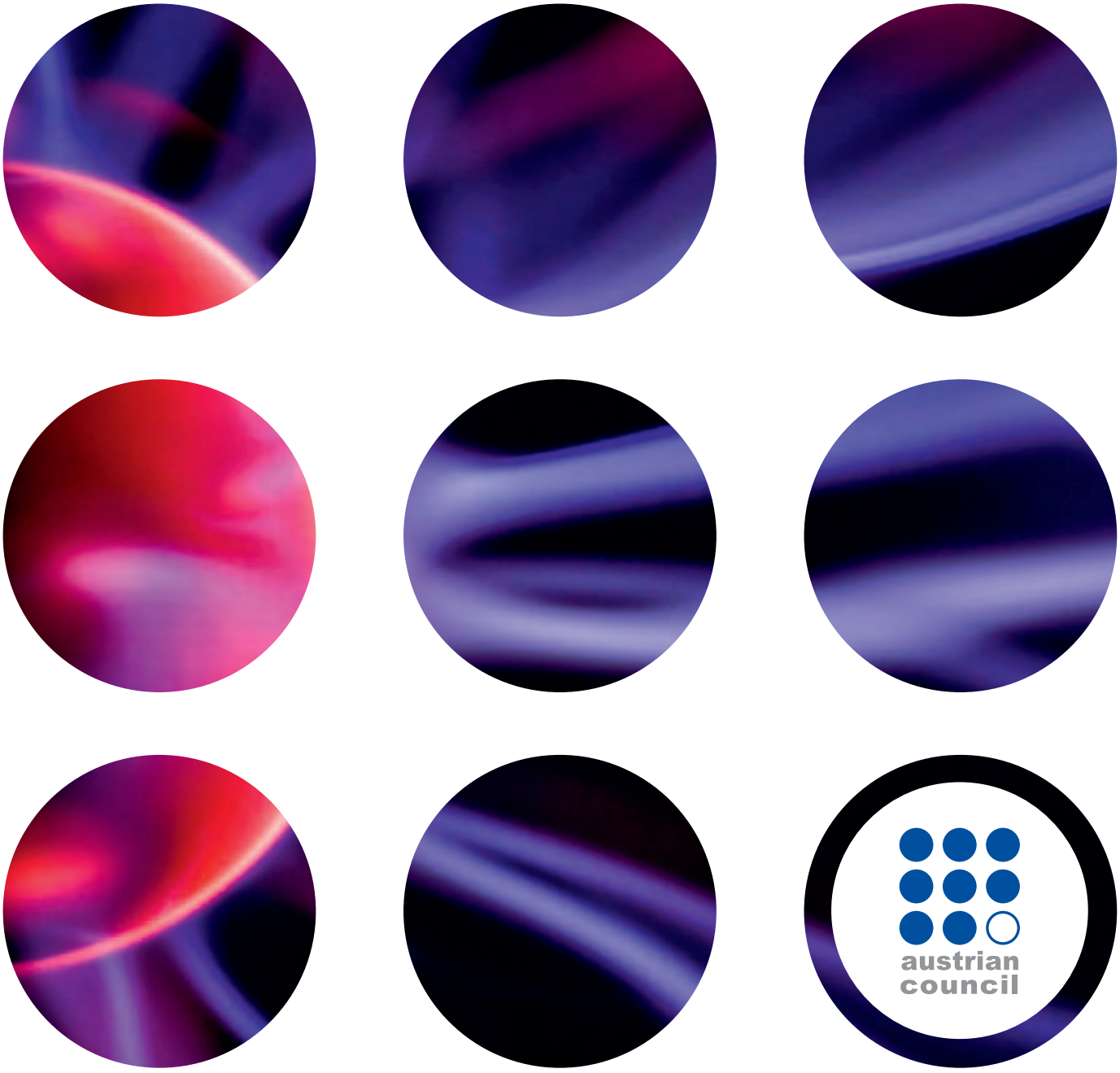

Report on Austria's Scientific and Technological Capability

2014

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contents

preamble

The Austrian Government has tasked the Austrian Council for Research and Technology Development with drawing up a yearly report on Austria's scientific and technological capability, which is submitted to Parliament together with the Research and Technology Report. The first report was presented in June 2012.

The report focuses on the degree to which the objectives set out in the Strategy for Research, Technology and Innovation (RTI Strategy), which remains a key guideline for RTI policy in the current Government programme, have been achieved. The Austrian Council was instructed to strategically monitor the implementation of the RTI Strategy and to evaluate the measures that have been put in place, as well as their goal orientation. The results of this monitoring will provide key data for evaluating the performance of the Austrian RTI system.

However, achieving this ambitious goal requires the speedy and determined implementation of the measures contained in the Strategy. The Austrian Council considers that Austria is still in a position from which it can join the leading group of nations and achieve the objectives of the Strategy. However, increased efforts are urgently needed if Austria is to genuinely make up ground against international competitors and not to fall back. Above all, this will require budgetary measures.

The Austrian Council will therefore continue to carry out the monitoring task entrusted to it by the Government and will keep under continuous review the challenges that have to be overcome if Austria is to join the ranks of the leading innovation nations. The Austrian Council sees its task as being to monitor developments in these areas and to assess their importance for the RTI system. With the strategic monitoring of the implementation of the RTI Strategy and its Report on Austria's Scientific and Technological Capability, the Austrian Council seeks to support the relevant ministries in their work and in this way to contribute to achieving the goals defined by the Federal Government.

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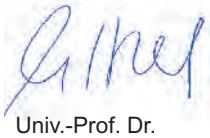

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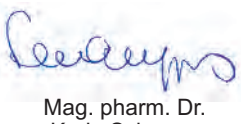

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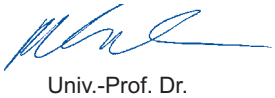

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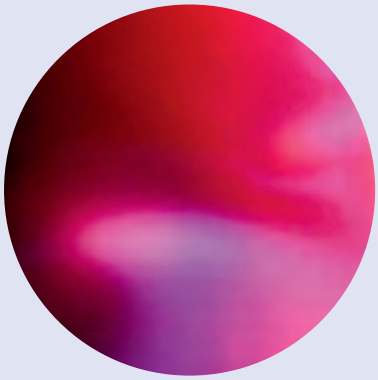





Executive Summary

executive summary

Against the background of a difficult global economic climate, Austria's economic development is to be viewed positively. Since the beginning of the millennium for example, Austria has recorded more or less stable GDP growth (both overall and per capita).[1] In terms of income per capita, Austria has thus strengthened its position as one of the top 5 European countries. This growth has been accompanied by relatively low income inequality (measured by the Gini co-efficient), high environmental standards and rising life expectancy by international standards.[2]

Among the factors cited negatively in the reports and rankings produced by the most important international organisations[3] are the pension system that is considered to be in need of urgent reform, high costs in the health care sector, the pent up need for educational reform, modernisation of administrative structures and a lack of reform in the areas of competition and regulation. This is aggravated by a severe imbalance in the structure of public finances. The public deficit that arose from the financial crisis (and the anti-cyclical investments necessary as a result) is now being countered largely by revenue-side measures to consolidate the budget, which only serves to exacerbate the effects of those aspects of the fiscal system that are unconducive to growth.[4]

All in all, despite a number of positive aspects, the challenges facing Austria as a result of changing global conditions have not faded away: globalisation, climate change, an ageing population, the financial crisis and technological trends etc. are affecting Austria too. While no single policy approach can provide answers to these challenges, there is nevertheless a consensus among experts that education, research and innovation are crucial for overcoming them.[5]

However, the Austrian education and RTI system has not yet responded to these changes adequately. In all relevant education and innovation ranking tables, Austria tends to be located in the middle. To use the diction of the Innovation Union Scoreboard (IUS), this means that Austria is still in the group of innovation followers and continues to have a performance deficit vis-à-vis the leading European innovation countries such as Sweden, Finland, Germany and Denmark. This is also confirmed by the indicators used in this report to measure innovation performance (see the "Evaluation of Austria's Performance" page 11 f).

[1] IMF (2013): World Economic Outlook Database; cf. Aiginger, K. (2013): Reformmüdigkeit als Gefahr für ein Erfolgsmodell. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 22–38.

[2] Cf. OECD (2013): Better Life Index.

[3] See also. OECD (2013): Economic Survey Austria; European Commission (2013): European Commission Council Recommendation on Austria's National Reform Programme; IMF (2013): Austria 2013 Article IV Consultation.

[4] The current deficit further curtails scope for government spending, above all for future expenditures, as a result of which taxes will have to be raised, despite a ratio of taxes and levies, which is higher than average. This lack of budgetary flexibility also means that, despite statements to the contrary, it will not be possible to reduce the burden on earned income, which is very high in an international comparison. Cf. Androsch, H. / Gadner, J. (2013): Die Zukunft Österreichs in der Welt von Morgen. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 254–272, p. 266; Keuschnigg, C. / Reitschuler, G. (2013): Mit einer Steuerreform in die Zukunft. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 164–172, p. 165 ff.

[5] Cf. The chapters in Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen; cf. Keuschnigg et al. (2013): Vision Österreich 2050: Vorsprung durch Bildung, Innovation und Wandel. Study on behalf of the Austrian Council and the Austrian Institute of Technology.

Results of the Monitoring of Innovation Performance

Priority Objectives: Above-Average Economic Performance, Catch up in Terms of Innovation Performance

Austria's performance in terms of the priority objectives defined in the RTI Strategy is largely positive in comparison with the previous reporting year. Austria enjoys higher than average GDP per capita and a low unemployment rate and thus remains one of the most successful European countries in these areas. There has been a significant increase in life expectancy among both men and women and a moderate increase in the quality of life. In the environmental indicators, resource productivity has improved somewhat, while emissions of greenhouse gases and energy intensity have remained practically unchanged.

In respect of innovation performance, however, there is still some catching up to do. Notably in respect of the implementation and utilisation of research results there is still a performance deficit vis-à-vis the leading innovation nations. Overall, however, the impact effects of the innovation system on Austria's economic performance are much better than suggested by innovation rankings like the Innovation Union Scoreboard. Therefore the possibility of catching up with the group of Innovation Leaders cannot be completely ruled out – provided, of course, that focused efforts are made.

Educational System (Without the Tertiary Sector): Trend Moving in the Right Direction

In the education system (without the tertiary sector) indicators show improvements across almost all areas, with the exception of the inheritance of education and the ratio of students-to-teaching staff at the primary level. Although these improvements still do not allow us to conclude that it will be possible to achieve the relevant goals of the RTI Strategy by 2020, the trend is at least pointing in the right direction.

Tertiary Education: Prospect of Achieving the Goal Unrealistic with Current Development Dynamic

A year-on-year comparison shows that there have been a number of positive developments in the tertiary education sector. Nevertheless, most of the indicators used still show a significant gap to the leading innovation nations. The only RTI Strategy goal for the tertiary sector that has already been achieved is the increase in the number of university graduates. Despite improvements in goal distance, there is no realistic chance of achieving the goals in 9 of the 15 indicators by 2020 if development trends remain the same.

Universities and Basic Research: Positive Trends in Research Performance Threatened by Declining Funding

In respect of universities and basic research, the quality of research performance has increased. This is due, on the one hand, to the large number of successful project applications to the European Research Council (e.g. IST Austria, IMP, IMBA) and, on the other, to individual universities improving their positions in international ranking tables. Financial uncertainty at universities and cutbacks in funding for the FWF could seriously threaten these achievements.

Research and Innovation in the Corporate Sector: Mixed Signals

On the whole, the signals in respect of corporate research and innovation are rather mixed. On a positive note, the goals for 2020 in one third of the indicators used have already been met and in several others 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 export performance or the relatively intensive co-operation between science and industry.

However, it is conspicuous that the goals in the majority of indicators have not been reached and that the development dynamic of a number of indicators, for example knowledge and research intensity of firms, was actually negative. Previously identified weaknesses in the area of start-ups and in venture capital intensity persist. The fall in R&D financing by foreign companies must be closely monitored, as it could indicate that Austria is becoming less attractive as a business location.

Science and Society: Negative Attitudes among Austrians to Science and Research Persist

In the area of science and society, the indicators on Austrian attitudes to science and research show a clear downward trend in comparison with 2013. As a result, all relevant indicators are now well below the set target and there is insufficient momentum to close the gap to the Innovation Leaders by 2020.

R&D Financing: Stagnation with no Prospect of Change

The distance-to-goal of the indicator to measure R&D intensity has narrowed somewhat compared to the previous year. At the same time, however, there has been a slight decline in the trajectory, which on the whole suggests it will not be possible to meet the target by 2020. Furthermore, the proportion of private-sector R&D funding remains well below the levels of the leading innovation nations. The very slow increase in the proportion of private-sector R&D financing is a worrisome development that has emerged in recent years and one which indicates inadequate growth in corporate research and innovation activity.

Summary: Overall, the Catch-Up Dynamics are Inadequate

On the whole, the catch-up process in Austria is still not yet dynamic enough. As other comparable countries exhibit a much greater development dynamic, maintaining the status quo is not an option. If Austria does not want to fall even further behind in global competition and lose any prospect of catching up with the leading group, it must accord the highest priority to education, research, technology and innovation, as well as provide the necessary funding and make structural adjustments.

Priority Fields of Action and Recommendations

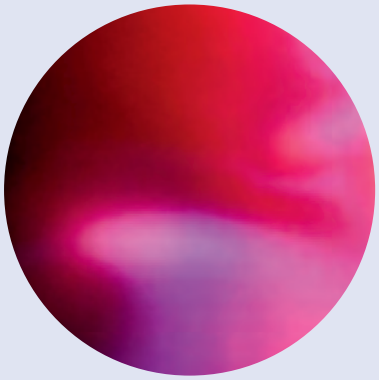
If Austria is to achieve its goal of joining the ranks of the Innovation Leaders, greater efforts are required in the following fields of action that have been prioritised by the Austrian Council:

- Educational system
- Basic research
- Start-ups and the growth of young innovative companies
- Private-sector R&D financing

The Austrian Council therefore recommends

- Intensifying the reform of the education system
- Increasing the resources for funding basic research through competitive processes
- Further optimising the legal and financial framework for Start-ups and growth
- Promoting measures to increase the private-sector's share of R&D funding




introduction






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introduction

This report analyses and evaluates Austria's scientific and technological capability in an international comparison as well as the progress that has been made toward achieving the goals of the Federal Government's Strategy for Research, Technology and Innovation (RTI Strategy). For this purpose, the Austrian Council uses a set of indicators that were presented for the first time in the Report on Austria's Scientific and Technological Capability 2012 and which since then have been refined. The 73 indicators depict the aspects of performance and the objectives contained in the RTI Strategy. They are based on international and national data from the OECD, Eurostat, Statistik Austria etc.

The following chapters analyse in detail the progress that has been made toward achieving the objectives set out in the RTI Strategy. The extent to which these goals have been met expressed in the form of the distance to the goal (goal distance) and the goal achievement prospect is, where available, measured against the explicit targets laid down in the RTI Strategy, and otherwise against the latest available average of the countries classified as the Innovation Leaders by the Innovation Union Scoreboard (IUS): Germany, Finland, Denmark and Sweden.

The higher overall strategic objective is to join the group of these Innovation Leaders. As the achievement of this goal does not just depend on Austria's performance, but also on that of the Innovation Leaders, the report uses a relative evaluation concept that measures progress toward the achievement of the goals relative to the leading European nations. If their performance improves while that of Austria remains unchanged, this standstill actually means that the country has fallen back.

An overview of the goal distances and goal achievement prospects for all individual indicators is presented in Figs. 1, 7, 10, 11, 13 and 16 on pages 12, 21, 26, 34, 40 and 50. Details of the methods used for the calculations and further information about the indicator sets, the data and the interpretation of the aforementioned figures are provided in appendices 1 to 3.

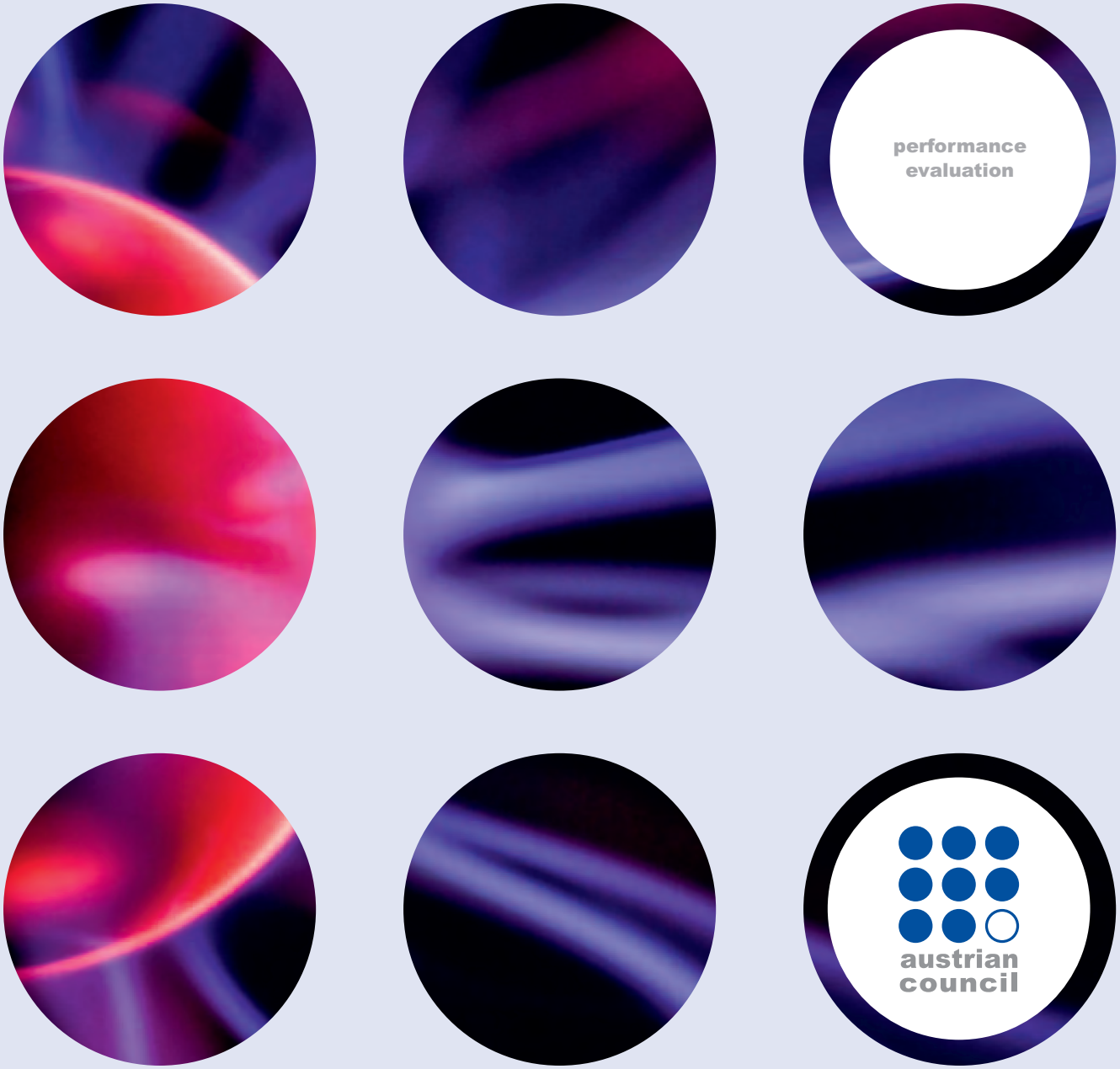
A list of measures supplied to the Austrian Council by the RTI Task Force provides another basis for the evaluation. It contains information from the responsible ministries regarding all the measures specified in the RTI Strategy and the extent to which they have been implemented. This information enables the Austrian Council to better assess and evaluate the possible causes of change on an individual basis. Additionally, the results of national and individual studies, evaluations and ranking tables are also drawn upon.

This year's report focuses primarily on the developments and changes that have taken place compared to the previous year. In particular, it analyses significant improvements or deteriorations in Austria's position relative to the leading innovation nations as well as their possible causes. These trends are shown for each area in the overviews referred to above (see Figs. 1, 7, 10, 11, 13 and 16). Based on the changes and their interpretations, specific recommendations are made at the end of each chapter. Finally, on page 71 ff. priority fields of action are defined and concluding recommendations made for the further development of the RTI system.

To facilitate comparison, the chapters of the RTI Strategy are used as the frame of reference for the structure of this report. The chapter "Evaluation of Austria's Performance" on page 11 ff. mirrors the individual chapters of the Strategy. However, in individual cases, and where thematically appropriate, the report deviates from the structure of the Strategy.

As the results of the PISA study were published in autumn 2013, this year's report has a stronger focus on the performance of the Austrian education system compared to the leading innovation nations. Areas in which no significant change can be detected in a year-on-year comparison have accordingly only been dealt with briefly.

Parallel to the Report on Austria's Scientific and Technological Capability 2014, a homepage has been set up on the Austrian Council's website (http://www.rat-fte.at/leistungsberichte.html). As well as information about the report and a range of download options, it also offers an interactive depiction of the indicator sets, which make 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

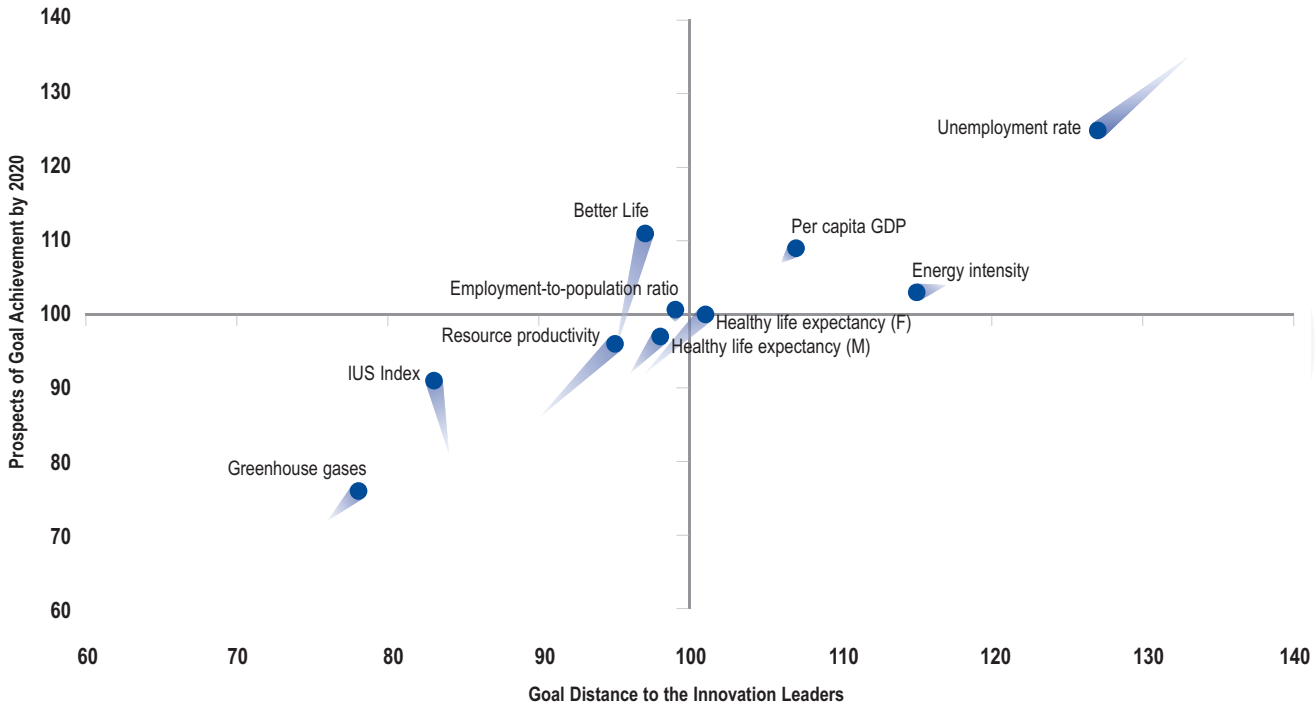
RTI Strategy Objectives

- *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*

The priority objectives defined in the RTI Strategy include goals for growth, competition, sustainability and problem-solving as well as a general innovation performance target.[6] To measure the progress being made toward achieving these goals, indicators covering the areas of innovation, the economy, employment, health, the environment, sustainability and quality of life are used. These represent key policymaking target functions, which generally serve as a higher overall goal in the areas of education, research and innovation. On the other hand, they also measure the impact of innovation.

