.

List of Abbreviations

AHS Secondary School of General Education
AIFMG Alternative Investment Fund Manager Act
AIT Austrian Institute of Technology
AMS Public Employment Service Austria
AplusB Academia plus Business
AUF Non-university research organisations
AWS Austria Wirtschaftsservice
BHS Secondary technical and vocational high school or college
BIP Gross Domestic Product
BMASK Ministry of Labour, Social Affairs and Consumer Protection
BMVIT Ministry for Transport, Innovation and Technology
BMWF Federal Ministry of Science, Research and Economy
BRIC Brazil, Russia, India, China
BWB Austrian Competition Authority
CERN Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
CF Cohesion Fund
COMET Competence Centers for Excellent Technologies
CWTS Centre for Science and Technology Studies
DEA Data Envelopment Analysis
EAFRD European Agricultural Fund for Rural Development
EEA European Economic Area
ERDF European Regional Development Fund
EMFF European Maritime and Fisheries Fund
EPO European Patent Office
ERC European Research Council
ESF European Social Fund
ESFRI European Strategic Framework for Research Infrastructure
EU European Union
EuVECA European Venture Capital Funds Regulation
FFG Austrian Research Promotion Agency
FP Framework Programme (EU Framework Programme for Research and Innovation)

FWF Austrian Science Fund
GEM Global Entrepreneurship Monitor
GmbH Limited Liability Company
GSK Humanities, social and cultural sciences
HAK Higher Commercial College
HTL Higher Technical Institute
PPPI Public Procurement Promoting Innovation
IPR Intellectual Property Rights
ISCED International Standard Classification of Education
IUS Innovation Union Scoreboard
KLIEN Climate and Energy Fund
LCU Leading Competence Units
NeuFÖG New Companies Promotion Act
ÖAW Austrian Academy of Sciences
OECD Organisation for Economic Co-operation and Development
ORF Austrian Broadcasting Service
OSTA Office of Science and Technology – Austria
PCT Patent Cooperation Treaty
PEEK Programme for Arts-Based Research
PISA Programme for International Student Assessment
R&D Research and Development
RRI Responsible Research and Innovation
RTI Research, Technology and Innovation
SME Small and Medium-Sized Enterprises
SNF Swiss National Science Foundation
STEM Science, Technology, Engineering and Mathematics
STRAT.AT Partnership Agreement between Austria and the European Commission 2014-2020
TU University of Technology
USA United States of America
WIFO Austrian Institute of Economic Research
WKO Austrian Federal Economic Chamber
ZIT The Technology Agency of the City of Vienna

appendix

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