In comparison with the previous reporting year, Austria's performance with regard to the priority objectives defined in the RTI Strategy is largely positive (see Fig. 1). Austria enjoys higher than average GDP per capita and lower than average unemployment and thus remains one of the most successful countries in Europe in these areas. At the same time, however, the employment rate has risen only marginally. There has been a significant increase in life expectancy among both men and women and a moderate increase in the quality of life. In the environmental indicators, resource productivity has improved somewhat, while emissions of greenhouse gases and energy-intensity have remained practically unchanged.

Fig. 1: Development of Goal Distance and Prospect of Goal Achievement in Relation to Priority Objectives, Most Recent Available Year



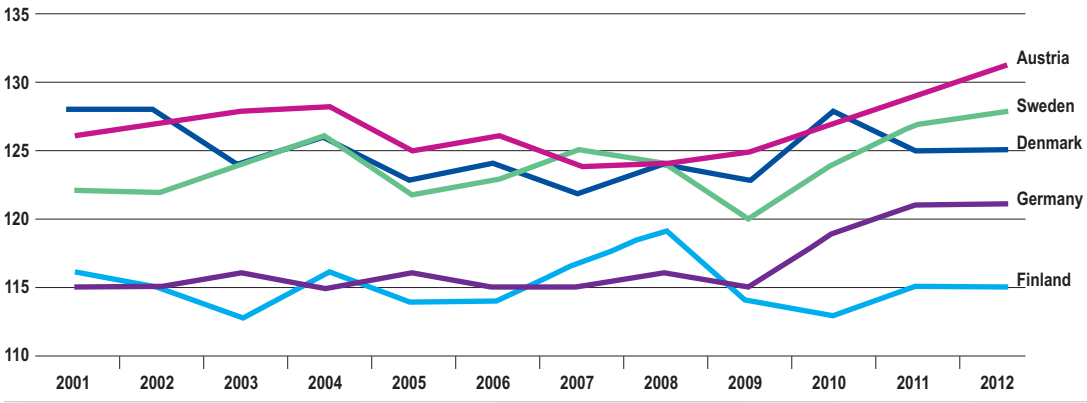
Sources: see Appendix 1, WIFO presentation. Raw data see Appendix 2. Explanation see Appendix 3.
Note: Goal Distance = Austria's actual value relative to the national target or the Innovation Leaders' actual value (average value most recent available year DE, DK, FI, SE);
Prospect of Goal Achievement = Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020.

[6] Strategy for Research, Technology and Innovation of the Austrian Federal Government, p. 9 ff.

Although the unemployment rate has fallen slightly since the height of the financial and economic crisis, at roughly 4.9 percent it is still higher than at the beginning of the previous decade. As the level of unemployment in the leading innovation nations has fallen more sharply since last year, Austria's position relative to the leading innovation nations has deteriorated, but remains well below the average of the Innovation Leaders. As matters stand, the level of economic growth expected in the coming years will not suffice to bring about a substantial reduction in unemployment in Austria. However, the trends do indicate that unemployment will stabilise at its current level.[7] This would enable Austria to retain its leading position in this area. Since 2000 the Austrian economy has grown by an annual rate of 1.5 percent in real terms. Although this is a good percentage point below the growth rates recorded in the preceding two decades[8], it is still well above those recorded in Western Europe and Germany. By comparison the European economy grew by a paltry one percent, that of Germany by just 0.9 percent. Cumulated over the last ten years, Austria's growth differential amounts to between five and seven percent. Thus the Austrian growth rate almost equalled that of the United States.[9]

This has enabled Austria to consolidate what is already a strong position among the leading countries in terms of per capita income, and to widen its lead over the top innovation nations further (see Fig. 2). Thus Austria today ranks third in the EU and eleventh in the world.

Fig. 2: Development of Per Capita GDP from 2001 to 2013 (average EU 28 = 100)



Source: Eurostat.

[7] Aiginger, K. (2013): Reformmüdigkeit als Gefahr für ein Erfolgsmodell. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 22–38.

[8] Generally speaking, after sometimes double digit increases in the 1970s, growth rates in all highly developed countries weakened in the new millennium. Cf. IMF (2011): World Economic Outlook Reports: Historical GDP by country.

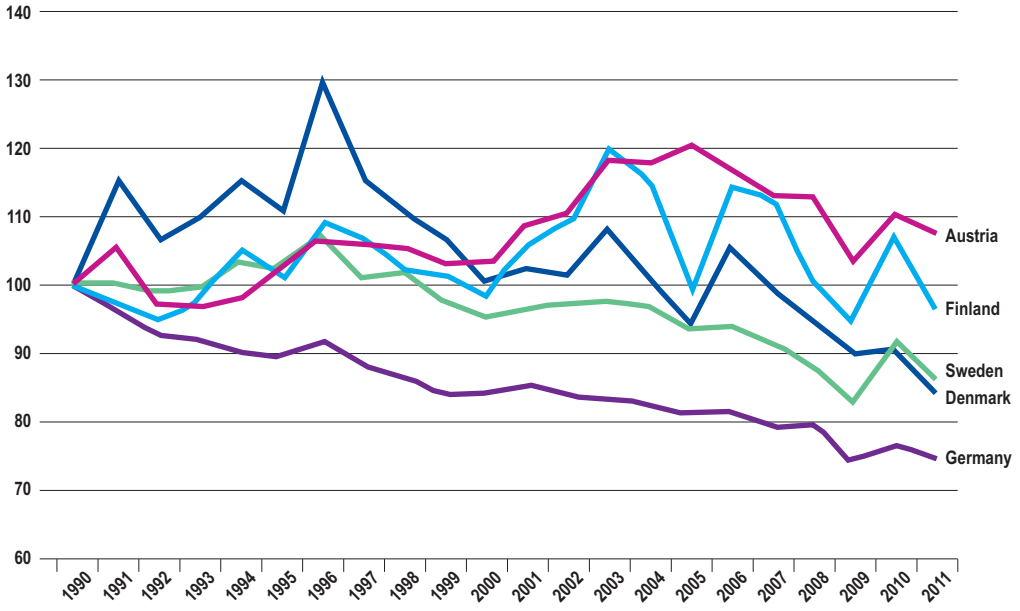
[9] This positive development was chiefly attributable to exports, which have increased by 3.5 percentage points since 2000. As growth in imports during the same period was weaker, the balance of trade deficit was transformed into a surplus of EUR 10.5 billion between 2000 and 2013. This was due first and foremost to rising exports to the countries of Central and Eastern Europe as well as to the USA and Asia. Cf. Aiginger, K. (2013): Reformmüdigkeit als Gefahr für ein Erfolgsmodell. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 22–38

priority objectives

Notwithstanding the positive trend, there has been only a marginal improvement in the employment rate compared to previous years and relative to the Innovation Leaders, as becomes clear from Fig. 1. Although employment in Austria has grown by a cumulative eight percent in the last ten years, bringing approximately 230,000 additional people into the workforce since the year 2000, the potential of those groups over the age of 30 is utilised less in Austria than in the leading innovation nations and in the Scandinavian countries in particular. This is linked to longer career interruptions and early retirements combined with the lower level of interest among older workers in further education and training and a lack of career planning models within companies.[10]

With regard to life expectancy there has been a significant improvement in terms of the goal distance, especially for women, but also, albeit to a lesser extent, for men (see Fig. 1, Indicators "Healthy Life Years M + F"). However, the development dynamic for women is much more pronounced, for which reason the number of years they can expect to live without illness or disability is already in line with the figure for the Innovation Leaders. Although convergence with the leading innovation nations can be observed in terms of quality of life, a more accurate assessment of the dynamic is still not possible due to unavailable time series.[11]

Fig. 3 Development of Greenhouse Gas Emissions from 1990 to 2011 (Base Year 1990 = 100)



Source: Eurostat.

[10] Aiginger, K. (2013): Reformmüdigkeit als Gefahr für ein Erfolgsmodell. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 22–38.

[11] It should be remembered that quality of life is a subjective notion that is interpreted very differently by individuals and in particular at the country level. Variables of quality of life that are important to the population of Sweden may differ from those that are important to the population of Austria. Aggregated comparisons of quality of life should therefore always be interpreted with a great deal of caution.

The environmental indicators show a slight improvement in resource productivity and stagnation in energy intensity and greenhouse gas emissions. In the case of resource productivity, the goal distance to the leading countries has narrowed but current momentum is insufficient to catch up with the Innovation Leaders by 2020. In the area of energy efficiency, Austria has lost ground somewhat in a year-on-year comparison. Due to the continued unfavourable level of growth, additional measures are still necessary to achieve a reduction in greenhouse gas emissions. In recent years, the Innovation Leaders have made consistent progress toward meeting the Kyoto Protocol targets – in particular to reduce emissions of greenhouse gases to 13 percent below 1990 levels (see Fig. 3).

According to the Greenhouse Gas Inventory for 2012 published by the Environment Agency Austria in January 2013, Austria has not met its Kyoto targets. Although emissions of greenhouse gases declined by 3.3 percent or 2.7 million tonnes of carbon dioxide equivalent last year, the target for the Kyoto period 2008 to 2012 of approximately 344 million tonnes of carbon dioxide equivalent was clearly exceeded, with CO_2 emissions totalling 415.9 million tonnes. To enable Austria to meet its obligations under the Kyoto Protocol, flexible mechanisms are now being used, i.e. Austria must purchase emission certificates of almost 70 million tonnes of carbon dioxide equivalent. In monetary terms, this amounts to approximately EUR 500 million, roughly the amount of the budget increase that is necessary to achieve the 2 percent target for the tertiary sector in the coming year.[12]

Finally, it is noticeable that Austria's economic performance, particularly in respect of GDP per capita, is evidently not solely the result of innovation efforts.[13] This is illustrated by the Innovation Union Scoreboard (IUS), according to which Austria still has some catching up to do in terms of its innovation performance (cf. Fig. 1, Indicator "IUS Index"). Austria has again fallen back one position since last year to tenth place. This is the fourth drop in its ranking in succession.[14] In contrast, Sweden, Denmark, Germany and Finland have confirmed their Innovation Leadership. Although the relative performance gap to the leading nations has narrowed, because Austria has grown faster than the Innovation Leaders since 2006 relative to the composite indicator, these countries are still well ahead and the Austrian dynamic has stalled since 2009. This also explains Austria's steady decline, as Belgium, the Netherlands, Ireland and the United Kingdom have all grown more rapidly than Austria. Most innovation ranking tables generally use indicators for structural change to depict the impacts of innovation.[15] However, by doing so, the IUS – like most other innovation rankings – underestimates Austria's performance, as it has no indicators to measure improvements in existing sectors, an area in which Austria has proven strengths. The next section of this report presents a number of indicators that illustrate this sectoral upgrading.

[12] Hranyai, K. / Janger J. (2013): Hochschulfinanzierung im internationalen Vergleich. In: WIFO-Monatsberichte 2/2013, pp. 173–186.

[13] Austria's economic success is attributed not just to its internationally competitive industry with its many dynamic small and medium-sized enterprises, but also to its vibrant tourism industry. Cf. OECD (2014): OECD Tourism Trends and Policies, p. 117; Ederer, S. / Janger, J. (2011): Wachstums- und Beschäftigungspolitik in Österreich unter neuen europäischen Rahmenbedingungen In: WIFO-Monatsberichte, 84(6), pp. 421–433.

[14] In this context, it should be noted that the reason for this decline is the introduction of the new "Share of Employment in Fast-Growing Innovative Firms" indicator. This measures the innovation intensity of fast-growing firms by sector and not by actual innovation content. The resulting distortion of Austria's performance is discussed in the section "Innovation Impacts in Detail".

[15] Janger, J. (2012): Strukturwandel und Wettbewerbsfähigkeit in der EU. WIFO-Monatsberichte, 2012, 85(8), pp. 625–640.

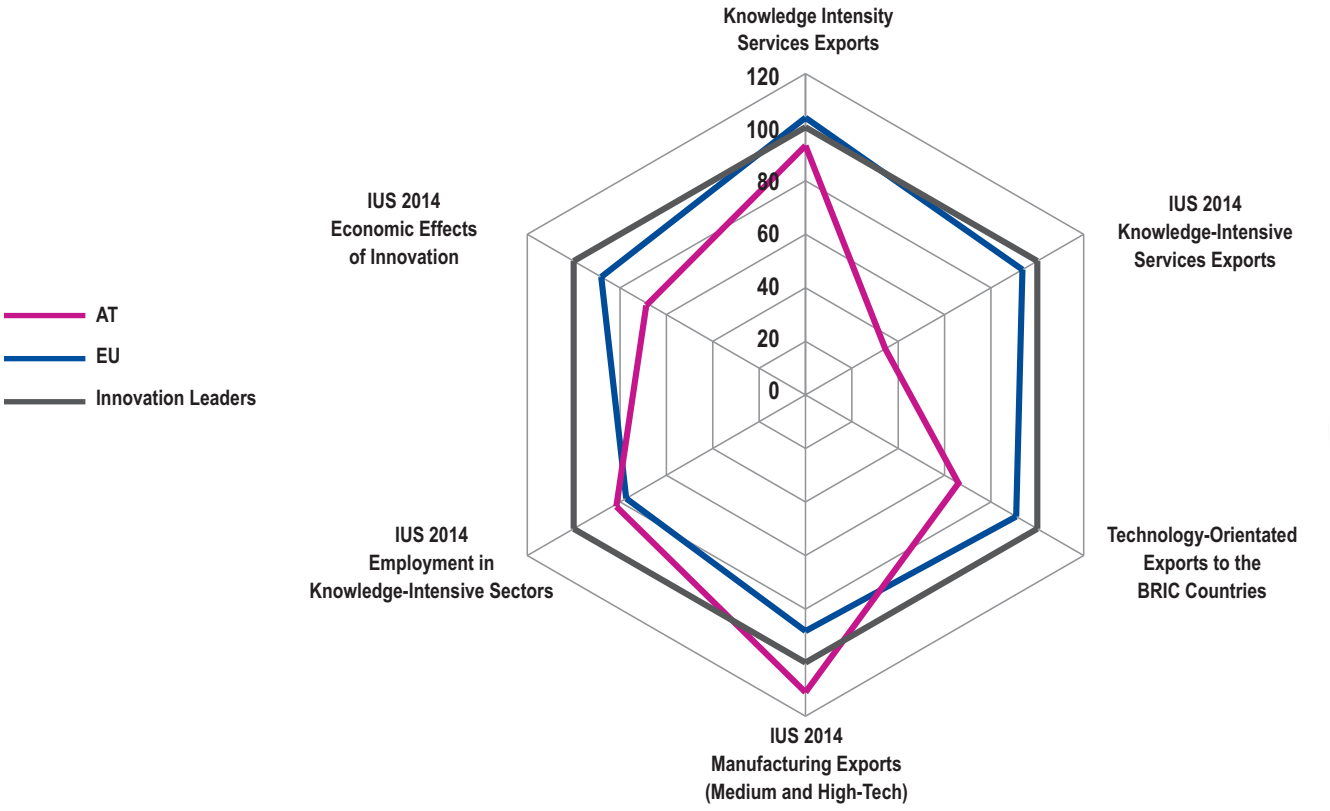
priority objectives

Innovation Impacts in Detail

As innovation impacts are partly overlaid by various other factors, the positive economic developments described in the previous section cannot be clearly attributed to innovation activities. However, by analysing corporate and structural performance indicators it is possible to obtain a sounder assessment of the impacts of innovation on economic developments and to assess the productivity, efficiency and effectiveness of innovation efforts.[16]

Basically, successful innovation efforts must impact either as an increase in innovation performance, 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**). Indicators that show sectoral upgrading deliver much more meaningful results on the economic success of innovation efforts for Austria. This becomes clear if one compares the following Figs. 4 and 5.

Fig. 4 Impacts of Innovation on Inter-Sectoral Structural Change Relative to the Innovation Leaders (=100)

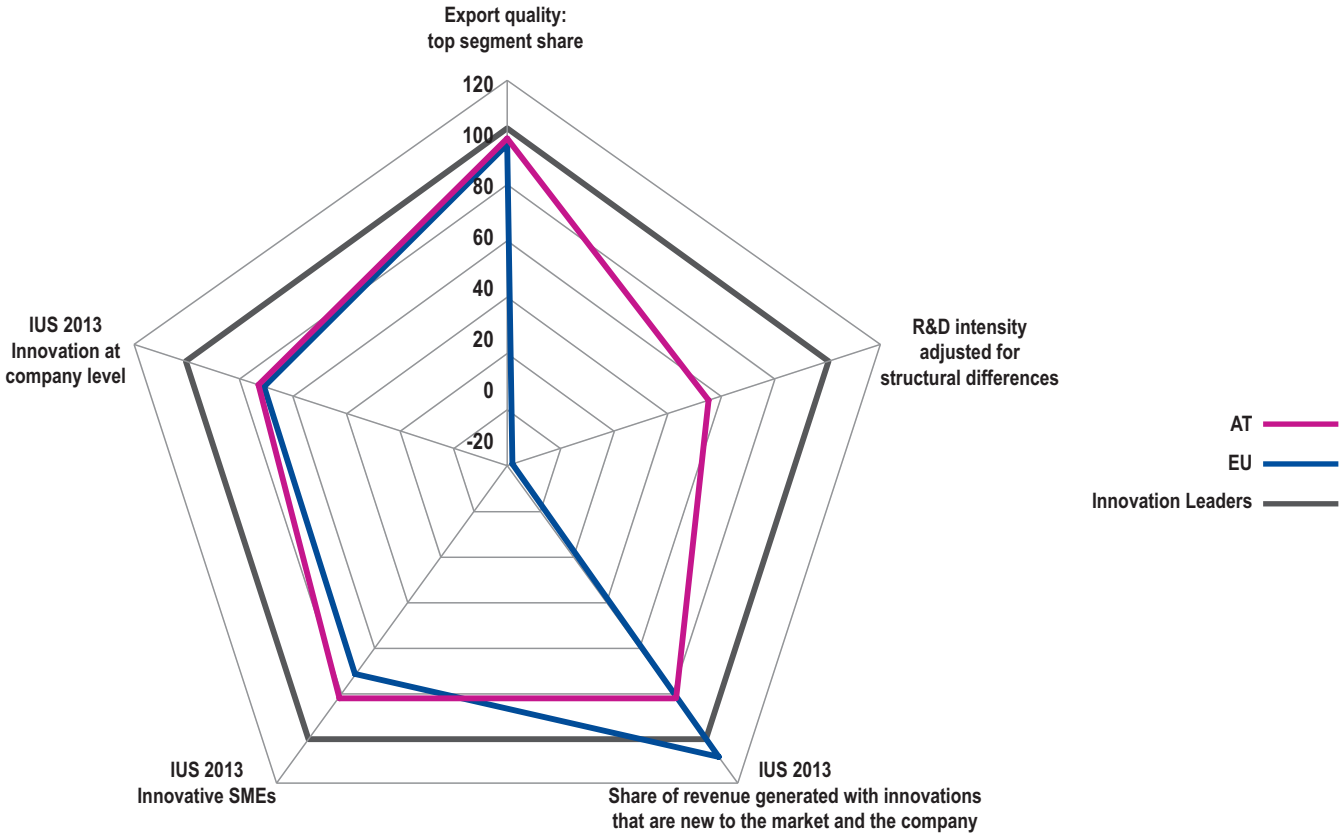


Sources: Innovation Union Scoreboard 2014, WIFO calculations.

[16] Although the EU has started publishing a new output indicator this year, it is calculated almost solely on the basis of existing indicators from the IUS and thus has the same problem with regard to underestimating innovation impacts.

Fig. 4 depicts the indicators for inter-sectoral structural change as a comparison between Austria and the average of the Innovation Leaders (= 100) and the EU. In some of these indicators, Austria trails relatively far behind not just the leading innovation nations but also behind the EU average – with the exception of the export of technology-orientated goods. But as these indicators do not take into account the real content of the innovation activity or sectoral upgrading, they present only an inadequate picture of the economic impacts of innovation.[17] In comparison, Fig. 5 depicts indicators for intra-sectoral change and sectoral upgrading from which industry-specific improvements can be seen.

Fig. 5: Effects of Innovation on Intra-sectoral Structural Change (Sectoral Upgrading) in Relation to the Innovation Leaders (= 100)



Sources: Innovation Union Scoreboard 2014, WIFO calculations. *Fig. EU-27 without PL, IE, LU.

[17] 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" demonstrates 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 "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.

This Fig. clearly shows that Austria lags only slightly behind the Innovation Leaders and that Austria's lead compared to the EU average is a large one. Austria fares relatively well above all in the quality of exports in technology-orientated sectors and enjoys a significant lead in the "Structurally-adjusted R&D Intensity" indicator. The decline in a year-on-year comparison is due above all to stagnating levels of corporate spending on R&D in Austria on the one hand and rising levels in the leading innovation nations on the other. The IUS indicators for sectoral upgrading, namely "Innovation at the Firm Level", "Innovative SMEs and Share of Revenues Generated with Innovations that are New to the Market and the Company" remain unchanged, as they are based on the Community Innovation Survey (CIS), for which new data will only become available in 2015.[18]
Viewed in terms of inter-sectoral structural change and sectoral upgrading, the impact effects of the innovation system can on the whole be regarded as a more promising point of departure than the IUS would suggest. Although there remains a performance deficit vis-à-vis the leading innovation countries, which in some cases has even increased slightly compared to the previous year, the possibility of catching up with the group of Innovation Leaders cannot be completely ruled out – provided of course, that focused efforts are made. This summative evaluation is analysed in detail and in terms of the relevant objectives and measures in the RTI Strategy in the chapters between pages 20 and 65.

Quantity and Quality of Inventive Activity

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.[19] 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.
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 Fig. 6, Indicator "First and Second-Generation Citation Counts"). The collapse of the "Average Citations per indicator Patent" at the current end-point must be interpreted with caution, as patent citations can of course change retrospectively. Patents that have received more than five citations and which can therefore be considered qualitatively significant are found less frequently in Austria than in the reference countries (see Fig. 6, Indicator "Patents with More than Five Citations").[20] Furthermore, Austria boasts fewer triadic patent families relative

[18] 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 innovation nations in the IUS.

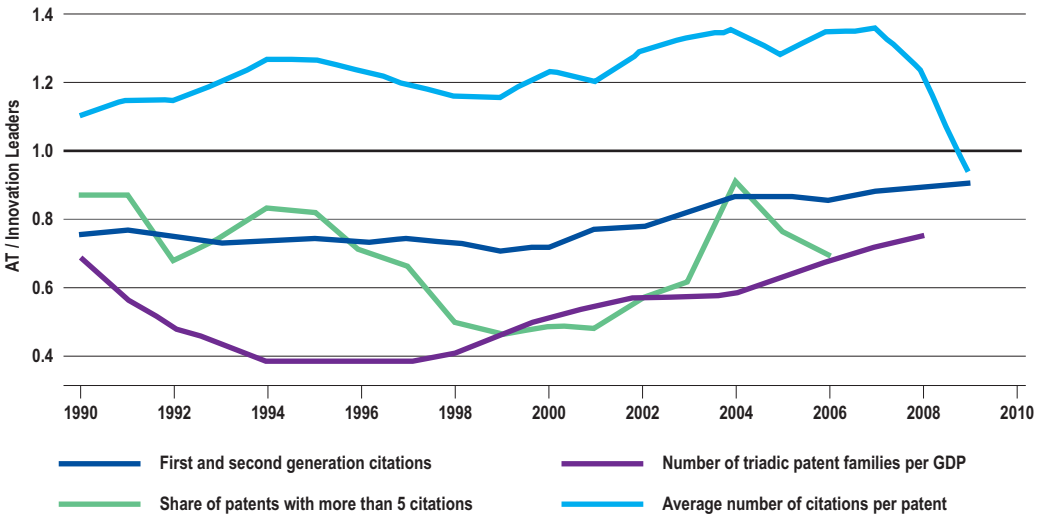
[19] Cf. Unterlass, F. / Hranyai, K. / Reinstaller, A. (2013): Patentindikatoren zur Bewertung der erfinderischen Leistung in Österreich. Study on behalf of the Austrian Council for Research and Technology Development.

[20] Changing the threshold from 5 to 6 or 7 results in the same picture.

to GDP, i.e. patents registered at the world's three major patent offices in Japan, the USA and Europe (see Fig. 6, Indicator "Number of Triadic Patent Families". Registrations at all three of these patent offices indicate the high quality of a patent. Both indicators, however, suggest that Austria is catching up.

Based on this analysis of the quality of technological inventions, it can be concluded (as was the case in the preceding section of this report) that although Austria still lags behind the leading innovation nations, there are clear signs that it is catching up. Provided that efforts are continued in the area of RTI policy, it is possible that the relevant RTI Strategy goals can be achieved by 2020.

Fig. 6: Quality of Austrian Patent Activities. Applications to the European Patent Office (EPO) According to Inventors in Relation to Innovation Leaders



Source: OECD, Regpat Database, July 2013; OECD, Citation Database, July 2013; OECD, Triadic Patent Families Database, July 2013; World Bank, WIFO calculations. Innovation Leaders: Average of DE, DK, FI, SE=1.0.

Note.: 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 2007 due to insufficient sample size.

educational system

Education System

As education and training are the foundation upon which a society's ability to compete and innovate are built, the value of knowledge and information has continued to rise throughout the world. As a result, however, the income gap between highly-qualified and low-skilled workers is growing even wider.[21]
This difference begins in early childhood. PISA study results show that even in industrialised nations, children from low income families are less likely to receive a good education than are children from wealthier families. Education is thus both the key to social advancement and integration but also to reinforcing social inequality.[22] Recognising that the Austrian education system fosters this "divisive aspect" of education,[23] the RTI Strategy sets a series of different goals in the area of pre-school, primary, secondary and tertiary education. In particular, they relate to the quality and social selectivity of the education system, quantity aspects (such as supervisory situation, number of secondary school graduates, young researchers, etc.) and gender aspects in research. The planned measures envisage steps toward a fundamental structural reform of the educational system.
A number of the goals defined in the RTI Strategy have already been achieved, but despite improvements in individual areas, most of the indicators are still below target while the growth rate is too low to attain the goals. This finding corroborates the analyses of the educational system as a key component of the innovation system, which at present constitutes the main bottleneck for the further intensification of innovation efforts.[24] Due to the large number of indicators for the education system, this chapter has been broken down into the following subchapters: "The Education System without the Tertiary Sector" and the "Tertiary Education System".

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.*

Educational System (without tertiary education)

As shown in Fig. 7, the education indicators – with the exception of one of the two indicators for the inheritance of education and the indicator for the student-teacher ratio in primary education - show improvements across all areas. While these improvements in important areas still do not permit the conclusion that the relevant RTI Strategy goals can be achieved by 2020, the trend is at least pointing in the right direction. Improvements can be seen above all in those indicators that are based on Austria's results in the PISA surveys (PISA indicators).[25] Thus Austria's

[21] Keeley, B. (2010): Humankapital. Wie Wissen unser Leben bestimmt. Bonn: Published under licence by the Federal Agency for Civic Education, Germany, p. 15.

[22] Kocka, J. (2009): Bildung und Bildungsbürgertum; in: Schlüter, A. / Strohschneider, P. (ed.): Bildung? Bildung! 26 Thesen zur Bildung als Herausforderung im 21. Jahrhundert. Bonn: Published under licence by the Federal Agency for Civic Education, Germany, pp. 132–142, here p. 132.

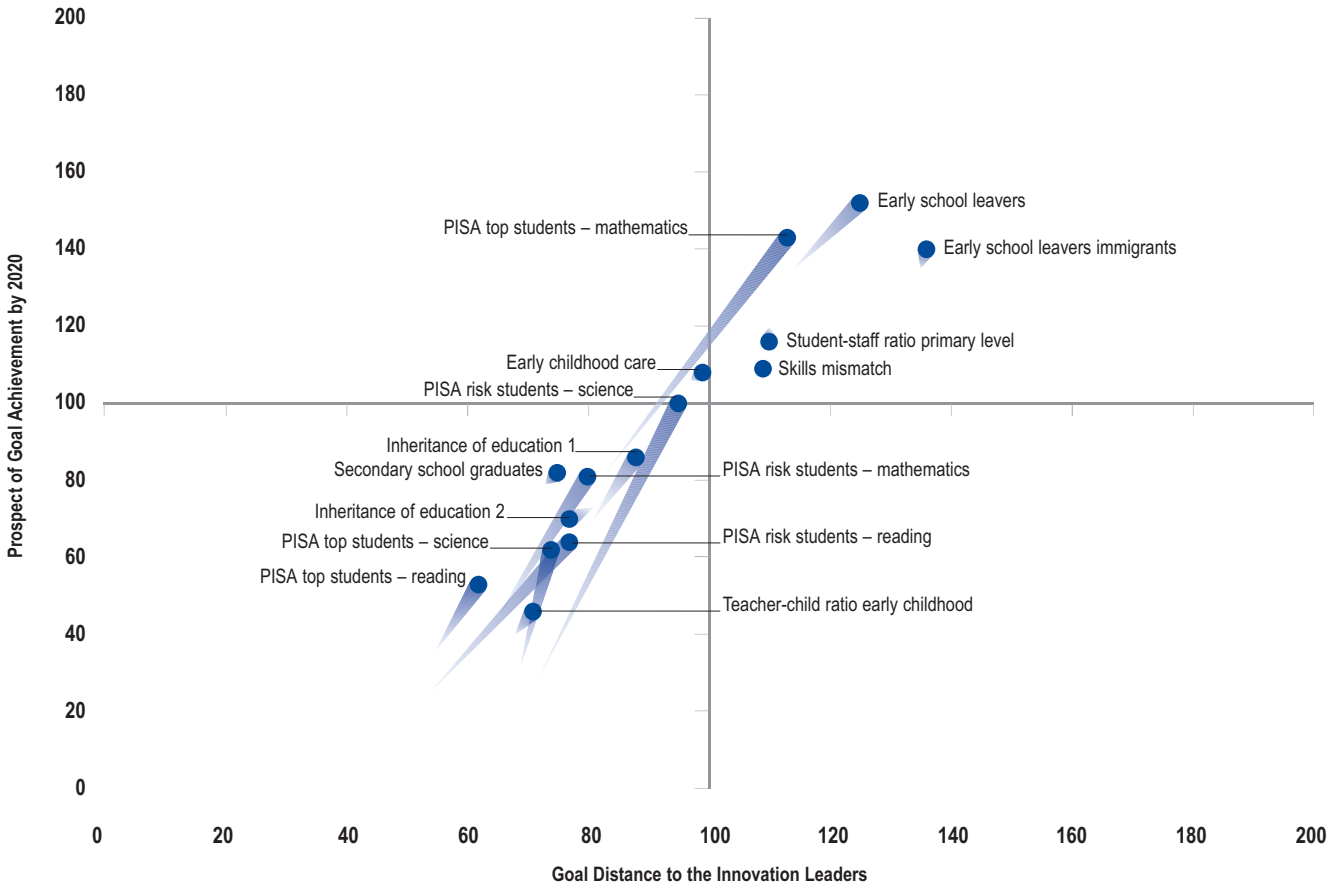
[23] "The Austrian education system distinguishes very early on between vocational and academic paths; access to education is strongly influenced by social stratification. Due to a lack of permeability of educational paths, this early selection phase has a decisive influence on the educational expectations of children and adolescents, and it is almost impossible to change course later." Strategy for Research, Technology and Innovation of the Austrian Federal Government, p. 14.

[24] Aiginger, K. / Falk, R. / Reinstaller, A. (2009): Evaluation of Government Funding in RTDI from a Systems Perspective in Austria. Vienna.

[25] In the case of the PISA indicators, there has been an improvement in Austria's goal achievement prospects. However, this is not solely due to Austria's improved performance in the latest PISA test, but because a number of Innovation Leaders such as Finland and Sweden achieved poorer PISA results than in previous surveys.

mean performance in the most recent PISA test[26] has returned to the levels found in 2003 and 2006, marking a reversal of Austria's poor performance in 2009.[27]
It is hard to judge the extent to which this marks the genuine reversal of a trend, as the comparability of Austria's PISA results in 2009 cannot be guaranteed. The PISA 2009 assessment was conducted at a time during which a dispute between teaching unions, the Ministry of Education and pupil representatives regarding increased working hours for teachers had created a negative atmosphere in relation

Fig. 7: Development of Goal Distance and Prospect of Goal Achievement in Relation to Priority Objectives in the Educational System (Without Tertiary Sector), Average Value Most Recent Available Year



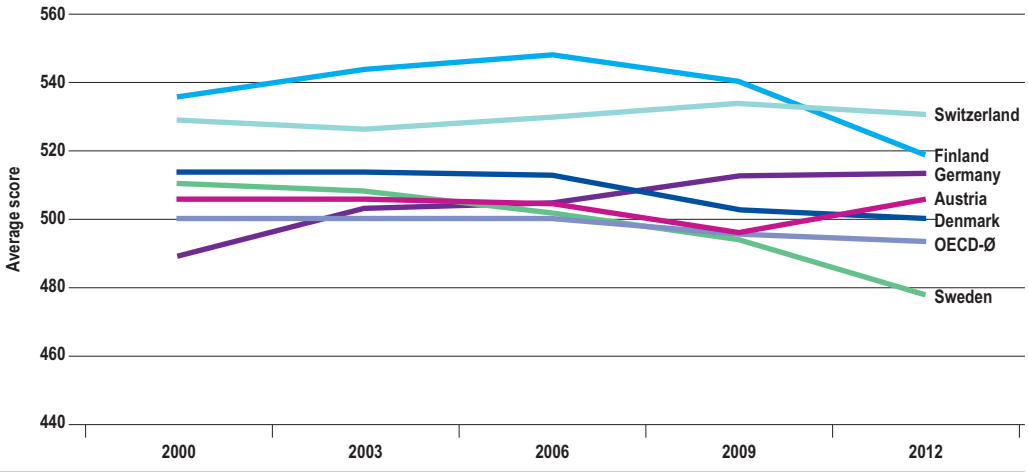
Sources: see Appendix 1, WIFO presentation. Raw data see Appendix 2. Explanation see Appendix 3.
Note: Goal Distance = Austria's actual value relative to the national target or the Innovation Leaders' actual value (average value most recent available year DE, DK, FI, SE); Prospect of Goal Achievement = Value projected for Austria in 2020 relative to the national goal or the value projected for the Innovation Leaders in 2020.

[26] OECD (2013a): PISA 2012 Results. Vol. I: What Students Know and Can do. Student Performance in Mathematics, Reading and Science. Paris: OECD Publishing.
[27] BMUKK (2013): PISA 2012: Trendumkehr und erstes Etappenziel erreicht. Vienna: Press kit, p. 2.

to education assessments, and there had been calls to boycott the PISA test.[28] The only thing that is clear at present is that in the performance areas tested, Austria has again reached the standard it had in 2000 when PISA surveys were begun. However, the results for the PISA 2000 assessment were biased upwards as the Austrian sample did not adequately cover students enrolled in combined school and work-based vocational programmes. The current result can therefore certainly be considered a slight improvement.

In the latest PISA 2012 test, students in Austria on average scored 506 points in mathematics, above the OECD average of 494 points (see Fig. 8).

Fig. 8: Development of the Mean Values in Mathematics Between 2000 and 2012



Source: Data from the OECD (2001), OECD (2004), OECD (2007), OECD (2010) and OECD (2013a).[29]

It is particularly encouraging that the group of at-risk students (very poor performers) has decreased from 23.2 to 18.7 percent since the last PISA survey[30], while at the same time, the group of top performing students has grown from 12.9 to 14.3 percent.[31] However, it is doubtful whether the positive trend will be sustained, as Austrian students – and girls in particular– are among those who enjoy mathematics the least. While in 2003 there was only a small gap of

[28] BIFIE (2010): PISA 2009. Internationaler Vergleich von Schülerleistungen. Erste Ergebnisse. Eds. Ursula Schwantner and Claudia Schreiner. Graz: Leykam, p. 13; cf. OECD (2013a): PISA 2012 Results. Vol. I, p. 52 f. (Info-Box: Measuring trends in PISA).

[29] OECD (2001): Programme for International Student Assessment (PISA). Literacy Skills for the World of Tomorrow: Further Results from PISA 2000. Paris: OECD Publishing, p. 100. Due to post hoc data corrections, the score originally recorded for mathematics of 515 points was corrected to 506 points; cf Neuwirth, E. (2006): PISA 2000: Sample Weight Problems in Austria. OECD Education Working Papers, No. 5, Paris: OECD Publishing; OECD (2004): Learning for Tomorrow's World – First Results from PISA 2003. Paris: OECD Publishing, p. 92; OECD (2007): PISA 2006: Science Competences for Tomorrow's World. Vol. I: Analysis. Paris: OECD Publishing, p. 316; OECD (2010): PISA 2009 Results, p. 135; OECD (2013a): PISA 2012 Results, p. 20.

[30] OECD (2010): PISA 2009 Results. Vol. I: What Students Know and Can do. Student Performance in Reading, Mathematics and Science. Paris: OECD Publishing.

[31] OECD (2013a): PISA 2012 Results. Vol. I, pp. 21 and 62.

eight points between girls and boys in mathematics, in 2012 boys scored 22 points higher than girls.[32] This is the largest increase in the gender gap observed among all 65 participating countries.
Girls in Austria not only perform poorly in mathematics, they also tend to have particularly low levels of enjoyment and motivation about learning mathematics in an international comparison. Compared to other OECD countries, students of both sexes in Austria are among those with the least instrumental motivation for learning mathematics.
As can be seen from Table 1, only 55.9 percent of the students surveyed agreed with the statement, "Learning mathematics is worthwhile for me because it will improve my career prospects". The OECD average was 78.2 percent. This fig. puts Austria in the last but one place among the OECD countries, with only Japan having a lower value.[33]

Table 1: Instrumental Motivation for Learning Mathematics

	Percentage of Students Surveyed who Agreed with the Statement "Studying maths is worth it because it improves my job and career prospects"
Austria	**55.9 %**
Switzerland	73.7 %
Germany	76.0 %
Sweden	85.5 %
Finland	85.4 %
Denmark	87.9 %
OECD-average	78.2 %

Source: OECD (2013c): PISA 2012 Results. Vol. III: Ready to Learn. Student's engagement, drive and self-beliefs. Preliminary Version. Paris: OECD Publishing, p. 287.

The weak point in Austria's PISA results is to be found in reading performance, where students scored 490 points on average, below the OECD average of 496 points. The gender difference pattern here contrasts diametrically with that for mathematics, with girls outperforming boys by an average of 37 points. Average reading performance is still well below the OECD average, although the at-risk group has fallen from 27.5 to 19.5 percent and the group of top performers has grown from 4.9 to 5.5 percent.
There is no significant gender difference between Austrian boys and girls in terms of science performance, with students scoring 506 points on average, 5 points over the OECD average of 501 points. Some 15.8 percent of students are low performers, while approximately 7.9 percent are top performers. This proportion is not significantly different from the OECD average and has remained stable over time.
The continuing strong linkage in Austria between student performance and socio-economic status remains problematic (cf. Fig. 7: Indicators "Inheritance of Education 1" and "Inheritance of Education 2"). Between the PISA sur-

[32] OECD (2013a): PISA 2012 Results. Vol. I, p. 82.
[33] OECD (2013c): PISA 2012 Results. Vol. III: Ready to Learn. Students' Engagement, Drive and Self-Beliefs. Preliminary Version. Paris: OECD Publishing, p. 287; cf. OECD (2013d): PISA 2012 Results. Country Note: Austria, p. 8.

veys in 2003 and 2012, countries such as Germany, Turkey and Poland were able to increase both their mathematics performance and equity in education. In Austria, there was no change in either student performance or equity in education during this period. The group of students considered "resilient", meaning that they beat the socio-economic odds against them and exceed performance expectations, has remained stable in Austria since 2003 at 5.6 percent in line with the OECD average.[34]

Most OECD countries have already succeeded in reducing performance differences between students who have an immigrant background and those who do not. While the share of students with an immigrant background in OECD countries increased from 9 percent in 2003 to 12 percent in 2012, the difference in performance in mathematics between immigrant students and non-immigrant students shrank by 11 points during the same period. It currently stands at 37 points before, and 23 points after, allowance is made for socio-economic status.

But not in Austria: here the share of students with an immigrant background rose from 13.1 percent in 2003 to 16.4 percent in 2012, and the performance gap between the two groups remained virtually unchanged at 59 points (2003: 60 points) or, after making allowance for socio-economic status, at 33 points (2003: 37 points). In contrast to this, Germany successfully reduced the performance gap from 81 points (2003) to 54 points (2012) before socio-economic status is taken into consideration and from 38 (2003) to 25 points (2012) after it is taken into consideration.[35]

The fact that Austria has so far failed to achieve adequate success in enabling students from immigrant backgrounds to obtain higher educational qualifications not only results in the loss of significant talent, it is also one of the reasons why there are too many school leavers in Austria who have only completed compulsory education. There is also already a shortage of skilled workers in many professions and the number of students with a high school leaving certificate (see Fig. 7: Indicator "Secondary School Graduates"), and subsequently those with a tertiary education certificate, is low in comparison with other countries. The plans and measures to overcome the selectivity of the Austrian education system are still inadequate. The New Secondary Schools (NSS) have so far been unable to bring about any significant improvements in terms of equality and equity of opportunity, although a definitive evaluation is not yet possible due to the time lag before the effects of educational measures are felt.[36] The most recent results of the educational standard test in the subjects mathematics and English certainly show that students' educational backgrounds continue to have a powerful influence on their results.[37] The Austrian Council therefore reiterates its recommendation that there

[34] OECD (2013b): PISA 2012 Results. Vol. II: Excellence through Equity. Giving every Student the Chance to succeed. Preliminary Version. Paris: OECD Publishing, p. 41; cf. OECD (2013d): PISA 2012 Results. Country Note: Austria, p. 4.

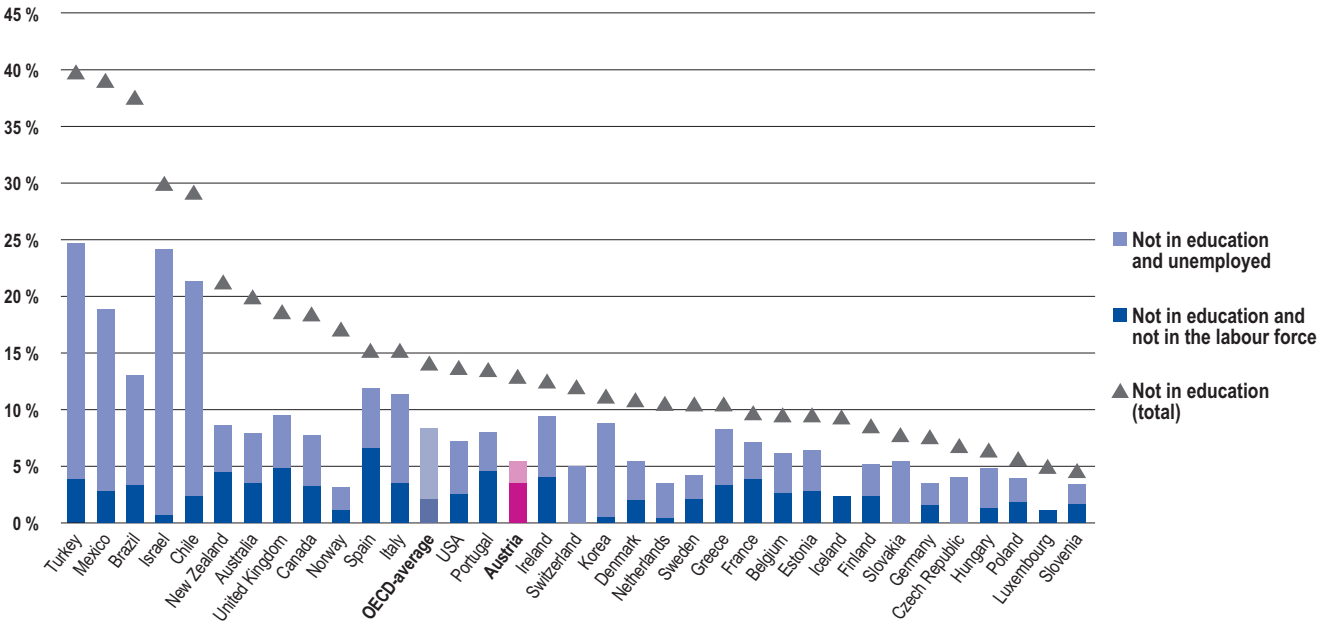
[35] OECD (2013b): PISA 2012 Results. Vol. II, pp. 73 and 75.

[36] For further information on the New Secondary Schools (NSS) and how they are impacting the selectivity of the Austrian education system see also the "Report on Austria's Scientific and Technological Capability 2013", p. 22 f.

[37] Referring to the fact that the NSS performed no better than the secondary schools in this educational standards test, the education researcher Stefan Hopmann pointed out that these tests say nothing about the actual quality of the school format, as only one third of performance differences can be explained by school type. As Hopmann considers students' socio-economic status to be the most relevant factor, he doubts, "that much of a difference remains between AHS and secondary school or New Secondary School once allowance has been made for social background." Compare the interview with education researcher Stefan Hopmann from the University of Vienna in the newspaper Die Presse on 3. 2. 2014: "Experte: Bildungsstandards sagen nichts über NMS".

be a commitment to comprehensive full-day schools in the secondary sector.
Finally, it should be stressed that Austria's positive performance in the indicator "Skill Mismatch" is largely attributable to the combined school and work-based vocational programmes (apprenticeship) and the secondary technical and vocational schools or colleges (BMS, BHS), as, "The transition between education and work has typically been smoother in countries with work-study programmes"[38] (see Fig. 9).

Fig. 9: Percentage of 15-19 year-olds neither Employed nor in Education or Training



Source: OECD (2013e): Education at a Glance 2013. OECD-Indicators,Bielefeld: W. Bertelsmann Verlag, p. 329.

The World Economic Forum's Risks Report 2014 also considers dual education to be an effective instrument for alleviating the problem of youth unemployment in many European countries.[39] Nevertheless, it should not be forgotten that the proportion of young people who, after finishing compulsory education, are neither in employment nor in training, is also too high in Austria. The decision taken by the Austrian Government at its closed-door retreat in January 2014 to extend compulsory education until the age of 18 as of July 2016 is a first important step.[40] However, at the same time, it should not be forgotten that training for a specific profession at an early age can also lead to disadvantages in terms of employability at a later age. This is demonstrated by the relatively low rate of employment among people over the age of 55.

[38] OECD (2013e): Education at a Glance 2013. OECD Indicators. Bielefeld: W. Bertelsmann Verlag. p. 404.

[39] World Economic Forum (2014): Global Risks 2014. Insight Report. Geneva: World Economic Forum, p. 35.

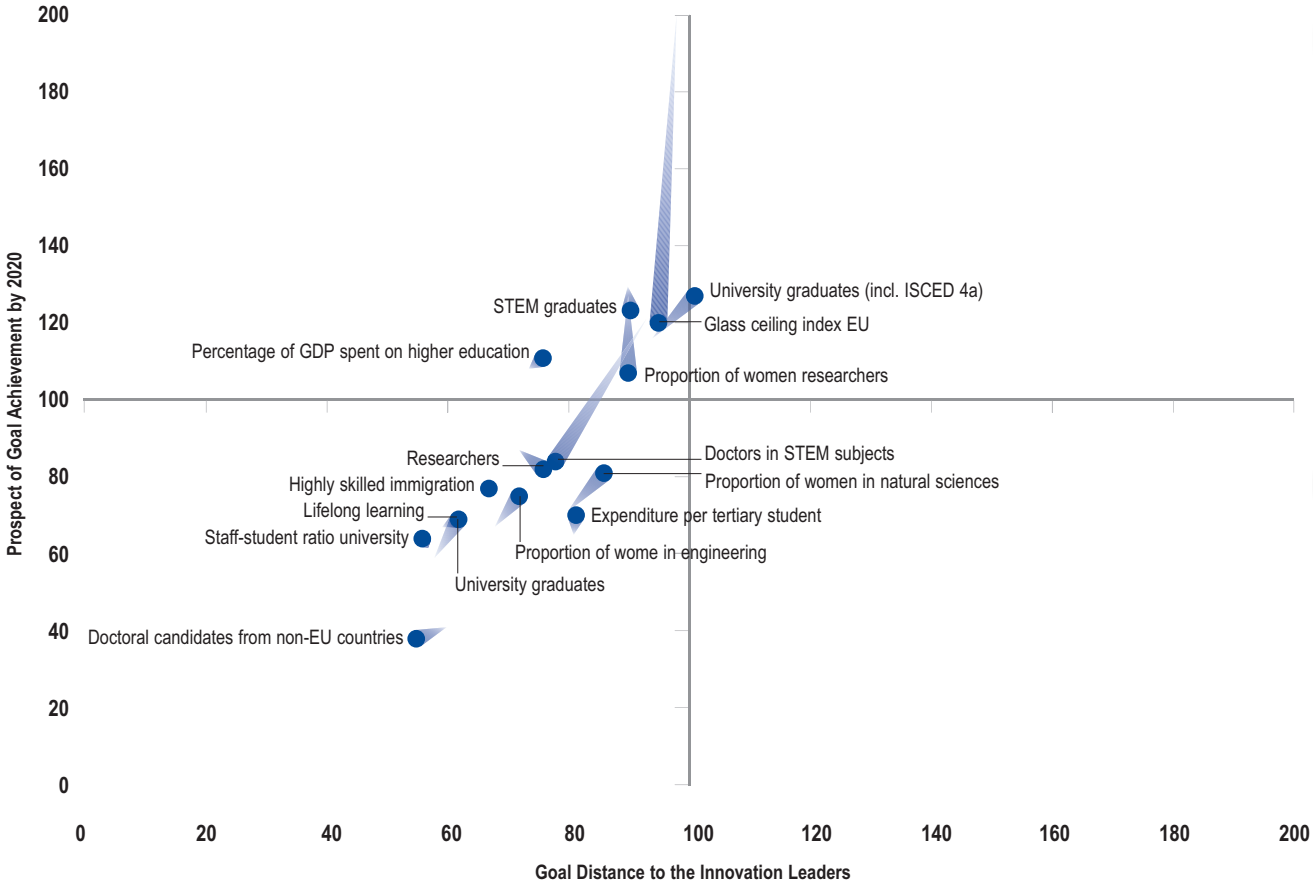
[40] See also the Government Policy Statement by Federal Chancellor Faymann (online at: http://www.bka.gv.at/site/cob__53429/currentpage__0/7791/default.aspx) and the reports in the newspaper Die Presse on 15 January 2014: "Ausbildungspflicht fix, Familienbeihilfe steigt stufenweise".

educational system

Tertiary Education System

There have been a host of changes in the tertiary education system since the previous year. While several of the indicators in Fig. 10 show a negative trend or are stagnating, in several others there have been positive developments and the distance to the Innovation Leaders has narrowed in a number of areas. An analysis of how values have developed over the long term confirms this positive snapshot for most indicators for the tertiary sector. However, the dynamics of the development need to be considered individually. For despite improvements in terms of the distance-to-goal, there is no prospect of achieving the goals in nine of the 15 indicators used if the trends remain unchanged. Indicators for the tertiary education system, which showed a highly dynamic development even in previous years (notably the indicators "University Graduates (incl. ISCED 4a)",

Fig. 10: Goal Distance and Prospect of Goal Achievement in the Tertiary Education System, Most Recent Available Year



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 in 2020.

"STEM Graduates" or "University Funding as a Percentage of GDP") have largely been able to maintain their trend. As a result, the gap to the leading innovation nations has continued to narrow in these areas. In fact, one of the goals of the RTI Strategy was achieved for the first time last year: The proportion of 30 to 34-year-olds with a tertiary education qualification (incl. ISCED 4a)[41] has now reached 38.25 percent, exceeding the target figure of 38 percent. However, this figure is still below the average of the Innovation Leaders, where the figure without ISCED 4a has already reached 42 percent.

Once again a positive trend can be observed in respect of the number of graduates in STEM subjects (cf. Fig. 10, Indicator "STEM Graduates"). Although growth has slowed somewhat since the previous year, the distance to the Innovation Leaders has narrowed. From a current perspective, the goal of producing as many graduates in STEM subjects as the leading nations by 2020 is within reach. The measures set out in the RTI Strategy to strengthen human potential, especially in STEM subjects (examples worth mentioning here include "sparkling science", "children's universities" and the Vienna Open Lab for the secondary level), as well as the quality package "Teaching" in the performance agreements and the EUR 40 million in action funding for higher education, appear to be providing further support for the positive developments that have already been apparent for some time.

But this does not mean it is possible to predict whether an adequate number of graduates in these subjects will be available for the labour market. However, the trend reversal in the "Doctors in STEM subjects" indicator observed since last year, seems to reveal significant demand from industry for STEM graduates. The prospect of achieving this goal has worsened significantly and the goal distance has widened, i.e. significantly fewer graduates in STEM subjects are currently enrolling in doctoral programmes. This is due on the one hand to the transition to structured doctoral programmes, as a result of which the number of doctoral students tends to be reduced to those who actually wish to pursue an academic career. On the other, it also indicates that a greater number of STEM graduates are entering the labour market.

A key factor for the increase in the number of STEM graduates is that women are now more motivated to study these subjects (see Fig. 10 Indicators "Proportion of Women in Science" and "Proportion of Women in Engineering"). The failure to increase the proportion of female graduates to the same level as the Innovation Leaders has been especially evident in engineering. In 2011 the number of science graduates rose by 11.6 percent to 5,464 and that of engineering and technology graduates by 6.6 percent to 4,881 in comparison to 2010.[42] In the past ten years, the number of female graduates in engineering has remained stable at 20 percent. The number of women science graduates is somewhat higher at 35 percent. However, Austria still lags behind the Innovation Leaders by approximately 10 percent.

The effects of the measures set out in the RTI Strategy to strengthen human potential in mathematics, information technology, science and engineering – especially in pre-school education – cannot, of course, be felt yet at universities, as it takes time for these measures to take effect. However, these measures can only achieve lasting success if they are reinforced and generate a positive understanding of science and technology among the population as a whole and young people in particular. Targeted improvements in teaching are also required,

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 educational certificate should be increased to 38 percent by 2020.*

[41] In international ranking tables graduates in the categories 5a and 6 of the international Standard Classification of Education (ISCED) are defined as university graduates. Owing to a number of specific characteristics of the Austrian post-secondary education system, graduates of secondary technical and vocational high school or college are included in this category.

[42] Statistik Austria (2013): Hochschulstatistik (compiled on 7. 8. 2013); Austrian Council calculations.

as structural reforms in the area of tuition are more likely than selective funding or awareness-raising programmes to bring about long-term changes in the study programmes chosen by young people. [43] Only then can it be expected that even more new students will enrol for this type of degree and that the recent increases in numbers can be exceeded.

However, in contrast to this, current data and trends show that conditions for university graduates are less than ideal both at universities and on the broader labour market. The relevant RTI Strategy goals are only being partially fulfilled (cf. the section "Gender Equality in Research" page 30). Even if marked increases can be seen in the number of female science and engineering graduates, this still does not alter the fact that the pace of progress is too slow for the achievement of the goal.

In recent years, there has been a steady increase in spending on universities (cf. Fig. 10, Indicator "Percentage of GDP spent on Universities"). Between 2000 and 2010, the percentage of GDP spent on universities rose from 1.04 to 1.52 percent, the equivalent of an annual increase of almost 8 percent.[44] However, in the years that followed, the trend was not sustained on the same scale. To achieve the target defined in the current Government programme of spending two percent of GDP on the tertiary sector[45], would require economic growth of 6.7 percent in the period up to 2020. Assuming that the proportion of financing provided by the public-sector remains stable at roughly 88 percent (basis 2010), public spending in 2020 will total approximately EUR 7.3 billion. This will require an annual increase in the budget for the tertiary sector of between EUR 300 and 500 million.[46]

The Austrian Council considers that achieving this goal should be regarded as the minimum required to achieve an internationally competitive quality of teaching and research at universities and universities of applied sciences. It would also make the urgently needed optimisation of conditions of study affordable. Continuous growth in student numbers has so far made it impossible to significantly increase university spending per student (cf. Fig. 10, Indicator "University Spending per Student"). The marked increase compared to the previous year is due to the equally sharp fall compared to 2012. At any rate, since 2005, spending per student has been stagnating at a low level compared to the leading innovation nations.

In 2002 an amendment to the Universities Act (Federal Law Gazette I No. 52, 20 March 2013) introduced a new form of university financing, which provides for the gradual introduction of study-place financing, the implementation of which was also confirmed in the current Government work programme.[47] This capacity-orientated, place-based system of university funding is also intended to bring about improved conditions of study. However, several framework conditions for this, such as the regulation of university access (capacity levels are currently regulated in five fields of study), and a suitable weighting scheme or cost calculation for the different discipline groups, still have to be optimised.

During the phased implementation of this system, which should be in place by the perform-

[43] 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, p. 43 ff., p. 61 f.

[44] Hranyai, K. / Janger, J. / Strauss, A. (2013): Forschungsquotenziele 2020: WIFO Study for the Austrian Council for Research and Technology Development.

[45] Work Programme of the Austrian Federal Government 2013–2018. Austria. A Story of Success. Vienna, December 2013, p. 44.

[46] Cf. Hranyai, K. / Janger J. (2013): Hochschulfinanzierung im internationalen Vergleich. In: WIFO-Monatsberichte 2/2013, pp. 173–186.

[47] Work Programme of the Austrian Federal Government 2013–2018. Austria. A Story of Success. Vienna, December 2013. p. 44.

ance agreement period 2019–2021, conditions of study will also be optimised. As part of this process, steps should be taken to speed up improvements in academic supervisory conditions (up to 200 additional professorships are to be created) as well as supplemental admission restrictions for heavily subscribed subjects and urgently needed infrastructure measures.

By nature, the effects of ongoing measures can only be judged after a lengthy observation period and cannot therefore be depicted adequately on the basis of the indicators used for the current period. Nevertheless, the present situation at the universities, shows that the measures that have been implemented so far will have to be intensified, if standards in teaching and research are to be raised to those of the leading innovation nations. This will, however, require sustained increases in investment.

However, as yet there is no sign of these necessary increases in the current budget trajectory for universities in the federal financial framework. Under no circumstances should improvements in the teaching and academic supervision situation be financed at the expense of research and development and vice versa. If the quality of teaching and research is to be raised, a substantial increase in the budget for universities is absolutely essential.[48]

In addition to the indicator "University Spending per Student", the values for the indicators "Supervisor-Student Ratio University (I)", "University Graduates" and "Lifelong Learning", are also stagnating. Measured against the goals of the RTI Strategy they are at a low level and (as yet) no significant progress is apparent.

There is no current data available for the "Immigration of Highly Qualified Workers" indicator. However, due to the very slow increase in numbers in the past, no substantial changes are to be expected. The "Doctoral Students from Non-EU Countries" indicator also shows that the trend is not moving in the right direction, in contrast to the Innovation Leaders. The majority of highly-qualified students from non-EU countries apply for structured doctoral programmes of the kind that were, until recently, financed by the FWF. The freezing of funding for further structured doctoral programmes conflicts with the urgent need to expand these programmes.

The Red-White-Red Card was introduced following an amendment to the Aliens' Act in 2011. In 2012 this was followed by an amendment of the Settlement and Residence Act (NAG) and the Act Governing the Employment of Foreign Nationals (AuslBG, Federal Law Gazette 2013/72). Both measures were intended to facilitate immigration by skilled and key workers. However, figures show that the expected increase in the immigration of highly-qualified third-county nationals has not yet come about. At the end of July 2013, a total of 1,536 Red-White-Red Card holders were registered at the Federal Ministry of the Interior. It is expected that some 1,100 new cards will be issued in 2013, roughly the same number as in 2012.

Red-White-Red Card holders are employed in a wide variety of fields. Approximately 30 percent are engineers, approximately 7 percent scientists and artists, 19 percent entrepreneurs, directors or senior executives while almost 4 percent are athletes. Twenty percent are key workers employed in trade and industry, in particular in the main and secondary building trades. A further six percent are employed in the service sector, for exam-

[48] Cf. Leitner, K. H. / Ecker, B. / Steindl, C. (2011): Finanzierungsmodelle universitärer Lehre: Internationale Beispiele, Erfahrungen und mögliche Strategien für Österreichs Universitäten. On behalf of the BMWF; see also the Recommendation of the Austrian Council for Research and Technology Development on the University and Science System in Austria from 5. 11. 2013 and the Recommendation of the Austrian Council for Research and Technology Development on the Percentage of GDP Spent on Research and Universities from 16. 1. 2014.

ple in retail and tourism, and here, in particular, as chefs.[49]

Although approximately ten percent more skilled workers were motivated to apply for Austrian work permits than was the case under the old system for key workers (presumably because of the transparent criteria), the Red-White-Red Card still only accounts for 1 percent of all valid residency permits. But forecasts at least predict that the Red-White-Red Card will make it possible to bring an additional 5,000 skilled workers to Austria.[50] The immigration management system should be improved further for this purpose.

Students from non-EU countries are only eligible for a Red-White-Red Card after they have completed a diploma or Master's degree. The scheme has not yet been extended to include students with a Bachelor's degree. Each year, approximately 1,400 students from third-party states graduate from Austrian universities.[51] Experience in other countries indicates that between 20 and 30 percent of these graduates remain in the host country after having completed their degree. Here too, Austria tends to be at the lower end of the tables.[52]

As part of efforts to attract highly-qualified workers, improvements should also be made for Austrian researchers who might be willing to return home. Suitable legal framework conditions should do more to support initiatives such as "EURAXESS – Researchers in Motion".

RTI Strategy Objectives

• *The reforms attempt (…) to balance out gender discrepancies in research.*

Gender Equality in Research

As mentioned earlier, the RTI Strategy goal of correcting the gender imbalance in research has only been partly achieved. Although there have been significant increases in the number of female science and engineering graduates, the trend remains too weak to achieve the goal (see Fig. 10, Indicators "Proportion of Women in Science" and "Proportion of Women in Science").

The percentage of women in research has scarcely changed since last year. In fact, the indicator "Proportion of Researchers" in Fig. 10 actually shows a significantly lower value in comparison with the average values for the Innovation Leaders. Although the trend continues to indicate that the goal can be achieved by 2020, increased measures should be taken to make it easier for women to pursue a scientific career.

The Glass Ceiling Index shows that efforts in this regard have not been sufficiently successful. Austria's position has deteriorated sharply compared to the previous year.[53] If the downward trend continues, there is no longer any prospect of achieving the goal. This means that women still have fewer career opportunities than men in many scientific and economic domains, not least of all because of traditional social and family attitudes. This view is corroborated by a long-term study carried out on behalf of the Austrian Chamber of Labour.[54] According to this study, women are more likely to have difficulty finding a job that is commensurate with their qualifications than men, notwithstanding the enormous increases in their levels of education. Thus more than one third of university graduates (35.4 per-

[49] Biffl, G. / Bock-Schappelwein, J. (2013): Zur Niederlassung von Ausländerinnen und Ausländern in Österreich. On behalf of the Federal Ministry of the Interior.

[50] Biffl, G. / Bock-Schappelwein, J. (2013): Zur Niederlassung von Ausländerinnen und Ausländern in Österreich. On behalf of the Federal Ministry of the Interior.

[51] Statistik Austria (2014): Statististical Database, enquiry 01/2014.

[52] prognos (2011): Studentische Mobilität und ihre finanziellen Effekte auf das Gastland. Cf. OECD (2011) International Migration Outlook, according to which some 17 percent of foreign students remain in the host country.

[53] The Glass Ceiling Index has so far been based on only a small number of data points, which leads to significant statistical fluctuations.

[54] Völkerer, P. / Pirklbauer, S. / Hauer, G. / Prenner, P. (2014): Frauen – Bildung – Arbeitsmarkt: Die Entwicklung der Qualifikationsstruktur von Frauen und Männern 1981–2010 in Österreich. Vienna.

cent) are employed in positions for which they are overqualified.

An analysis of the composition of supervisory boards across all sectors of business in the General Income Report 2013 of the Austrian Audit Office shows that on average only 23.2 percent of supervisory board members are women. Universities boast the highest percentage of female supervisory board members (members of the university council), namely 45.8 percent, not least of all because of the statutory gender quota of 40 percent.[55] Although the number of women professors has increased in recent years, they still only account for 22 percent of the total.[56] By contrast, in the education sector, where there is a clear female predominance in the category childcare and education, 71.4 percent of all staff are women.[57] In comparison, the average share of women in supervisory boards in this category is just 29.8 percent.[58] Here too, it is fair to say, there is a veritable imbalance.

The gender-specific measures set out in the RTI Strategy have almost all been implemented already. As this has evidently not resulted in any significant improvement in the gender balance, it has to be asked whether the measures taken were in fact suitable and whether perhaps there are structural and cultural obstacles that block their action. The current career structures at universities, for example, continue to put women at a structural disadvantage.[59] Academics obtain professorial appointments at a relatively late age and such appointments require them to move to a different university. This makes it harder to combine having a family and a career, especially for women. In the USA, for example, such obligatory transfers from one university to another take place immediately after a candidate has completed her doctorate. At the same time, the tenure-track system leads directly to early professorial appointments, as associate professors have the opportunity to obtain a non-time-limited position at their own university. This is made harder in Austria as appointments to full professorships are made according to procedures laid down in paragraph 98 of the Universities Act of 2002.

The GENDERA[60] project has shown that one of the biggest obstacles for women in the field of science and research is the persistence of male-dominated work cultures and ways of thinking, which for example, make the availability of scientists round the clock, the norm. The European Commission has also noted that the unwritten laws arising from gender stereotypes constitute the biggest barrier in this regard.[61] This includes the fact that the constant demand for excellence is anchored to criteria such as "mobility", although these are actually of little relevance to the quality of research.

[55] Austrian Audit Office (2013): Über die durchschnittlichen Einkommen und zusätzlichen Leistungen für Pensionen der öffentlichen Wirtschaft des Bundes. Austrian Audit Office Report, Income Series 2013/1, p. 19 ff.

[56] Statistik Austria (2012): Scientific and artistic personnel at state universities in the academic year 2012/2013 (cut-off date 31. 12. 2012).

[57] Statistik Austria (2013): Total number of teachers in the 2012/2013 academic year (incl. those on leave).

[58] Austrian Audit Office (2013): Über die durchschnittlichen Einkommen und zusätzlichen Leistungen für Pensionen der öffentlichen Wirtschaft des Bundes. Austrian Audit Office Report, Income Series 2013/1, p. 19 ff.

[59] Janger, J. / Pechar, H. (2010): Organisatorische Rahmenbedingungen für die Entstehung und Nachhaltigkeit wissenschaftlicher Qualität an Österreichs Universitäten. Wien: WIFO; cf. Janger, J. / Strauss, A. / Campbell, D. (2013): Academic careers: a cross-country perspective. In: WWWforEurope Working Paper Series, 2013, 37.

[60] GENDERA (Gender Debate in the European Research Area) was a project conducted as part of the 7th EU Framework Programme. Its main task was to discuss and further develop existing analyses and recommendations for rectifying the underrepresentation of women in specific scientific fields and in decision-making positions, and to implement best practices through the national GENDERA task forces. In Austria, the project partner and co-ordinator for domestic GENDERA activities was Joanneum Research.

[61] European Commission (2009): Women in science and technology: Creating sustainable careers. Brussels.

This creates a necessity for change to the organisational and work culture at science and research institutions, and in particular for changes with regard to ideas about working hours. Working practices that have developed from the long-hours culture (i.e. round the clock availability and long hours of physical presence at work) should be replaced by flexible working hour models, which enable both women and men to fulfil care responsibilities (work-life balance). Furthermore, the indicators and methods used to measure performance should be critically reviewed with regard to the objectivity ascribed to them.

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy in the 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. Most of the recommendations made in the previous year remain valid.

Education System (Without Tertiary Sector)
The Austrian Council recommends a modernisation of the structures of the education system, above all via strengthening school autonomy and streamlining the division of competences between the Federal Government and provinces.
The Austrian Council recommends that to overcome early-age selection in the education system, there be a commitment to, and appropriate implementation of, comprehensive full-day secondary schools, alongside ability differentiation and talent development.
The Austrian Council recommends greater promotion of German and other first language skills, since the development of appropriate linguistic competence constitutes a precondition for all forms of education. Besides more high-quality kindergarten places, this also requires a substantial increase in the number of qualified educators.

Tertiary Education System
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 EUR 400 million, that is required should be made available for the tertiary sector.
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. At the same time, adequate financing of both teaching and research must be ensured.
The introduction of study-place financing should not endanger efforts to catch up with the leading group of countries also in the area of research. An appropriate increase in the university budget is therefore essential.

Gender Equality in Research
The Austrian Council recommends stepping up measures to increase the number of women in those fields in which women are underrepresented, and already starting in the primary education sector.
To promote gender equality in research, the Austrian Council recommends the development of attractive career models for women both 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.

Research at Universities and Non-University Research Institutions

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Science and research are nowadays amongst the pillars that support highly developed economies.[62] Every year the public-sector and industry invest growing sums in science, research, development and technology transfer, with the goal of being able to respond more effectively to the social and economic challenges of the future. An essential factor underpinning an effective innovation system is the quality of basic research.[63] An analysis of developments in the last 300 years shows that societies that do not conduct basic research motivated by curiosity and unconstrained by unpredictability stagnate economically.[64]

Countries with a high level of research intensity such as Sweden, Finland, Denmark and Germany, but also Austria, have in recent years increasingly placed and continue to place emphasis on the promotion of basic research. Scientific insights are intended to strengthen the flow of knowledge in innovation systems and to still the "hunger" of business and societies for new insights, technologies, products and applications.[65] Accordingly, the RTI Strategy of the Federal Government emphasises the central role which basic research plays in innovation systems.[66]

In this sub-chapter, the Austrian Council mainly emphasises developments related to the goals of the RTI Strategy in respect of the quality of university research and financing of basic research. Also analysed are goals related to university career structures. In light of the limited changes in the areas of non-university research and research infrastructure, as well as the fact that there are no standardised indicators available to identify the relevant goals in the RTI Strategy, only limited attention is paid to these themes in the 2014 report.

Universities and Basic Research

In the area of universities and basic research only one of the desired goals of the RTI Strategy has been achieved to date. Fig. 11 provides an overview of the most important developments related to the financing and quality of university research, and especially of basic research, since the reporting year 2013. Compared to the previous year, there have been significant changes regarding three indicators: funding for competitive financing of basic research has declined, with the value for 2014 dropping back to the initial value in 2007. University research performance has improved and the number of acquired ERC grants has recently risen significantly. The other indicators demonstrate only minimal change compared to the previous year (see Fig. 11).

The growth in the number of approved ERC grants is especially noteworthy. The European Research Council (ERC) allocates research funding exclusively on the basis of the excellence of the project that has been submitted and of the researcher(s). This means that this indicator (cf. Fig. 11, Indicator "ERC Grants per 1,000 Researchers") is without doubt one of the most important yardsticks of the quality

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.*

[62] Keuschnigg, C. (2013): Wachstum und Wohlfahrt durch Wandel. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 210–225.

[63] 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, p. 74 f.

[64] Nowotny, H. (2005): Unersättliche Neugier: Innovation in einer fragilen Zukunft. Berlin: Kadmos Kulturverlag.

[65] Weissenberger-Eibl, M. (2013): Die Zukunft von Wissenschaft und Forschung und die Entstehungsbedingungen von Innovation. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 86–93, p. 87 f.

[66] Strategy for Research, Technology and Development of the Austrian Federal Government, p. 18.

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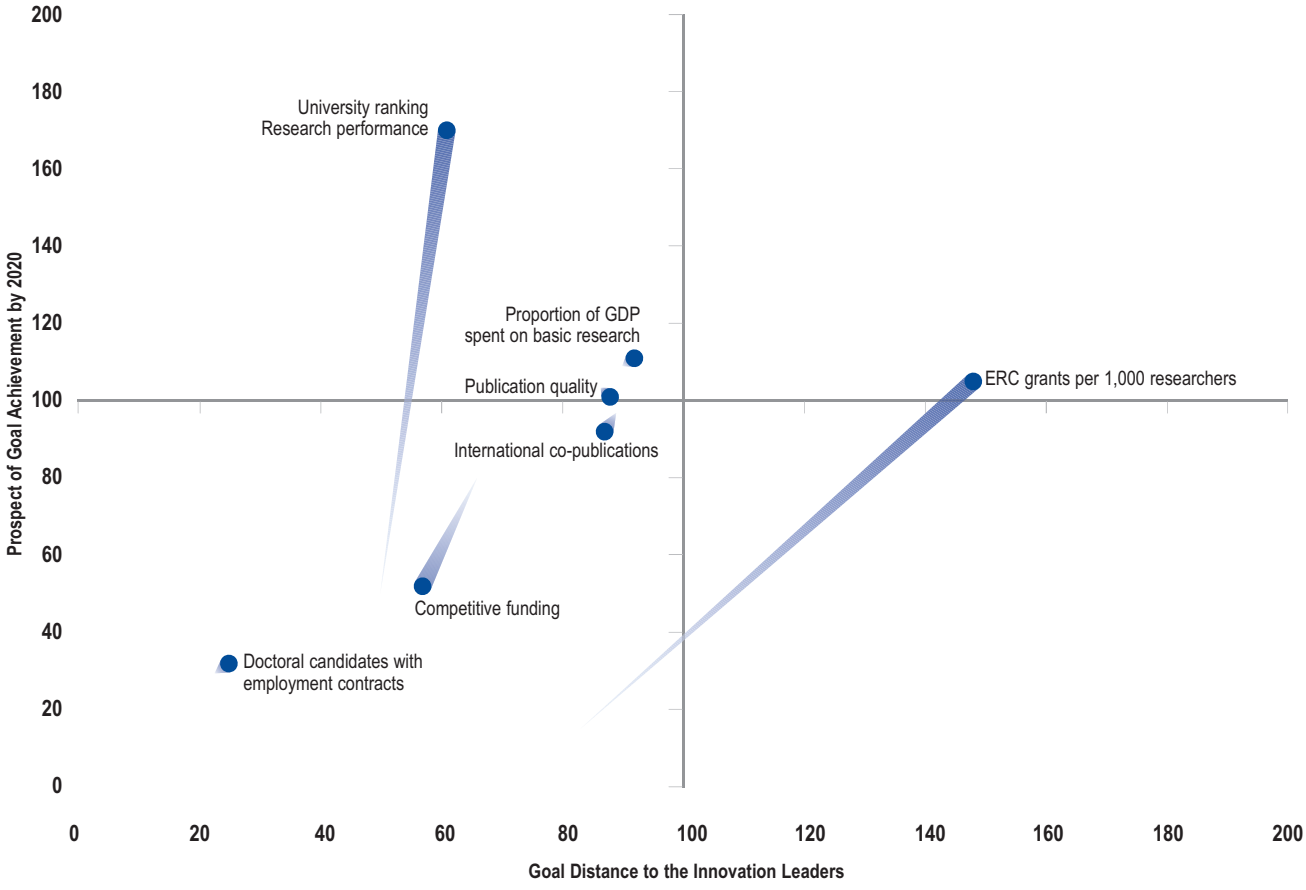
and international competitiveness of basic research in Austria. The high number of successful project applications demonstrates that the performance of researchers at Austrian universities and research institutions is above average.

This solid trend can be regarded as confirmation that Austrian researchers are internationally well networked and that the quality of their research is recognised. The continued strong performance of Austrian researchers in international co-operative research is also demonstrated by the high level of participation in European Framework programmes, and by a return of 125 percent in 2013 (see also Fig. 16, on page 50).

The indicator "University Research Performance" measures the position of Austrian universities relative to international counterparts by reference to scientific performance parameters. In view of the fact that two universities – the universities of Vienna and Innsbruck – have climbed into higher bands, Austria's position in this respect and the dynamic have significantly improved compared to 2013. Austria thus still has four universities in the top 500 but

Fig. 11: Goal Distance and Prospect of Goal Achievement in the University Sector and in Basic Research, Most Recent Available Year



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 in 2020.

now two are in the top 200 and 2 in the top 300. [67] However, this dynamic is predicated on only a short data series and must thus be treated with caution.

The evaluation of quality in basic research is also illustrated by the indicators "Publication Quality" and "International Co-Publications" as forms of quantifiable scientific output factors. These tend to capture the whole basic research landscape and not just individual institutes and universities, as is the case with the university ranking or acquired ERC grants. For the former indicator, those articles are considered that are numbered amongst the ten percent of most cited articles in their discipline. In this respect, Austrian researchers are located in the upper middle field, yet very clearly behind the leading countries (where Switzerland, Sweden, the Netherlands, Finland and Denmark deserve a particular mention).[68] The number of citations of Austrian researchers continued to increase steadily in preceding years, but the indicator shows little variation, since this trend is also to be found in the comparison countries.

In the past, the number of international co-publications has risen more quickly than the average rate of the Innovation Leaders, which is reflected in the indicator's consistent upward trend. Recently, however, this trend has reversed. The gap to the leading countries is still narrow, but the developmental trend does not permit any optimism regarding the achievement of the goal set for 2020.

One reason for this can be found in the average conditions prevailing at universities and other research institutions as they pertain to the recruitment of talented scientists. Notwithstanding excellent best practice conditions at individual institutions such as IST Austria, overall, Austrian universities still have some work to do to ensure that careers are as attractive as in the leading countries. This includes in particular the prospects for tenured appointment, high research autonomy, good opportunities for co-operation with renowned colleagues in one's discipline as well as the available infrastructure.[69] In many areas, the latter constitutes a necessary precondition for excellent research. Yet, the resources available for this are often limited (see also chapter "Research Infrastructure" on page 38 ff.).

There are top research institutes and centres, yet overall, too few of them offer young, talented scientists optimal research conditions. The consequences of this include, amongst other things, increasing emigration of Austrian researchers, coupled with difficulties in recruiting internationally successful scientists to domestic universities. Not only to achieve high success rates in research grant applications but in particular to secure Austria's position as a science and research nation, it is thus necessary to create the conditions for a larger number of optimal research institutions with excellent infrastructure.[70]

If in addition one considers the indicator "Doctoral Students with Employment Contracts", it becomes clear that funding for young researchers in Austria is not yet as extensive as one would wish. Despite ongoing efforts and relevant measures, such as the gradual increase in the number of career or training positions, success is still a long way off. The lack of training positions and opportunities for employment constitutes a gap in research conditions which

[67] Cf. Centre for Science and Technology Studies (CWTS) Leiden Ranking 2013 (online at: http://www.leidenranking.com/

[68] Kratky, C. (2013): Wird Österreich im Jahr 2050 in der Grundlagenforschung zur Weltspitze zählen? In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 78–84.

[69] Janger, J. / Nowotny, K. (2014): Bestimmungsfaktoren für die Arbeitsplatzwahl von Wissenschaftern und Wissenschafterinnen. In: WIFO-Monatsberichte, 2014, 87(1), pp. 81–89; cf. Reinstaller, A. / Unterlass, F. (2014): Forschergehälter an Universitäten nach Karrierestufen im internationalen Vergleich. In: WIFO-Monatsberichte, 2014, 87(1), pp. 55–66.

[70] 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, p. 81 f.

massively limits the catching up process and will prevent better performance in the long term.

As in previous years, it is necessary at this juncture to point to the need to increase scientific competence by means of appropriate support for young scientists and the establishment of additional training positions. Austria lacks a genuine tenure-track career model of the kind that also exists at leading German and Swiss universities, such as the Technical University of Munich or the ETH Zurich, and without which it will be unable to enhance its international competitiveness in the recruitment of top researchers.[71] This kind of career model links the prospects of a non-time-limited position with high research autonomy, which permits young scientists to undertake independent research from the very start of their careers.

In respect of research financing, there are two contrary developments (cf. Fig. 11, indicators "Percentage of GDP Spent on Basic Research" and "Competitive Financing").Changes in the percentage of GDP spent on basic research are modest compared to the previous year. At 0.53 percent of GDP, Austria's spending on basic research as a percentage of GDP remains just below the average of the Innovation Leaders (0.57 percent of GDP). The trend is actually above the average of the Innovation Leaders. It thus currently seems very likely that Austria will by 2020 be able to achieve the RTI Strategy goal of advancing into the group of these countries. Austria will not, however, be able to catch up with the leading nations of Switzerland and South Korea, whose current spend of 0-8 percent of GDP is the highest in the world and which intend to invest in this sector even more strongly in the coming years. Yet it has today already caught up with countries such as the USA, France or Japan.

Austria's 2020 target for investment in basic research comprises 0.94 percent. To achieve this, growth in this sector would in the years up to 2020 have to increase by more than 12 percent annually. The expenditure trajectory implications of the goal of achieving the target of investing 2 percent of GDP in the tertiary sector are a doubling of funding from the current level of about EUR 1.7 to 3.9 billion.[72]

Although a 92.5percent growth between 2002 and 2011 in basic research expenditure means that funding has nearly doubled, additional efforts remain necessary in order to catch up with the leading group of nations.[73] According to Statistik Austria, expenditure in 2011 was EUR 1.58 billion. This constitutes 19.4 percent of Austria's total R&D expenditure. The university sector accounts for the largest proportion, namely, 72.4 percent of total expenditure. At EUR 325.8 million and EUR 100.6 million respectively, the corporate-sector and non-university public-sector institutions, play a subordinate role.[74] Significant shifts in these relative proportions are not to be expected. From now until 2020, public-sector investment will thus become increasingly important for this central pillar of the innovation system.

In contrast to the positive performance in respect of the funding ratio, there has in comparison to last year been a further decline in com-

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

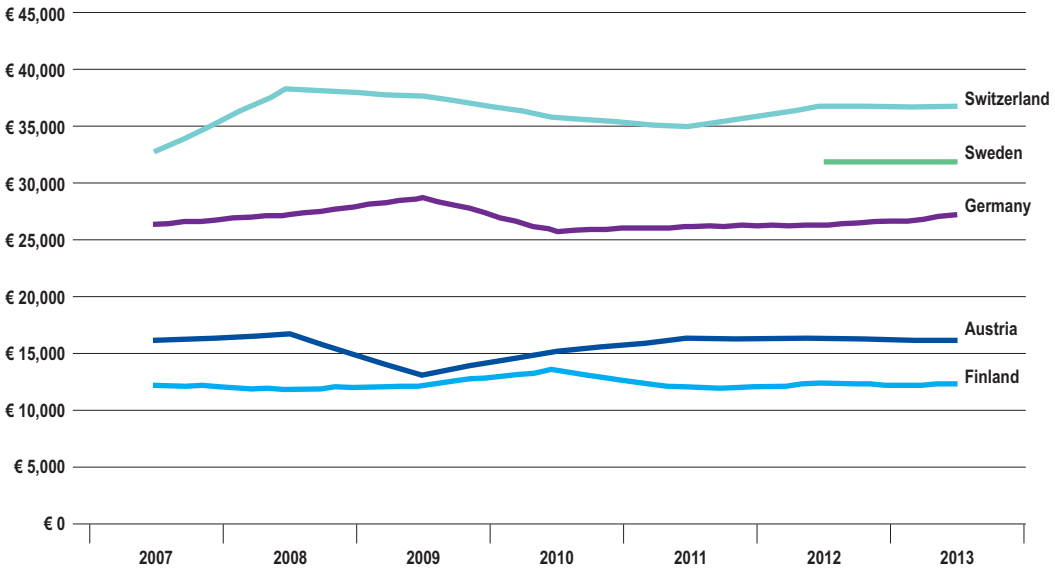
[72] Statistik Austria, WIFO calculations; Percentage of GDP spent on basic research: GDP from 2014 updated on the basis of WIFO forecast, from 2018 onward with 4 percent.

[73] It should be pointed out here that a number of countries do not collect data on R&D spending by type of research, as it is often difficult to differentiate between basic research and applied research. There is no such data available from Germany, for example. To enable a comparison, the innovation leader Denmark and the four countries with the highest basic research intensity were referenced. See also Appendix 1.

[74] 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, p. 75 f.

petitive funding of basic research. On the one hand, the gap to the Innovation Leaders has widened, and on the other, the trend is worsening, which means that the prospect of achieving the goal has to be considered rather low.
The Austrian Science Fund (FWF), which operates on the principle of allocating the available funds via a competitive process, had approximately EUR 202.6 million available in 2013. Although there have been numerous increases in the FWF budget since 2007, Austria does not compare favourably with the budget for the funding agencies of Switzerland, Finland, the United Kingdom, Germany, Sweden or the Netherlands. The leading position is assumed by Switzerland, which in 2013 invested EUR 88.5 per inhabitant in competitive funding for basic research. With an investment of only EUR 23.8 per inhabitant, Austria comes last amongst these countries.[75] This is to be considered a significant problem, since the availability of third-party funding constitutes one of the most central criteria which researchers employ when selecting where they will work, and as such, it strongly influences international competiveness in the recruitment of leading researchers.[76] The temporary freezing of FWF-funded structured doctoral programmes will lead to Austria falling further behind in basic research.
Fig. 12 depicts total relevant research funding per country calculated as an average per researcher. This shows that a growing number of researchers can absorb the simultaneous increase in funding. This process can also be observed in other countries, yet Austria is only marginally catching up.

Fig. 12: Funding Awarded to Basic Research on a Competitive Basis per Researcher



Source: WIFO, FWF.

[75] Cf. FWF (2014): Jahrespressekonferenz Geschäftsjahr 2013. Vienna, 2 April 2014, p. 23.
[76] Janger, J. / Nowotny, K. (2013): Career choices in academia. In: WWWforEurope Working Paper Series, 2013, 36.

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Non-University Research

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.*

In comparison to last year, there has been no major change in non-university research. Those measures that are currently being implemented have already been positively emphasised in previous years' reports on Austria's scientific and technological capability. It is worth noting, however, that this applies primarily to reforms in the internal structures of research institutions and that thus only one of the three goals set out in the chapter is being addressed. By contrast, it remains unclear how the measures are to contribute to 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 make for a more compatible overall structure in the non-university research sector and work toward the development of role models.

The Austrian Council thus again urges a comprehensive analysis of the non-university research sector in order to generate an overview of its structure, with a view to using this as the basis for further reform measures. The goal is to develop clear role models, performance targets, success factors and structural adjustments that do justice to the different institutions of the non-university research sector. In this context, it is necessary to consider above all the functional differentiation according to the specific range of tasks of the individual institutions.

Research Infrastructure

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.*

In its Report on Austria's Scientific and Technological Capability 2013 and in a recommendation,[77] the Austrian Council has already emphasised that greater support for the research infrastructure in Austria and international participation in large-scale research infrastructure constitutes an essential factor for the success of science in Austria and thus also for the country's economic development. The current situation, i.e. the lack of a funding level which goes beyond the basic funding of smaller infrastructural units, constitutes a massive limitation of the research and development opportunities of universities and other research institutions oriented toward basic and applied research. Efforts to make optimal use of infrastructure by means of increased co-operation between the research institutions, will only be effective if it proves possible to significantly increase the acquisition of new, and the modernisation of existing, research infrastructure. In the view of the Austrian Council, the funds available for research infrastructure at universities from the Higher Education Area structural funding instrument are insufficient to achieve the targets.

[77] Recommendation of the Austrian Council for Research and Technology Development on Research Infrastructure in Austria, 24 November 2011.

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy 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. Most of the recommendations made in the previous year remain valid.

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 the 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 Austrian Council recommends a determined effort to increase the number of suitable career positions and structured doctoral programmes.

Non-University Research

The Austrian Council again recommends a holistic analysis of the non-university research sector. This should prioritise clear role models, performance targets, success factors and structural adjustments that do justice to the different institutions of the non-university research sector.

Research Infrastructure

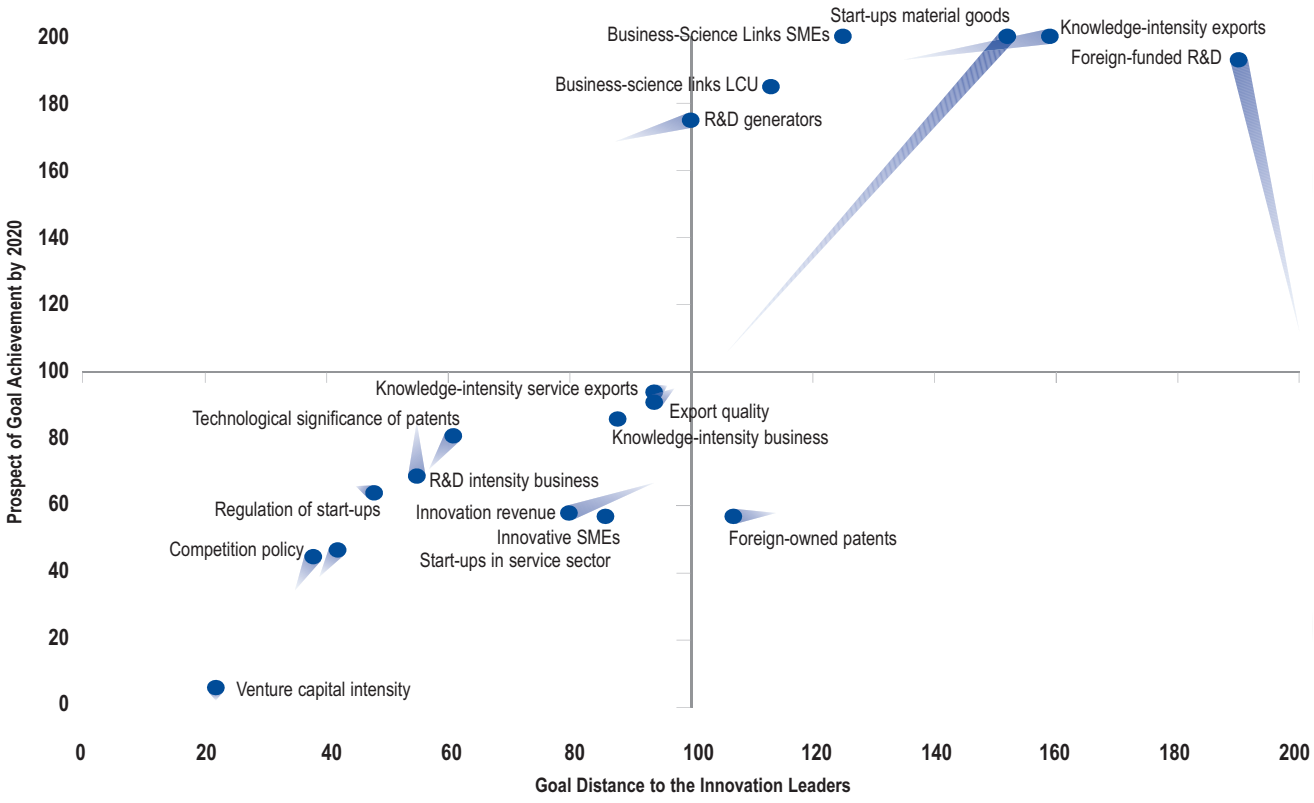
The Austrian Council again recommends that it is in Austria's scientific and economic interests to make available a level of funding sufficient to modernise and extend the necessary research infrastructure at universities and at non-university research institutions. This requires at least a doubling of the funding volume of approximately EUR 240 million allocated between 2002 and 2011 within the framework of the Research Infrastructure Programme. The guideline for a competitive allocation should promote in particular co-operation between research institutions and thus also contribute to enhancing the organisations' profile.

corporate research and innovation

Research and Innovation in the Corporate-Sector

An essential answer to the grand challenges in a rapidly changing world is adaptive capacity and innovation.[78] Highly-developed industrial countries are dependent upon the efficient implementation of scientific knowledge and technological innovation in society and the market, so that they can overcome increasingly complex challenges, thus maintaining or extending their prosperity.[79] Only if it proves possible to activate the potential of innovation and the knowledge generated in the university sector, non-university re-

Fig. 13: Goal Distance and Prospect of Goal Achievement in the Area of Corporate Research and Innovation, Most Recent Available Year



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 in 2020.

[78] See Aiginger, K. (2013): Reformmüdigkeit als Gefahr für ein Erfolgsmodell. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 22–38; cf. Keuschnigg, C. (2013): Wachstum und Wohlfahrt durch Wandel. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 210–225.

[79] 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, p. 83 ff.

search institutions or in the corporate-sector will it be possible to secure competitiveness and the quality of the business location into the future.[80] The RTI Strategy therefore regards the "transformation into a knowledge-based economy" as a high priority.[81] A further increase in innovation performance and the efficient utilisation of knowledge are especially central in this regard. The targets in respect of corporate-sector innovation efforts relate above all to corporate research, co-operation between science and industry, start-ups, venture capital and competition.

On the basis of the available data for this area, Fig. 13 shows that there have been no fundamental changes since the compilation of the Report on Austria's Scientific and Technological Capability 2013. Overall, one can see a moderate to strongly positive trend for about a third of the indicators; in respect of another third there has been stagnation compared to the previous year and a final third demonstrates a moderate upward trend.

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. Some of the indicators presented are currently only marginally removed from the target. 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 appear to be sufficiently dynamic to achieve the targets by 2020. This applies above all to the weaknesses in the area of start-ups, something that was noted last year, as well as to venture capital intensity and as regards innovation that is new to the market, i.e. the "radicalness" of innovation activity.

Innovation and Corporate Research

The indicators related to innovation and corporate research in Fig. 13 suggest that Austria has – in accordance with the RTI Strategy – developed into a knowledge-based economy.[82] In recent years, the Austrian economy has overall become more research intensive and the services it provides are more knowledge-intensive.[83] Having said that, the relevant indicators show that the corresponding targets have not necessarily been achieved. In this area, knowledge-intensive exports have already been achieved, but in the areas "knowledge-intensive economy", "knowledge-intensive service exports" and "export quality", the achievement of the targets appears to be unlikely, notwithstanding the limited goal distance.

Already achieved and specifically manifested in the "R&D Generators" indicator was the target of increasing the number of companies systematically engaged in R&D, from an estimated 2,700 in 2010, by approximately ten percent by 2013. The prospects of also achieving the target of increasing the number of R&D generators by approximately 25 percent by 2020 are also good.[84] New figures for the proportion of innovative SMEs (Indicator "Innovative SMEs") will only be available in 2015. If the efforts in respect of SMEs are pursed in a targeted manner, the goal of catching up with the Innovation Leaders is within reach, however. An optimal utilisation in the new EU Framework Programme *Horizon 2020* of the *SME instrument*, which is strongly targeted at innovation, could make an important contribution to this.[85]

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.*

[80] Cf, for example Weissenberger-Eibl, M. (2013): Die Zukunft von Wissenschaft und Forschung und die Entstehungsbedingungen von Innovation. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 86–93.

[81] Strategy for Research, Technology and Development of the Austrian Federal Government, p. 24.

[82] Strategy for Research, Technology and Development of the Austrian Federal Government, p. 24.

[83] 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, p. 182 f.

[84] 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, p. 85 f.

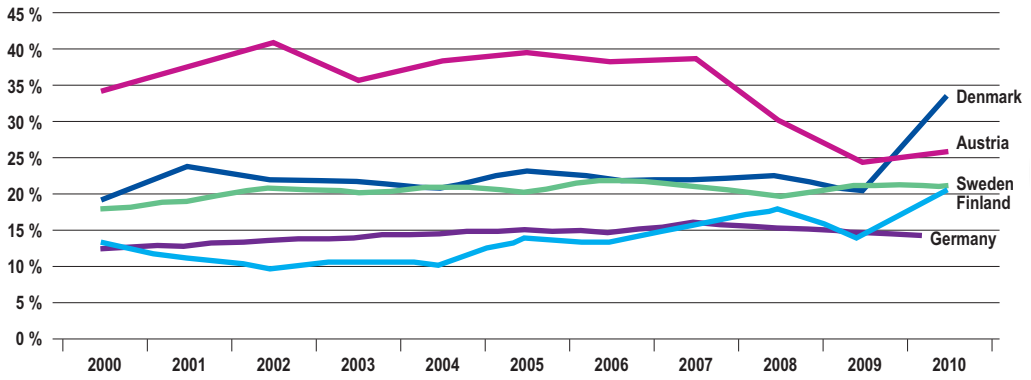
[85] http://ec.europa.eu/programmes/horizon2020/en/area/smes

corporate research and innovation

On the other hand, the R&D intensity of the corporate-sector, (i.e. the R&D expenditure of the corporate-sector adjusted by industry-specific R&D intensity) has not significantly improved (cf. Fig. 13, Indicator "R&D Intensity Business"). The goal achievement prospect for this indicator has actually decreased somewhat since last year. This reflects in part the fundamental weakness of the contribution of the private-sector to overall R&D intensity in comparison with the Innovation Leaders. In addition, in light of the stagnation of the R&D contribution of business, it is important to emphasise yet again the necessity of an appropriate legal and political framework for the corporate-sector. Alongside the existing portfolio of direct funding, stronger incentives could be provided,[86] for example via a differentiation of the research premium in the sense of a further increase for early-stage, small and R&D intensive businesses, though it is necessary bear in mind the already high proportion of public funding.[87] An evidence-based evaluation of the leverage effects of direct and, above all, of indirect funding could support Austria's efforts to close the gap to the Innovation Leaders.

The indicators regarding the proportion of foreign-funded R&D and the related foreign ownership of patents hint at the attractiveness of Austria as an R&D location. In both respects, Austria is either ahead of, or at least level with, the Innovation Leaders. Yet while the Innovation Leaders demonstrate an upward trend in this regard or at least a constant development, (see Figs. 14 und 15) Austria's record in respect of both indicators shows a decline over the last ten to fifteen years.[88] A continuation of this trend would, in the opinion of the Austrian Council, represent a significant reduction in the attractiveness of Austria as an R&D location. Accordingly, future developments should be closely observed, so as to enable timely action on any countermeasures that may be necessary.[89]

Fig. 14: Percentage of Foreign-Owned EPO Patents with Participation of Inventors Residing in Austria, Austria Compared to the Innovation Leaders



Source: WIFO.

[86] Austrian Council Recommendation Regarding the Efficient Translation of Research Results into Innovation, 24 November 2011; Recommendation regarding RTI-related start-up activities, 19 November 2012

[87] See also OECD (2013): Science, Technology and Industry Scoreboard, p. 106 ff.

[88] It is remarkable that comparable countries like Ireland or Slovenia have recently experienced an upward trend for foreign-funded R&D.

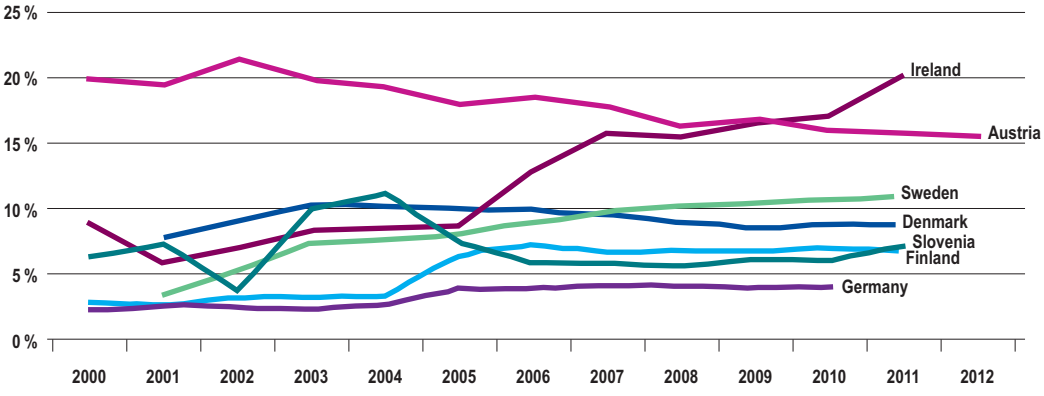
[89] Cf. Keuschnigg et al. (2013): Vision Österreich 2050: Vorsprung durch Bildung, Innovation und Wandel. Study on behalf of the Austrian Council for Research and Technology Development and the Austrian Institute of Technology, p. 118 ff.

Whether an innovation asserts itself in the market and results in market innovation is dependent on many factors.[90] The relevant indicator "Innovation Revenue" in Fig. 13 has dropped back over the course of the last year, i.e. Austria remains some distance behind the leading countries.

The transfer of new knowledge and new business models into marketable products and services is a complex process dependent on existing conditions but also on cultural specificities.[91] For "radical innovation" it is sometimes necessary for there to be a willingness to engage in high risk. Yet patterns of innovation are also strongly shaped by the structural specialisation of an economy. Austria is traditionally specialised in sectors where the maintenance of competitiveness is based largely on incremental innovation and where economic performance has thus far been satisfactory. (See Chapter "Priority Objectives", page 12).

If one wishes to push for structural change toward research-intensive sectors that are increasingly characterised by "radical innovation", it is necessary to have improved framework conditions.[92] This includes above all the optimisation of start-up dynamics, enhancing the quality and quantity of university research and of university graduates, and an increase in innovation financing, etc. (cf. section "Start-Ups and Venture Capital Financing", page 45, section "Universities and Basic Research", page 33, section "Tertiary Education System", page 26 and the chapter "Financing Research, Technology and Innovation" on page 65). An improvement of Austrian performance in this area can thus only be achieved by means of long-term and sustainable efforts on the part of all relevant actors. Towards the end of 2012, new useful instruments such as the FFG *Market Bonus* and *Market Start* were launched, which will impact on the financial framework conditions for the implemen-

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



Source: Statistik Austria.

[90] 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, p. 177 ff.

[91] Austrian Council Recommendation Regarding Optimised Proof-of-Concept-Support in Knowledge Transfer, 3 December 2013.

[92] 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, p. 177 ff.

tation of research findings towards innovation and marketable products. They will above all constitute an improvement for young and innovative businesses.

Yet in the opinion of the Austrian Council, it remains necessary to bed these individual measures in a genuine overall plan, which supports a "more radical" concept of innovation. In addition to the willingness of the agencies to take more risks in the funding of such endeavours, this includes the testing of alternative funding allocation models, which above all implies adapting the relevant criteria and mechanisms when evaluating projects.[93] In addition, it is necessary to optimise the relevant incentive structures at governance level (at the interface between the responsible ministries and agencies) and to bring about improvements in respect of the fundamental drivers of radical innovation, such as university research and teaching, as well as innovation risk financing (venture capital) etc.[94]

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.*

Co-operation Between Science and Business

New data regarding indicators of co-operation between science and business will only be available in 2015 (cf. Fig. 13, Indicators "Business-Science Links SMEs + LCU"). However given the above average performance in the past, no fundamental changes are to be expected in this respect. The large and differentiated portfolio of domestic funding instruments like the *Christian Doppler Laboratories*, *COMET* competence centres, *Research Studios Austria* and *Laura Bassi*, has proved itself in the research partnership between universities and business.[95]

The *COMET* programme plays a central role in this and not only because of its large budget. The Austrian Council is thus keeping under constant observation the further development of the programme and takes the view that there should be an intensive analysis and monitoring of the long-term effects and efficiency of *COMET*. In the context of co-operation between science and business, it is also worth noting the newly established programme of the BMWFW *Knowledge Transfer Centres and IPR-Utilisation*, the impact of which clearly still needs to be subjected to a monitoring-based evaluation.

An especially important and sensitive phase in the marketisation process is the proof-of-concept phase, which is also supported by diverse funding instruments, such as the *PRIZE/Knowledge Transfer Centres and IPR Utilisation*, the AWS *pre-seed* programme and FFG *feasibility studies*.[96] Details are discussed in the section "Funding System" on page 57.

Still worth questioning is the termination of the important and successful FWF programme line *Translational Research* in the *BRIDGE* programme. Although a response was made to its suspension and the FFG-part of the *BRIDGE* programme was extended in the direction of science, this leaves an absence of an important conceptual and monetary pillar of science and technology transfer.

Austria still trails behind the Innovation Leaders in the indicator "Technological Significance of Patents". Yet Austria is constantly catching up in this regard. In this context, the Austrian Council welcomes the newly-created programme line to support the utilisation of IPR at universities (especially via the support for patents and prototypes), which supplements the proven instruments which have been managed above all by the AWS.

The Austrian Council has also called for a structural and substantive debate on the subject of IPR and recommended the development of a comprehensive Austrian strategy regarding in-

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

[94] 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, p. 177 ff.

[95] 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, p. 92 f.

[96] Austrian Council Recommendation Regarding Optimised Proof-of-Concept-Support for Knowledge Transfer, 3 December 2013.

tellectual property in line with the model of the other innovation-based economies.[97] The Austrian Council thus welcomes the fact that the development of such a national strategy is a goal in the new Government's programme.[98]

Start-Ups and Venture Capital Financing

As in previous years, the indicators presented in Fig. 13 regarding "Start-ups and Venture Capital" mainly show a large goal distance and limited goal achievement prospects. An exception is the indicator "Start-Ups Material Goods". Yet, it is worth noting that the data are insufficient to undertake a detailed evaluation of the extent to which the target has been achieved of increasing the number of knowledge and research-based start-ups by an average of 3 percent per year up to 2020. The sector-based evaluation which Statistik Austria has employed for this report for business start-ups (differentiated by products and services) is of limited utility.[99]

The generation of the relevant database thus remains one of the main tasks for the coming years. It is to be welcomed that the main actors in the RTI system, i.e. the responsible ministries, the relevant funding agencies, the chambers of commerce and the Austrian Council have agreed to facilitate Austria's participation in the Global Entrepreneurship Monitor (GEM) 2014. As part of an additional RTI module within the framework of the GEM 2014 it is intended to investigate a starting point for RTI-start-ups and spin-off start-ups from universities and research institutions by carrying out a survey among a representative cross-section of the Austrian population. Additional possibilities for genuine data-based monitoring of such start-ups are also currently under discussion by the Working Group Knowledge Transfer and Start-ups of the RTI Task Force.

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 redesigned. The *Gründungs.Investitions.Scheck* scheme, which provides access to innovation and technology consultancy services, was successfully established. The *AplusB* programme will be continued in a third round following a revision of the guidelines[100]. However, a comprehensive evaluation of this funding programme will only be possible once a robust data monitoring of RTI-related start-ups is in place. This could also form the basis for improving coordination between the various levels and actors in the funding system.[101]

Although progress is being made with the dismantling of administrative and regulatory hurdles, there has been no real breakthrough. The introduction of the business portal USP as a one-stop-shop for firms can be considered a success.

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 percent until 2020.*
- *Starting a business should be made much easier and relieved of cost burdens.*
- *The growth of innovative firms should be accelerated.*

[97] Austrian Council Recommendation for a National Strategy for Intellectual Property, 6 June 2013.

[98] Work Programme of the Austrian Federal Government 2013–2018, p. 30.

[99] A new indicator that measures employment in fast-growing, innovative companies as a percentage of total employment was included in the IUS for the first time this year. However, it too has the problem that corporate research intensity is not measured by actual performance but by sector affiliation. This means that fast-growing companies in sectors classified as high-tech are considered to be innovation-intensive. However, the evidence shows that this is only partly true, as there are innovation-intensive companies in low-tech sectors and companies with a low level of innovation activity in high-tech sectors.

[100] Austrian Council Recommendation regarding RTI-related start-up activities, 19 November 2012.

[101] Cf. Fink, M., et al. (2012): Understanding Entrepreneurship Policy in Austria. Institute for Small Business Management and Entrepreneurship, Vienna University of Economics and Business, June 2012. Each year institutions at the federal level and provinces award direct grants totalling more than EUR 100 million to new companies between the idea-generation phase and one year after the company came into existence.

The indicator on "Start-up Regulation", which basically measures the time and expense involved with setting up an LLC (GmbH) does not point to any improvement in the prospects of goal achievement compared to the Innovation Leaders. The introduction of the "GmbH light", following an amendment to the law that came into force on 1 July 2013, was not included in the indicator. Following a 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. However, due to a lack of reliable data, the extent to which the "GmbH light" in its now final form can contribute to stimulating RTI start-ups remains unclear. In any case, it is essential to ensure a stable legal framework and the legal certainty 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 2013 and the many individual recommendations made by the Austrian Council,[102] this underlines the necessity to consider additional tax concessions geared specifically to start-ups and early-stage businesses.

Still well below the target is venture-capital intensity. In the current IUS, Austria has fallen back a further place since last year and now ranks only 17th among the 20 EU countries listed. 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.[103] The public-sector is trying to counter the supply problem with targeted measures. As announced, two sources of financing have been established at the AWS, the *Business Start-up Fund* and the *Business Angel Fund*. These revolving funds are intended to help fill the gap in the early financing period and improve the equity capital situation of young entrepreneurs. The *Venture Capital Initiative* that is also managed by the AWS will be continued too, and in a new form, will also involve the provinces by leveraging EBRD funds as well as National Foundation funds.

The funds provided by the public-sector will only be able to marginally narrow the gap between Austria and the leading venture capital markets. 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 international investors to Austria.[104] There has been little progress here since last year and there are still no plans for 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 is to stimulate the market for raising internation-

[102] 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 dated 24 November 2011); Austrian Council Recommendation regarding RTI-related start-up activities, 19 November 2012

[103] 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 Investitionspotenzial von Risikokapital in Österreich. In: WIFO-Monatsberichte, 2013, 86(8), pp. 673–683.

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

al capital and, inter alia, also to create harmonised licensing criteria for venture capital funds. 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 amendment to this law promised in the Government's work programme.[105]

To further increase venture capital intensity and compensate for the weakness of the venture capital market in Austria, other instruments should also be considered. These might be tax concessions for investments in early-stage businesses or safe conditions for new sources of cash from public participation models such as crowdfunding.[106]

Promote Innovation Through Competition

The indicator "Competition Policy" in Fig. 13 shows some distance to the Innovation Leaders. On the whole, though, Austria has probably not exhausted the possibilities for promoting innovation through competition.[107]

The reform of competition law on 1 March 2013, broadened the investigative powers of the Federal Competition Authority (BWB) and also introduced the possibility of competition monitoring. However, there are still indications of a lack of competition intensity in a number of sectors in Austria, above all in the services sector.

Each European Semester, the European Commission analyses the economic 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 the free professions.[108]

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.

RTI Strategy Objectives

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

[105] 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.

[106] See also Leo, H. (2012): Strategien zur Erhöhung der privaten F&E-Ausgaben. Study on behalf of the Austrian Council for Research and Technology Development; cf. also 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, p. 96 f.

[107] See also Böheim, M. (2010): Wettbewerbspolitik nach der Wirtschaftskrise. In: WIFO-Monatsberichte, 10/2010, pp. 831–846.

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

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. Most of the recommendations made in the previous year remain valid.

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 innovative concepts and a mix of funding instruments and supporting framework conditions. For the implementation, please refer to the relevant individual Austrian Council recommendations.[109]

With regard to foreign-funding of R&D, the Austrian Council recommends that future developments be closely monitored, so as to enable any necessary countermeasures to be taken and thus to prevent a continuation of the negative trend with potentially deleterious effect on Austria's attractiveness as a location for R&D.

The Austrian Council also recommends the swift development and implementation of a comprehensive national strategy for intellectual property.

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.[110]

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 excellent data. Nor will it be possible to implement the planned start-up strategy of the Knowledge Transfer and Start-ups Working Group of the RTI Task Force until the question of data has been resolved.

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 – above ten percent – for early-stage and small businesses, should therefore be considered and, if and when necessary, developed and implemented in detail.

Co-operation Between Science and Business

The Austrian Council recommends that in view of its strategic relevance, the further development of the *COMET* programme be treated as a high priority. In particular, the efficiency and long-term effects of the programme are to be analysed.

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.

[109] Austrian Council Recommendation for a National Strategy for Intellectual Property, 6 June 2013; 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).

[110] Austrian Council Recommendation for an Amendment of the Alternative Investment Fund Manager Act (AIFMG), 6 March 2014; 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).

Political Governance of the RTI System

political governance

Nowadays Austria is a country with a high level of research intensity and a large number of RTI actors and funding programmes. The result is an extremely complex system.[111] The importance of efficient organisation and targeted steering of the RTI system, and thus of flows of capital for research funding, is therefore growing all the time.[112]
So it is hardly surprising that the RTI Strategy dedicates an entire chapter to this topic,[113] setting out a series of goals and measures to meet the challenges of governance in its manifold facets. The main aspects addressed by the chapter are the more efficient organisation of governance structures, improving Austria's international positioning, optimising the setting of thematic priorities, increasing efficiency in the funding system and improving social attitudes to science.

As there are only a small number of goals in these areas that can be depicted using indicators, the issues addressed are evaluated mainly in qualitative terms. Those indicators that are available are presented in Fig. 16 and offer a broad overview of the trends in the very heterogeneous thematic areas. Generally speaking, they show a downward trend in the indicators that measure Austrian attitudes to science and research, an above-average performance with regard to participation in EU Research Framework programmes and return flow ratios as well as stagnation in the area of R&D financing. The latter topic is included in the indicators on R&D intensity and the share of private-sector funding in Fig. 16, but is dealt with separately in the chapter starting on page 65.

Governance Structures

The Austrian Council has defined RTI governance in its working programme as a central element for achieving innovation and has also focused greater attention on the steering of the Austrian RTI system. The topic was explicitly defined as a field of action in the Federal Government's RTI Strategy and specific goals have been defined and a number of measures taken. Thus for example, an inter-ministerial task force was set up to co-ordinate the steps to implement the RTI Strategy. The Austrian Council has made several recommendations concerning RTI governance and, within the framework of its monitoring remit, commissioned a large-scale "RTI Governance"[114] project to analyse the status quo and answer fundamental questions about RTI governance in Austria.
As part of this project, a review was carried out of the developments that have taken place since the RTI Strategy was adopted. In numerous orientation meetings, interviews and workshops, a common understanding between the responsible key actors at the ministries, funding agencies and research institutes was reached with regard to the state of progress, options for modifying and correcting processes and also their impacts. This formed the basis for defining areas in which guidance and action is needed for the future process, which in turn formed the basis for the recommendations made by the

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.*

[111] Filz, W. (2013): FTI-Governance: Projektergebnisse. Study on behalf of the Austrian Council for Research and Technology Development, p. 9 ff.
[112] Cf. Biegelbauer, P. (2010, ed.): Steuerung von Wissenschaft? Die Governance des österreichischen Innovationssystems. Innsbruck-Wien-Bozen: Studienverlag.
[113] RTI Strategy of the Austrian Federal Government, p. 32 ff.
[114] Filz, W. (2013): FTI-Governance: Projektergebnisse. Study on behalf of the Austrian Council for Research and Technology Development.

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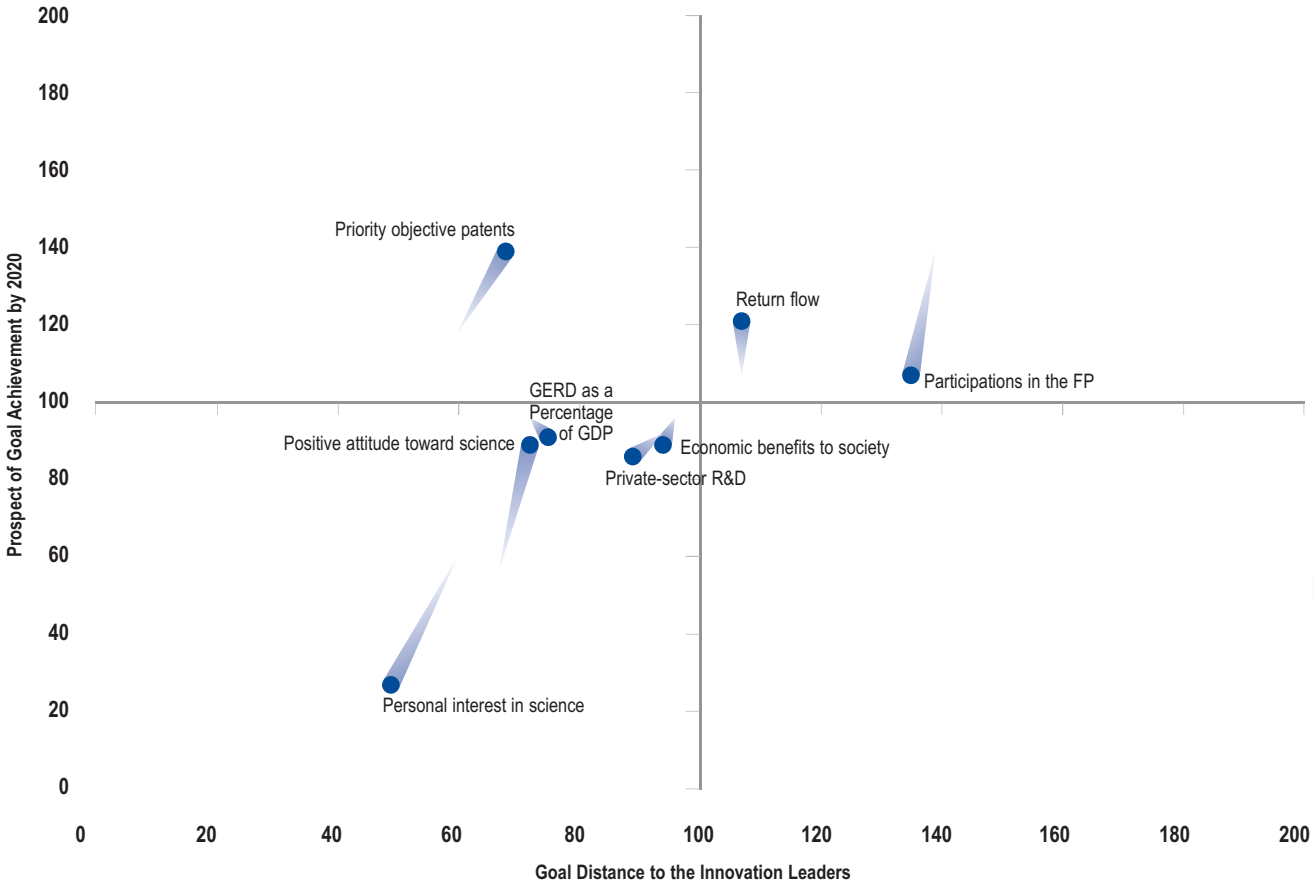
Austrian Council in its white paper on steering research, technology and innovation in Austria.[115]

The white paper, which was conceived as a position paper and collection of implementation-orientated options for decision-makers, was submitted to the Government on 26 September 2013 and then presented to the public. It sets out positions and proposals for optimising the efficiency of RTI governance in Austria and outlines necessary steps and specific areas of action, which the Austrian Council considers to be essential if Austria is to achieve the Government's goal of becoming an Innovation Leader.

The formation of a new government at the end of 2013 and the reorganisation of the ministries with responsibility for RTI only recently creat-

Fig. 16: Goal Distance and Prospect of Goal Achievement in the Area of Political Governance of the RTI System, Most Recent Available Year



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 in 2020.

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

ed a new starting situation. Following the adoption of the Federal Ministries' Act on 31 January 2014, the Ministry for Science and Research was merged with the Ministry of Economic Affairs. Organisational restructuring processes are necessary to integrate previously separate structures, the results of which will only become apparent after a fairly lengthy interval.

The Austrian Council does not therefore consider that it serves any useful purpose to offer an assessment of current developments at this time. It is also still too early to evaluate the effects of the recommendations from the white paper. An appraisal and evaluation of the results of the monitoring of future developments is planned for a later date.

International Positioning

2013 was dominated by preparations for a new seven-year European Union budgetary period. The flagship programme for research was officially launched on 1 January 2014 under the name *Horizon 2020*. In the previous period, Austria had basically been able to position itself very well in the Seventh Framework Programme. 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 by the "Returns Ratio" and "Participation in the Framework Programme" indicators.

The flow of return funds, which illustrates Austria's success in obtaining European funds relative to its total contribution to the EU budget, has risen in a year-on-year comparison. By contrast, there has been a sharp drop in successful participation in the Framework Programme. 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.

There are a number of reasons for this which need to be taken into account. On the one hand, although the budget in the Framework Programme *Horizon 2020* is substantially higher in nominal terms[116], it has to be remembered that the budget in the Seventh Framework Programme had been on an accelerated growth path, which has now been curbed. As a result, there will be no further increase in the amount of funding available and the individual areas will receive less money. On the other hand, the quality of funding applications, and in particular those from the new member states of the European Union, has improved significantly. From a scientific point of view, this development is to be welcomed, as participation by these countries enriches the network of European scientific and research institutions. These partners make an important contribution to the European innovation system and help open markets. However, from an Austrian perspective, the chances for successful participation in projects have been eroded. In the longer-term, this could also lead to a decline in the high return rate.

From a domestic perspective, there must thus be stronger structural-level support for the Austrian research community in the establishment of networks and in the submission of applications. The documents produced by the relevant working groups of the Task Force reinforce these demands and provide a comprehensive framework for a solution.[117] It is now necessary to translate these concepts into day-to-day research activities and to furnish appropriate means for their realisation. In addition to the

RTI Strategy Objectives

- *We want to develop a fine-tuned international science and research foreign policy by bundling existing measures to support internationalisation. To do this, we need to create the appropriate institutional structures.*
- *Austria should position itself optimally in the 'European Knowledge Area' by assuming a shaping role in the formulation of overall European policy on research, technology and innovation.*
- *In addition, we should strive for even more Austrian participation in European funding programmes, for example in the Research Framework Programmes or the European Structural Funds, with the goal of further increasing the return ratio.*
- *Selective, global collaboration should be set up and expanded with innovation front runners such as the USA, selected Asian countries, and the rising BRIC countries.*
- *Collaboration with Central, Eastern and Southeastern European countries should be further enhanced.*

[116] See also the Austrian Council's statement on the EU budget 2014–2020, 27. 2. 2013.

[117] BMVIT, BMWF, BMWFJ, BMEIA (2013): Beyond Europe – Die Internationalisierung Österreichs in Forschung, Technologie und Innovation über Europa hinaus. Empfehlungen der AG 7a an die FTI-Task-Force der Bundesregierung.

important networking activities, this will require the continuation of ongoing and comprehensive guidance on the part of the agencies.

The complex system of developing key areas and work programmes in the Framework Programme *Horizon 2020* will in future continue to be governed by the active presence of experts. An analysis of participation by national experts in boards, committees and other important stakeholder groups recently revealed a sobering picture from an Austrian perspective: The list shows a comparatively small number of people from Austria, adversely affecting the possibility of influencing programme content.[118]

Accordingly, the Austrian Council is of the opinion that working on boards and committees has to be made more attractive to national experts to enable Austria to exert a greater influence. In particular, there needs to be an increased Austrian presence on advisory boards and in expert groups for evaluation and monitoring activities as well as a larger number of national experts in the European Commission. In addition to the information that is required regarding opportunities for participation, there should also be an incentive for individual institutions. Government ministries and interest groups should jointly develop the solutions and models that this requires. The high profile ERA Council Forum Austria, recently established by the Ministry of Science, Research and Economic Affairs[119], and the ERA Policy Forum, are a tangible sign of Austria's desire to strengthen the position of domestic research in a European context and could address this deficit.[120]

Research infrastructures form a key element of European networking activities. Yet we must increasingly move away from the idea that specific items of infrastructure have to be purchased, owned and utilised by individual research institutions. Instead, it is necessary for researchers to have easy and inexpensive access to the infrastructure they need. Here there is enormous potential at both the European and the global level. It is impossible to quantify the additional benefit that results from collaboration on shared infrastructure on the basis of the data that is available, but there are several instances in which it has been confirmed by all concerned.[121]

It is in precisely this area that Austria has a structural problem to contend with. At the European level, the European Strategy Forum for Research Infrastructure (ESFRI) constitutes an important initiative. For this reason, Austria has actively contributed to the discussions about ESFRI. However, to date, Austria has only been partially successful in gaining memberships to new initiatives and securing participations. In particular, there is an absence of adequate and long-term budget planning and financial security for cost-intensive investments in participations that have to be seen over lengthy investment periods.

Moreover, membership of international research infrastructures, such as CERN, EMBL, ESO, ESRF and others (where Austria is already a member), are extremely important for small countries to ensure links with top international researchers.[122] Thus participation in European projects and research infrastructures at the national level should continue to be planned and encouraged. The Austrian Council there-

[118] Data available at http://ec.europa.eu/programmes/horizon2020/en/experts

[119] www.era.gv.at

[120] See also the proposals in BMWF, BMVIT, BMWFJ (2013): Österreichischer EU-Aktionsplan: Österreichs FTI-Akteure stärken – Europa aktiv nutzen – zur Gruppe der Innovation Leaders aufsteigen. Empfehlungen der AG 7b an die FTI-Task-Force der Bundesregierung.

[121] There are examples of this at the universities (e. g. Campus Vienna Biocenter, ZMF at the Medical University of Graz etc.) and at technology parks (e. g. Hagenberg, Technopole etc.).

[122] See also BMVIT, BMWF, BMWFJ, BMEIA (2013): Beyond Europe – Die Internationalisierung Österreichs in Forschung, Technologie und Innovation über Europa hinaus. Empfehlungen der AG 7a an die FTI-Task-Force der Bundesregierung, p. 12 f.

fore 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.

At the global level, innovation frontrunners are of huge importance for the Austrian scientific community. Partnerships with a number of selected countries have proven their value and were reinforced in 2013. It is clear that the Asian countries in particular are engaged in a dramatic catching up process, with China, Korea and Singapore, for example, using massive investments and considerable human resources to mobilise substantial potential in the area of research and development.

A highly-competitive rivalry has thus developed between the leading innovation nations, as they seek to establish research partnerships with these countries in the hope of opening up markets. [123] This in turn requires a resource-intensive acquisition process for initiating joint projects. The Office of Science and Technology Austria (OSTA) in China, proves that effective support can be established on location within a comparatively short period of time. Together with the office in the USA, the two OSTA constitute important instruments for positioning Austria internationally. As far as plans for additional offices are concerned, it is worth questioning where the focus of our country's international presence should be placed. Evidence-based decision-making processes must be put in place for a strategic selection of target countries.[124] As was already explained in the Report on Austria's Scientific and Technological Capacity 2013, the Austrian Council recommends expanding the network of offices of Science and Technology, provided there is a long-term perspective and a clear strategic objective of co-operation with selected countries.

Setting Priorities

The extent to which goals have been achieved in respect of setting priorities can be measured both in substantive terms and with regard to governance. Substantively, it is possible to analyse in which areas priorities are being set, whether they are in line with the priorities defined in the RTI Strategy and whether the priority achieves the desired effect of increasing Austria's specialisation. In respect of governance, it is possible to verify whether the current decision-making processes are conducive to achieving the goals of the RTI Strategy, namely to systematically select and justify priorities, which on the one hand, address social challenges and on the other, prevent market and system failure.

Two approaches are used to monitor goal attainment. The indicator used to measure goal attainment "Priority: Patents" (see Fig. 16) shows that the level of inventive activity in all fields of technology that are important for overcoming societal challenges remains well below that of the Innovation Leaders. However, the distance to the goal has narrowed since the previous year and it appears that the trend will remain sufficiently dynamic for the goal to be achieved by 2020. This is largely attributable to the down-

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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.*

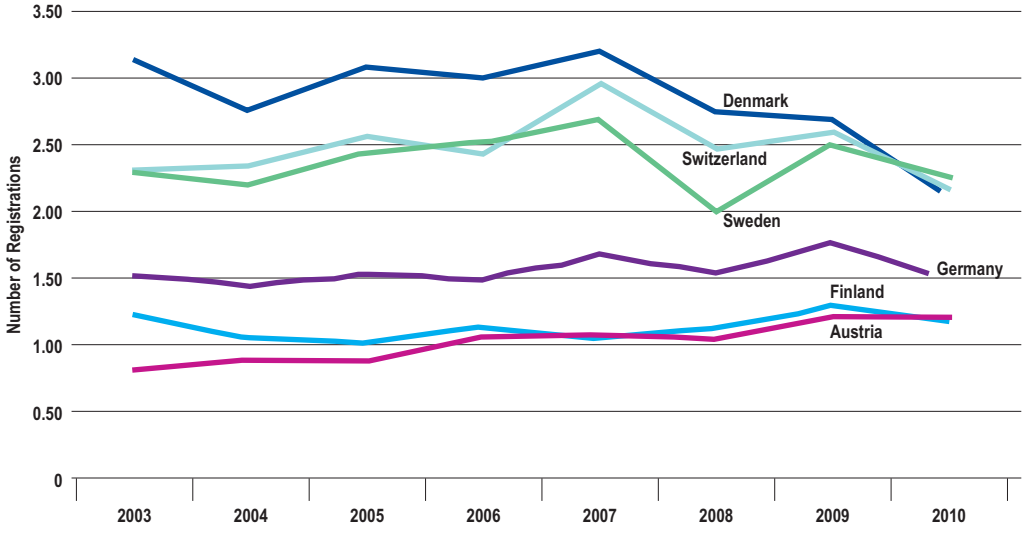
[123] Sigl, L. / Witjes, N. (2014): Koordinations- und Kooperationsstrukturen für die Internationalisierung österreichischer Forschung, Wissenschaft und Technologie (EU-Drittstaaten), Zukunftsräume der internationalen FTI-Kooperation. Study on behalf of the Austrian Council for Research and Technology Development, p. 5 f.

[124] Sigl, L. / Witjes, N. (2014): Koordinations- und Kooperationsstrukturen für die Internationalisierung österreichischer Forschung, Wissenschaft und Technologie (EU-Drittstaaten), Zukunftsräume der internationalen FTI-Kooperation. Study on behalf of the Austrian Council for Research and Technology Development, p. 21 ff.

ward trend for patent registrations in the Innovation Leaders (cf. Fig. 17). Austria is roughly on a par with Finland. All other Innovation Leaders, and above all Switzerland, remain at a higher level, notwithstanding a steady downward trend.

However, this indicator exclusively measures Austria's performance in respect of the grand challenges and thus less the actual priority areas of RTI policy, which do not necessarily have to concentrate on the grand societal challenges. To evaluate the actual key areas of Austrian RTI policy, WIFO carried out a more detailed analysis of patent statistics for this report.[125] This identified all those thematic priorities of Austrian RTI policy, which can be depicted with the help of patent indicators.[126] These are energy, mobility, intelligent production and ICT. A specialisation index for Austria (RTA – Revealed Technological Advantage) relative to the Innovation Leaders can be compiled for these. Due to the time lag for patent indicators, data is only available up to 2010, which means that the year in which the Strategy was launched is just about covered. However, it is clear that Austria indeed boasts an above average degree of specialisation in the chosen key areas, with the exception of ICT (see Table 2).

Fig. 17: PCT Patent Registrations in Selected Technological Fields To Solve the Grand Challenges in Austria and the Leading Innovation Nations (No. of Registrations Relative to GDP Expressed in EUR bn. Purchasing Power Standards.



Source: Innovation Union Scoreboard 2014.

[125] Hranyai, K. / Unterlass, F. (2014): Überprüfung der Anwendbarkeit von Patentindikatoren für die Untersuchung der thematischen Schwerpunktsetzung in der österreichischen FTI-Strategie. Study on behalf of the Austrian Council for Research and Technology Development.

[126] The first phase of the pilot study mainly drew upon the technological priorities of the BMVIT as defined in the RTI Strategy, which are more application-orientated.

Table 2: Austrian Specialisation by Priority Areas as Defined by the RTI Strategy, by Patent Applicants, EPO Patents

Energy	ø RTA 2008–2010	ø RTA from 2000	Number of Patents 2008–2010	Number of Patents from 2000
Energy Efficiency				
Energy efficiency in buildings and lighting	2.9	2.0	86	200
Heating (incl. water and space heating; air-conditioning)	2.1	2.6	10	30
Insulation (incl. thermal insulation, double-glazing)	6.6	5.2	26	62
Lighting (incl. CFL, LED)	2.3	1.4	50	108
Combustion Technologies with mitigation potential	0.8	1.0	8	24
Technologies for improved input efficiency (Efficient combustion or heat usage)	0.8	0.9	2	5
Technologies for improved output efficiency (Combined combustion)	0.8	1.0	6	19
Renewable Energy				
Renewable energy generation	1.0	1.6	90	202
Geothermal energy	1.6	4.5	2	10
Hydro energy – conventional	3.1	10.5	6	36
Hydro energy – tidal, stream or damless	1.1	2.5	1	7
Marine energy (excluding tidal)	0.8	0.3	3	4
Solar thermal-PV hybrids	1.0	10.4	1	3
Solar photovoltaic (PV) energy	0.6	0.8	26	59
Solar thermal energy	2.4	2.7	36	65
Wind energy	1,0	1.0	29	46
Alternative energy production	1.0	0.9	193	544
Mobility				
Alternative Propulsion Systems				
Emissions abatement and fuel efficiency in transportation	0.7	0.6	47	157
Technologies specific to propulsion using electric motor (e.g. electric vehicle, hybrid vehicle)	0.9	0.5	13	22
Fuel efficiency-improving vehicle (e.g. streamlining)	0.1	0.5	1	15
Technologies specific to hybrid propulsion (e.g. hybrid vehicle propelled by electric motor and internal combustion engine)	1.0	0.7	7	17
Technologies specific to propulsion using internal combustion engine (ICE) (e.g. conventional petrol/diesel vehicle, hybrid vehicle with ICE)	0.6	0.6	28	111
IT Infrastructure				
Traffic control systems	1.8	1.4	22	59
Intelligent Production				
High-tech materials and surfaces				
Advanced Materials	2.3	1.4	307	687
High-performance, resource-efficient and robust manufacturing processes				
Advanced Manufacturing	1.3	1.2	216	798
Flexible and versatile production systems				
Advanced Manufacturing	1.3	1.2	216	798
Information and Communications Technologies (ICT)				
Micro- and nano-electronics				
Micro- and nanoelectronics	0.6	0.6	104	345
ICT	0.5	0.5	717	2,423
Computer	0.5	0.4	235	747
Consumer	0.3	0.3	59	246
Tele	0.3	0.2	99	335
Other ict	0.8	0.7	390	1,340
All technology fields			**4,043**	**14,651**

Sources: OECD, REGPAT database, July 2013, WIFO calculation. RTA revealed technological advantage; Values above 1 show Austria's specialisation relative to the Innovation Leaders.

Juxtaposing Austria's specialisation in the priority areas with a list of the top ten fields of technology in Austria allows conclusions to be drawn about the types of priority that have been defined (see Table 3). This in turn, makes it possible to answer the question as to whether it is simply a case of "picking the winners", or whether the key areas really are consistent with the RTI Strategy objectives (i.e. to set priorities in generic cross-cutting areas and grand challenges, in which strengths already exist).

The analysis shows that the Austrian priorities are focused on the contribution of those fields of technology referred to earlier which are of relevance to the grand challenges (energy, mobility) and their character as cross-cutting technologies, which should benefit Austrian industry as a whole (e. g. Advanced Manufacturing). Although most of the priority areas have a positive specialisation, they are not as strong as the top 10 fields of technology in Austria, which have no relation to cross-cutting technologies. The priorities defined in the past are thus con-

Table 3: Comparison of the Top Ten Technology Fields Defined as Priorities in the RTI Strategy and the Main Groups Used in the IPC Classification System By Revealed Technological Advantage, Applicants and EPO Patents, 2008-2010

Technology Field	Technology Field	ø RTA 2008–2010	Number of Patents 2008–2010
Main Groups in the IPC Classification			
E01 Construction of roads, railways or bridges	Construction; earth boring; mining	5.08	82
B61 Railways	Performing operations; transporting	5.00	60
B30 Presses	Performing operations; transporting	4.75	26
B44 Decorative arts	Performing operations; transporting	4.07	23
A42 Headwear	Human necessities	3.98	9
A44 Haberdashery, jewelry	Human necessities	3.95	22
C21 Iron metallurgy	Metallurgy	3.89	697
B22 Casting, metallurgy	Performing operations; transporting	3.68	62
F26 Drying	Mechanical engineering; lighting; heating; weapons; blasting	3.68	16
F21 Lighting	Mechanical engineering; lighting; heating; weapons; blasting	3.52	139
Priorities Defined in the RTI Strategy			
Insulation (incl. thermal insulation, double-glazing)	Energy efficiency	6.56	26
Hydro energy – conventional	Renewable energies	3.14	6
Energy efficiency in buildings and lighting	Energy efficiency	2.89	86
Solar thermal energy	Renewable energies	2.36	36
Lighting (incl. CFL, LED)	Energy efficiency	2.35	50
Advanced Materials	High-tech materials and surfaces	2.28	307
Heating (incl. water and space heating; air-conditioning)	Energy efficiency	2.06	10
Traffic control systems	IT-infrastructure	1.84	22
Geothermal energy	Renewable energies	1.56	2
	High-performance, resource-efficient and robust manufacturing processes		
Advanced Manufacturing	Flexible and versatile production systems	1.27	216

Source: OECD, REGPAT Database, July 2013, WIFO calculation.

sistent with the goals of the RTI Strategy of reinforcing cross-cutting fields which bear reference to existing strength areas of the Austrian economy and which contribute to overcoming the grand challenges. The only priority area in which Austria is currently less highly specialised is ICT. However, this could also be due to the chosen ICT sub-groups, which are extremely broad, while in practice priorities are more narrowly defined. Despite this, the priorities set in the field of ICT should be monitored more closely. For the time being, it remains to be seen, whether realigning the ICT research funding portfolio will bring about any changes here.

However, based on the data currently available, it already seems unlikely that there is any "picking the winners" that needs to be questioned.

In terms of governance, the decision-making process is not yet in line with the RTI Strategy goals of systematically selecting priority areas in research and technology development and developing them across departments; at least, these processes have not yet been made transparent.[127] In the view of the Austrian Council, the measures taken in this area do not permit the conclusion that anything will change in the medium term.

Funding System

The research funding system in Austria is basically highly differentiated and supports research institutions with a very varied mix of instruments. Viewed positively, this diversity can be seen as offering a comprehensive portfolio, but upon closer inspection it becomes apparent that there is a tendency toward excessive regulation, fragmentation, unclear competencies and complex, non-harmonised sets of rules for individual instruments.[128] As a result of this complexity, modifying existing instruments to suit new conditions is a cumbersome process, leading to a tendency to create new instruments rather than alter existing ones.

An additional challenge arises from the fact that while private-sector funding has stagnated since the start of the economic crisis, a tighter national budget framework has meant that the public-sector has been unable to compensate for this and bring about the desired growth in research financing. Extensive administrative processes and rigid structures in the funding landscape lead to financial costs, which do not always benefit research itself.[129]

Referring to this fact, the Austrian Council in its white paper on steering research, technology and innovation in Austria has called for a simplification of the funding landscape and a strengthening of the core activities of the funding agencies. In addition to a clear orientation toward basic research, applied research, knowledge transfer and marketisation, it is also important to act to improve the interface between the individual areas.[130]

An example of this is the proof-of-concept phase, which is addressed by diverse funding schemes, such as PRIZE and the aws *pre-seed programme*, and FFG feasibility studies (cf. the section "Co-operation between Science and Business", page 44). In this regard, it is worth point-

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.*

[127] Filz, W. (2013): FTI-Governance: Projektergebnisse. Study on behalf of the Austrian Council for Research and Technology Development, p. 29.

[128] Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 11 ff.; Filz, W. (2013): FTI-Governance: Projektergebnisse. Study on behalf of the Austrian Council for Research and Technology Development, p. 18 ff., p. 25 ff.

[129] Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 12 f.

[130] Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 18 ff.

ing to the relevant recommendation of the Austrian Council.[131] Even if a proof-of-concept funding does not have to be undertaken within the framework of a single programme, it would be desirable in future to adjust or extend the relevant funding schemes, above all as regards the target accuracy and efficacy of the existing instruments. The organisation of the available proof-of-concept support, including the alignment of existing instruments between the agencies can also be taken as a benchmark case for the implementation of the white paper on RTI governance.[132]

Yet deficits are not only visible regarding funding supply. Notwithstanding the needs-based organisation of instruments for specific target groups, there are some difficulties regarding acceptance. For example, there has been little take-up of some seemingly attractive and in part newly established instruments, while other calls are strongly over-subscribed. Thus there are very attractive schemes in place for funding recipients to facilitate the transfer of research results to the market.[133] It is apparent, however, that as a rule, institutions with wide-ranging experience in the submission of funding proposals are the most successful, which means that there is still considerable mobilisation potential here. To this end, the presentation of the benefits for funding applicants should be improved by appropriate communication and appeal in particular to first-time applicants.

To date, the analysis of funding-applicant behaviour and the impact of individual instruments could only be based on individual statistics and by surveying the agencies. Better agency data and evaluation tools have more recently made it possible to analyse thematic and regional variations. Taken together with the FFG's evaluation of the fiscal impact of the research premium, it becomes possible to depict the overall landscape of the domestic research system. These insights must now flow into a holistic political approach in accordance with the goal defined in the RTI Strategy.[134] To make progress toward this goal, the Austrian Council white paper on steering research, technology and innovation in Austria recommends a streamlining of structures and a bundling of the individual agencies' portfolios.[135]

Yet one also has to have regard to the fact that an overarching policy approach crosses the substantive boundaries of individual ministries' responsibilities and a common focus is demanded, in particular, as regards themes that cut across existing boundaries. However, the bundle of measures necessary for this goes beyond the funding of basic research and applied research, but can also relate to pushing forward innovative public procurement or pre-commercial procurement models. In this regard it is worth making positive mention of the inter-ministerial implementation by the BMVIT and BMWFW of the principle of public procurement that is conducive to promoting innovation.

Research funding systems traditionally exhibit some weaknesses that it has in recent years not proved possible to significantly improve. In particular for research institutions that receive a significant proportion of their funding via the funding system, the allocation of general costs is a central issue affecting the maintaining of operations and building up new resources. The

[131] Austrian Council Recommendation Regarding Optimised Proof-of-Concept-Support for Knowledge Transfer, 3 December 2013

[132] Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 18 ff.

[133] 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, p. 92 f.

[134] RTI Strategy of the Austrian Federal Government, p. 11.

[135] Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 18 ff., p. 20 ff.

Council has in the past already pointed to the fact that general costs are essential, since they provide an unbureaucratic and targeted support for research performance.[136] As with other forms of cost recognition, funding recipients need at the outset of the project to be provided with legal security to calculate and allocate individual costs.

A further weakness is the generally stagnant size of the programme budgets. This does not increase the likelihood that the goal of spending 3.76 percent of GDP on research by 2020 will be achieved. If one considers the requirements of an RTI system with healthy growth, then the increase in human capital, infrastructure and unbroken value creation chains are essential preconditions in research. This requires room for manoeuvre that can be provided by reducing administrative burdens, harmonising instruments and permitting high-risk research. In the light of the limited flexibility of established instruments, the Austrian Council recommends making greater use of the National Foundation for this purpose.[137] The annual volatility of the funds available to the National Foundation is a product mainly of the financial markets and should be balanced out by a minimum payment that would permit longer-term budget planning. This would enable applicants to have a more realistic expectation of project size when submitting their applications, but also allow a more appropriate allocation of funding on the part of the Foundation.

The private-sector should not be disregarded when it comes to goal attainment. The corporate-sector's share of research and development must be more strongly networked and also have a more simulating impact on other research institutions. As described in the section "International Positioning", networking is an essential component to the strengthening of the competitiveness of research groups. In order to promote corporate activities, i.e. make private-sector support by foundations and public benefactors more attractive, it is necessary not only to create awareness but also to adapt numerous (legal) framework conditions.[138] As regards the development and concrete indicators in the private-sector, we refer you to chapter 6 on page 65. Even if it is not possible to predict the extent to which European legal provisions such as, for example, subsidy laws might have an impact, there is nonetheless a tense mood among the relevant businesses.

As set out in the chapter starting on page 65, the Austrian Council recommends an improvement of the conditions that apply at national level to corporate research with a view to simplifying taxation regarding the donation of private funds by foundations and public benefactors. The Austrian Council further considers it important that when drafting and revising European law, the Austrian government intervenes in favour of, and does not consent to, measures that would be deleterious to research.

In the financially relatively small, but very relevant area of research funding via the European Regional Development Fund (ERDF), it is possible to see how difficult it is to bring about a simplification. On the one hand, the European Commission demands that Funding Priority 1, Research, Technological Development and In-

[136] Recommendation of the Austrian Council for Research and Technology Development Regarding the Award of Overhead Costs to Subsidised Research Projects, 16. 12. 2011.

[137] Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 21.

[138] See also Leo, H. (2012): Strategien zur Erhöhung der privaten F&E-Ausgaben. Study on behalf of the Austrian Council for Research and Technology Development; cf. Kratky, G. (2013): Mäzenatentum für die Forschung.

novation (R&D&I) should, together with funding priorities ICT, SMEs and CO_2, receive 80 percent of available funds. On the other hand, it is difficult to apply the existing legal regulations to research projects. As the Austrian Council has set out in one of its recommendation[139], it is also necessary, however, to bring about a significant improvement and simplification at the national level.

The appraisal of projects is important for compliance with guidelines and ensuring that public funds are used for the designated purpose. An appraisal process constitutes a burden or unusual procedural situation for the institution concerned. With a view to mutual resource efficiency, repeated appraisals by different appraising bodies that examine similar matters, or matters in respect of which there is no significant difference, should be avoided. The burden could be reduced and legal security enhanced by subsequent appraisal bodies recognising already approved content. In connection with this, it will also be necessary to undertake structural changes to make a real impact on the research system.

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.*

Research and Society

To judge by the Eurobarometer data from 2010, while public attitudes in Austria are relatively positive about the economic benefits of science and research to society compared to those in other countries, Austria trails behind when it comes to personal interest and positive attitudes toward science and research. In the current issue of the Eurobarometer published in February 2014, the picture looks rather different. As Fig. 16 shows, all three indicators on Austrian attitudes to science and research ("Economic Benefits of Science to Society", "Positive Attitude Toward Science" and "Personal Interest in Science") show a clear downward trend. As a result, all relevant indicators are now well below the target for 2020.

The "Special Eurobarometer 401" devoted particular attention to the topic of attitudes to science and research in Europe. The survey shows a general lack of interest in science and research across Europe, although it is conspicuous that there are significant differences between the member states with regard to knowledge about science and research. A correlation analysis demonstrates that there is a relationship between national innovation performance and the extent to which people are informed about developments in science and technology: *"The better a member state scores on the innovation performance index, the more likely it is for it to have a higher proportion of people who are informed about developments in science and technology. For example, Sweden is the country with the highest score on the Innovation scoreboard with a score of 0.747 and is also the country with one of the highest proportion of respondents who feel informed about developments in science and technology (61 percent)."*[140] With a score of 30 percent, Austria is at the lower end of the tables, ahead of Italy (29 percent) and a number of East European countries. The picture is similar in respect of the question of personal interest in science and research. With a score of 45 percent, Austria is in the lower band of the rankings. All these details suggest that there is an acute need for action. Improvements in overall national innovation performance can only be achieved with a population that is both well in-

[139] Recommendation of the Austrian Council Regarding the Simplification of Administrative Procedures in Research Funding – With Particular Reference to Structural Funds (European Regional Development Funds), 3. 12. 2013.

[140] EU Commission (2013): Special Eurobarometer 401: Responsible Research, Innovation, Science and Technology, p. 13.

formed and interested, for example, where there is an understanding of the need for large public investments in science and research.

The portfolio of instruments for societal dialogue currently available in Austria is highly diverse, often piecemeal and therefore not very visible to the public. It has to be assumed that existing supplies of information appeal to a social strata that is already interested in, and familiar with, science and research. This means that groups which are educationally disadvantaged, or have little or no interest in research, are not being addressed using low-threshold content (i.e. that is easy to access and understand) and, as a consequence, have no knowledge of what is on offer. This assumption is supported by the Eurobarometer socio-demographic analysis cited earlier, according to which there is a correlation between a person's level of education and their interest in and knowledge about science and research.

These findings clearly show that Austria must make greater investments in the dialogue between research and society. It is essential that the "culture of appreciation"[141] for science, technology and innovation demanded in the RTI Strategy, must be promoted more vigorously and systematically than in the past by implementing appropriate measures. Additional measures, such as increasing the percentage of university graduates, embedding scientific work and academic writing in curricula and increasing the number of jobs for highly-qualified workers in technology companies will also have a positive impact on awareness.

Besides a number of small initiatives, such as the children's universities, "sparkling science" or the youth innovation competition "Jugend Innovativ", which although very positive are nonetheless restricted to specific target groups, the Long Night of Research is so far the only real format with a nationwide impact that offers an easily accessible dialogue. However, for organisational reasons, it can only be held every two years. The Austrian Council therefore considers it essential that the Long Night of Research remains able to offer a programme, which offers the broadest possible coverage at the regional level, is suitable for the target group and allows research institutions and teams to design their individual contributions to the event independently. The Federal contribution should focus on providing optimal framework conditions and broad advertising as well as on generating maximum awareness for the event. This will on the one hand ensure a varied and distinctive programme in the regions, and on the other ensure the high quality of the event advertising.

As all the latest analyses and studies show, early childhood education plays a key role when it comes to getting children and young people interested in scientific topics.[142] Besides parents, it is above all teachers in schools and kindergartens who are the most important disseminators. However, if they are to be effective, structures for extra-curricular learning activities[143] and regular forums for dialogue must first be established and funding ensured to cover the ongoing costs.

The funding agencies have had very good experience with programmes that provide targeted support for science communication.[144] The Austrian Council will therefore invite the participating ministries and agencies to discuss possibilities for intensifying such schemes. As contemplated in the section "Funding System", the National Foundation could be used to create such instruments.

[141] RTI Strategy of the Austrian Federal Government, p. 43.

[142] Cf. for example Spiel, C. (2013): Bildung 2050 – Die Schule der Zukunft. In: Rat für Forschung und Technologieentwicklung (ed.): Österreich 2050 – FIT für die Zukunft. Vienna: Holzhausen, pp. 52–59; Spiel, C., Schober, B., Finsterwald, M., Lüftenegger, M., Wagner, P. (2012): Der Beitrag der Schule zur Förderung von Bildungsmotivation und Lernen. In: Franz, J. / Franz, C. (ed.), Carinthische Dialoge 2007–2011, p. 118–137. Carinthische Dialoge: Vienna; Deutsche Akademie der Technikwissenschaften – Acatech (2011): Monitoring von Motivationskonzepten für den Techniknachwuchs (MoMoTech).

[143] Numerous initiatives are listed on http://www.technischebildung.at/initiativen/.

[144] Examples include the FWF science communication programme WissKomm at the federal level and the ZIT programmes COMMUNICATION and TECHNOLOGY AWARENESS at the regional level.

An important role in science communication is also played by the media, which irrespective of the technological platform, is the most important channel for propagating information to the public. Experiences from the private-sector show that high-quality products, be they in the print media or on television, can reach a respectable audience.[145] It is thus all the more astonishing that the public broadcaster is scaling back such formats still further: Between 2006 and 2009, the Austrian Broadcasting Corporation (ORF) reduced its science reporting by almost half, while the private stations ATV and Puls4 quadrupled their offerings in the same period.[146]

In this connection, the Austrian Council draws attention to the importance of the public broadcaster and its remit to satisfy public demand by providing high-quality information in attractive formats. Accentuating research and development, would, in suitably produced programme formats, certainly counteract the deficits referred to earlier in the Eurobarometer analysis. Furthermore, these platforms would also provide a forum for high-calibre debates on ethics and integrity in research without polemics and polarisation.

Finally, thought should be given as to how the popular image of the scientist can be brought back into line with reality: The cliché of the unworldly, eccentric scientist beavering away in his or her ivory tower must be corrected by accessible, communicative testimonials. As well as prominent figures from science and research, who are already well established in their chosen fields, it is important to introduce the public to young researchers who are just starting their careers. This can not only help change prevailing clichés, it can also present new role models and career options to broader sections of the population. This could help make the scientific and academic professions more attractive and establish them as a desirable career goal for greater numbers of young people.

[145] http://www.oeak.at/

[146] 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.

Recommendations of the Austrian Council for Achieving the Goals of the RTI Strategy with Regard to the Governance of the RTI 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. Most of the recommendations made in the previous year remain valid.

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.

Setting Priorities

The Austrian Council recommends an overarching national management of themes that has regard to 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 co-ordination. Overlaps and gaps should be avoided. Furthermore, there should also be co-ordination with other types of instrument such as open-topic and structural measures. A central aspect is the development of comprehensible criteria for identifying topics

Funding System

The Austrian Council recommends a detailed analysis of the regional and 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' portfolios.

The Austrian Council recommends an evaluation of the funding lines for the proof-of-concept phase in respect of their target accuracy and efficacy, as well as a review of the competencies of the funding agencies for these programmes, with a view to a reform of RTI governance.[147]

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 concerning the chapter "Financing Research, Technology and Innovation" on page 65.

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). The Austrian Council therefore recommends that the content of the reform agen-

[147] Austrian Council Recommendation Regarding Optimised Proof-of-Concept-Support for Knowledge Transfer, 3 December 2013; Rat für Forschung und Technologieentwicklung (2013): Weißbuch zur Steuerung von Forschung, Technologie und Innovation, p. 18 ff.

da and the goals defined in the Government working programme be implemented as a matter of priority.

Research 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.

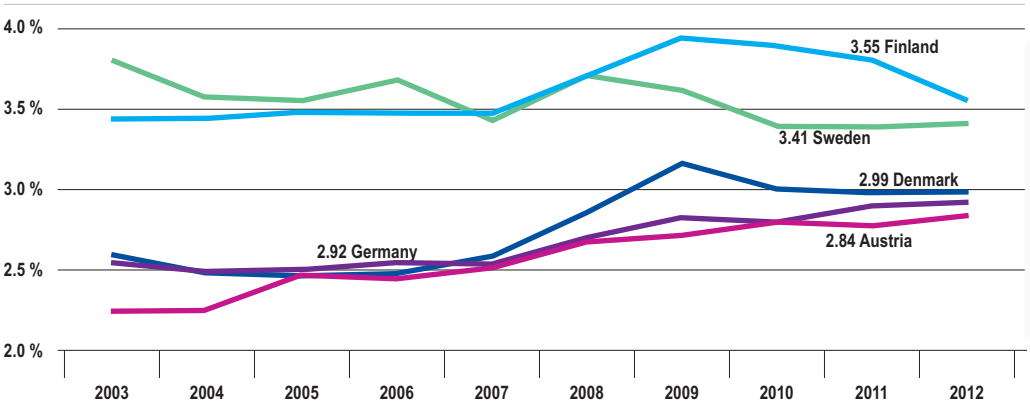
The Austrian Council calls upon the media – in particular the media with a public service remit – to focus more strongly on science communication and to generate attractive, informative formats for the public.

Financing Research, Technology and Innovation

financing

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 of GDP by 2020 (to the level of the Innovation Leaders, see Fig. 18) 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.

Fig. 18: GERD-to-GDP Ratio of the Innovation Leaders Compared to Austria (in Percent)



Source: OECD.

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.*

In its work programme the Austrian Government again classified science and research as primary pillars of Austria's overall development and potential.[148] Although no explicit reference was made to the goal of spending 3.76 percent of GDP on science and research by 2020, it is implicitly reflected in the reaffirmation of the RTI Strategy as the frame of reference for RTI policy.

As is clear from Fig. 16 (page 50) the distance-to-goal of the indicator "GERD as a Percentage of GDP" has narrowed somewhat compared to the previous year. At the same time, however, there has been a slight decline in the trajectory, which on the whole suggests it will not be possible to achieve the target by 2020.

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 trajectory required to achieve the 3.76 percent target was calculated in detail.[149] Public-sector spending on R&D would have to rise from EUR 3.7 billion in 2013 to approximately EUR 5.1 billion in 2020 to achieve the target (see Fig. 19). Yet based on the current federal financial framework for the period 2014–2017, a trend toward stagnation can be observed. At present, it does not appear that the expenditure trajectory needed to achieve

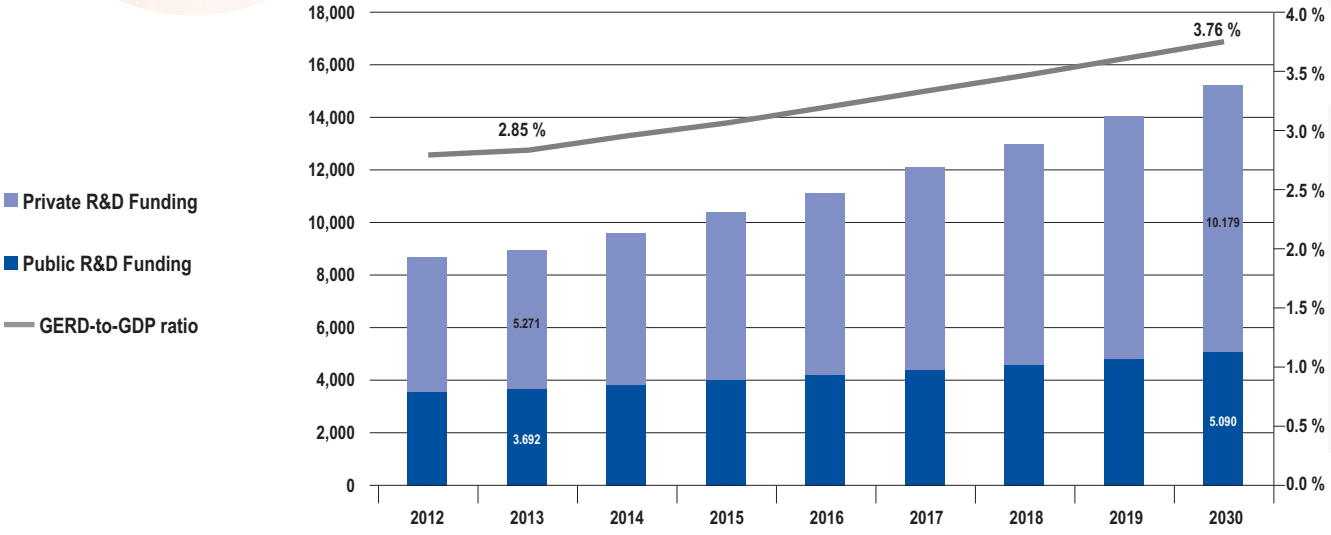
[148] In its work programme the Austrian Government announced that specific budgetary measures would be taken to reach the goal of spending 2 percent of GDP on tertiary educational institutions by 2020, see Work Programme of the Austrian Federal Government 2013–2018. Austria. A Story of Success. Vienna, December 2013, p. 44.

[148] WIFO (2013): Forschungsquotenziele 2020. Study on behalf of the Austrian Council for Research and Technology Development.

the goal can be realised, so there is a high probability that the GERD-to-GDP target will not be achieved by 2020.

The cumulative gap between target and goal for public-sector R&D spending based on the current federal financial framework for 2014–2017 amounts to approximately EUR 2 billion (see Table 4).[150]

Fig. 19: Trajectory of Funding to Achieve the Target GERD-to-GDP Ratio of 3.76% in 2020 (in € mn.)



Source: WIFO Forschungsquotenziele 2020.

Table 4: Gap Between Current and Target Funding Levels (Cumulative Additional Funding Requirement up to 2018)

	Additional Funding Requirement in Each Year (excl. Research Premium) in Mn.	Additional Funding Requirement in Each Year (excl. Research Premium) in Mn.
2014	164	141
2015	255	285
2016	342	430
2017	441	591
2018	534	753
Cumulative	**1,736**	**2,200**

Source: WIFO Forschungsquotenziele, updated November 2013.

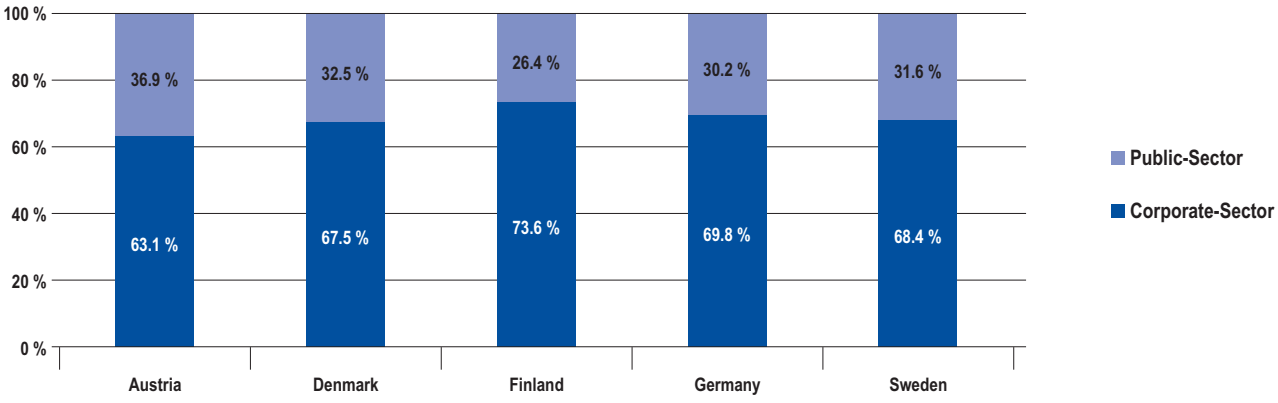
[150] This calculation depends on a number of assumptions, inter alia: Steady growth in the percentage of GDP spent on research; Target share of public-sector and private-sector spending 33.33 % and 66.67 % respectively in 2020; the share of Federal funding incl. research premium as a percentage of total spending remains stable at 81 %; from 2014 onward research premium continued at a rate of 10 % of private-sector funding in year t-1.

Apart from the target-goal gap 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 (cf. Fig. 20).

Moreover, Fig. 21 shows that in contrast to the trend in the leading innovation nations, the share of private-sector R&D financing in Austria is declining steadily. In addition, Austria has a relatively high subsidy intensity (measured as public-sector R&D financing relative to GDP) (see Fig. 22).

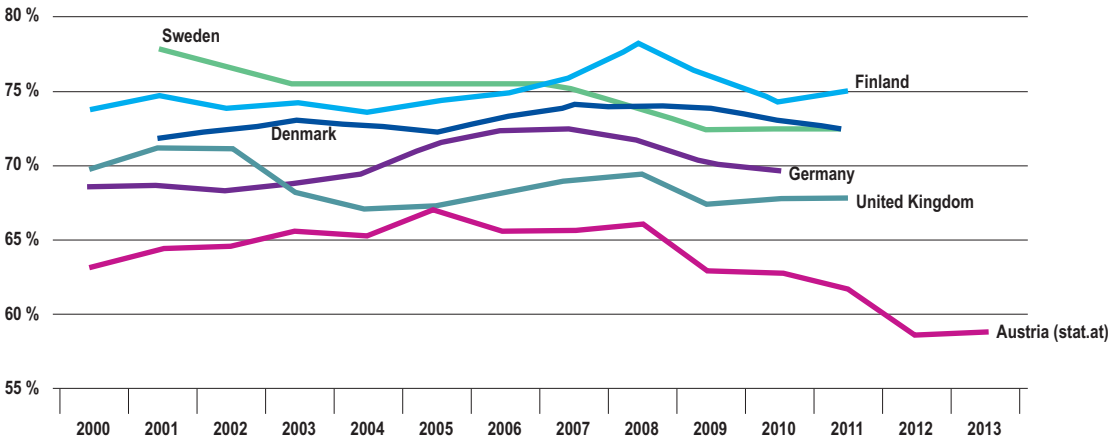
financing

Fig. 20: Public and Private-Sector Contribution as a Percentage of Total Research Expenditure



Source: OECD, MSTI.

Fig. 21: Development of the Private-Sector Contribution to R&D Funding (as a Percentage of Total R&D Spending)



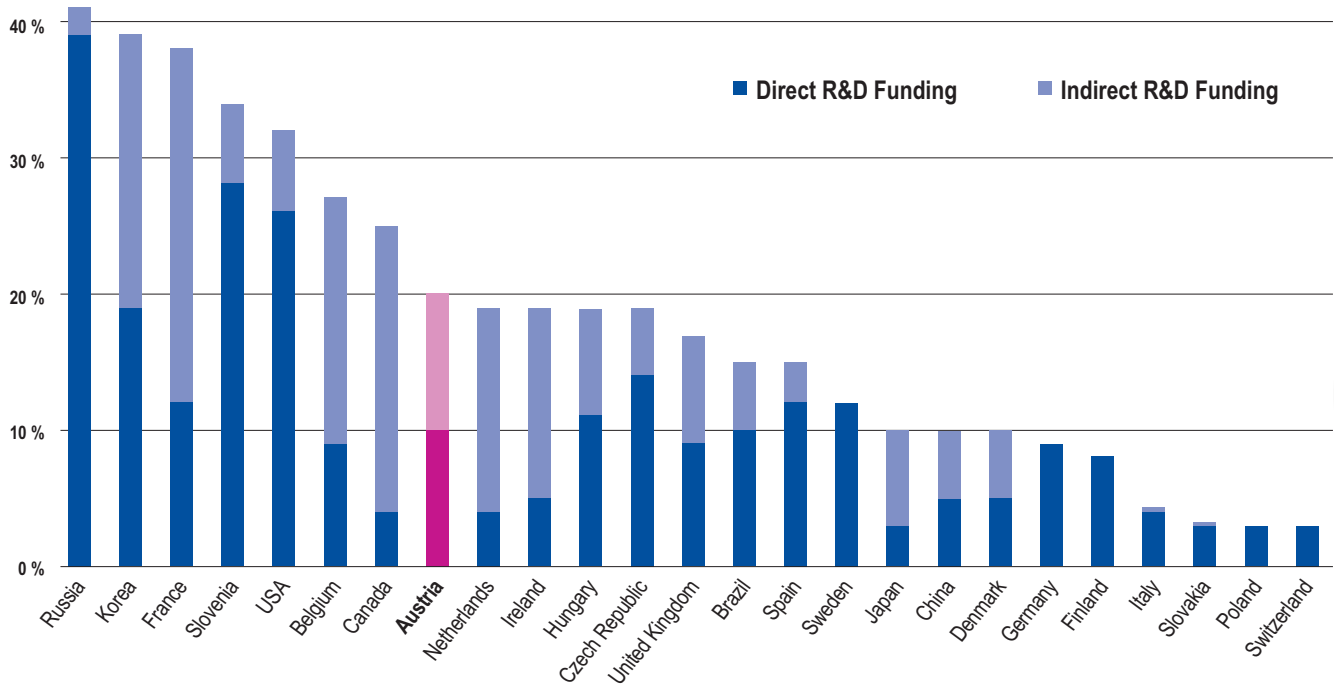
Source: OECD, MSTI.

financing

The key question, therefore, is what can be done to increase the proportion of private-sector R&D funding? The RTI Strategy offers no direct answers in this regard and nor does it suggest measures to tackle this situation. However, a number of options to raise the share of private-sector R&D spending do exist; these include concentrating public funds and instruments in a way that increases their leverage effect, i.e. increases incentives for private-sector spending on R&D.[151] One might, for example, award direct R&D subsidies by means of auction mechanisms or take up suggestions put forward in the Report on Austria's Scientific and Technological Capability 2013, for example, to optimise the framework conditions for private venture capital financing, etc. Such concepts must be increasingly tested to see, if and how, they raise the proportion of private-sector spending.

An increase in the proportion 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).

Fig. 22: Public-Sector Direct and Indirect R&D Funding Relative to GDP



Source: OECD, Science, Technology and Industry Scoreboard 2013.

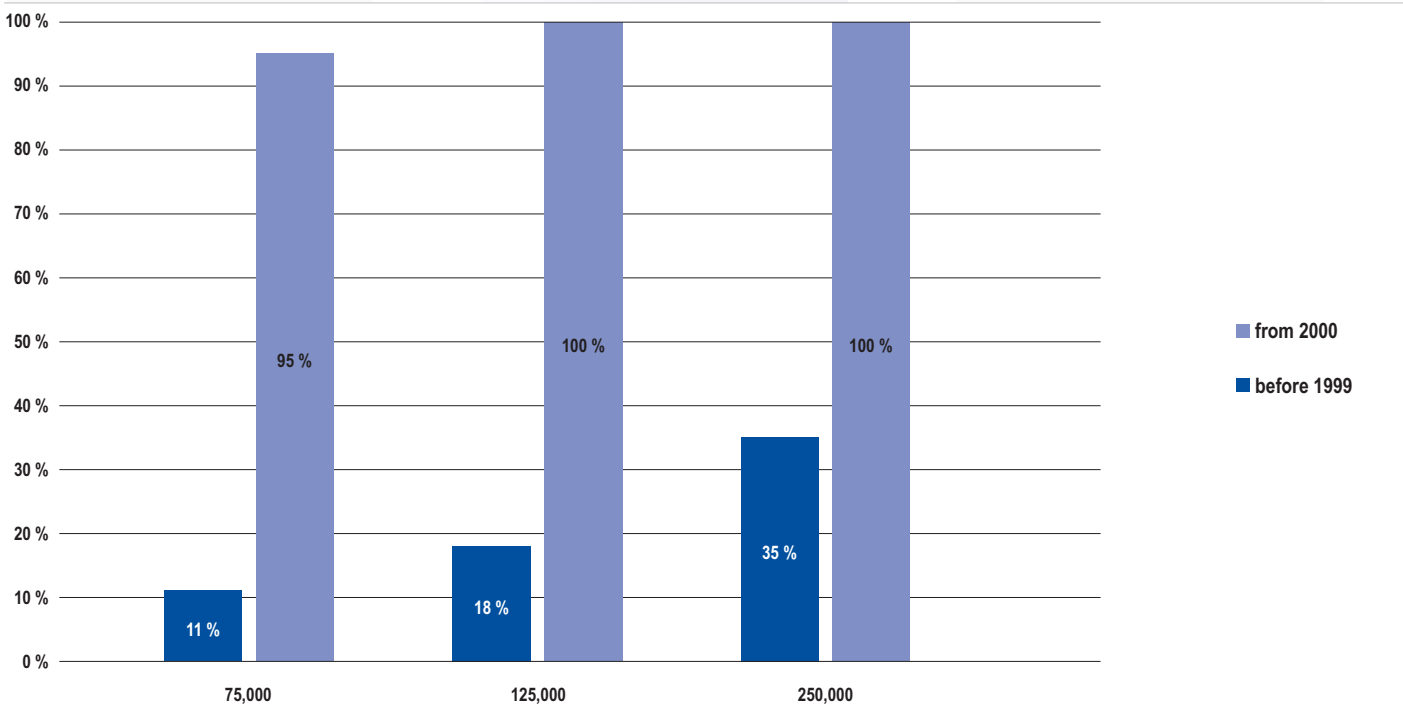
[151] See also, for example, Leo, H. (2012): Strategien zur Erhöhung der privaten F&E-Ausgaben. Study on behalf of the Austrian Council for Research and Technology Development; cf. Janger, J. / Böheim, M. / Falk, M. / Falk, R. / Hölzl, W. / Kletzan-Slamanig, D. / Peneder, M. / Reinstaller, A. / Unterlass, F. (2010): Forschungs- und Innovationspolitik nach der Wirtschaftskrise. In: WIFO-Monatsberichte, 2010, 83(8), pp. 675–689.

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 to donate among Austrians, the volume of the donations is quite low. [152]

As in this context it would be particularly important to reform the fiscal framework, the Austrian Council has drawn up a proposal for a reform that could, and must, be incorporated into existing tax law.[153] The most important points of this proposal are as follows:

Basically, donations to a taxative list of non-profit organisations are tax-deductible up to a maximum amount of ten percent of the annual earnings of the donor. Yet due to an inconsistency in the tax system, private foundations are, in practical terms, unable to avail themselves of this deduction, for the following reasons: The investment income of pri-

Fig. 23: Endowment of a Scientific Foundation with € 500,000, Tax Deductibility of Donations in Percent Depending on Revenues



Source: Association of German Foundations

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

[153] Leitner&Leitner, Gesetzesinitiative zur steuerlichen Entlastung von Stiftungen, Expert opinion on behalf of the Austrian Council for Research and Technology Development.

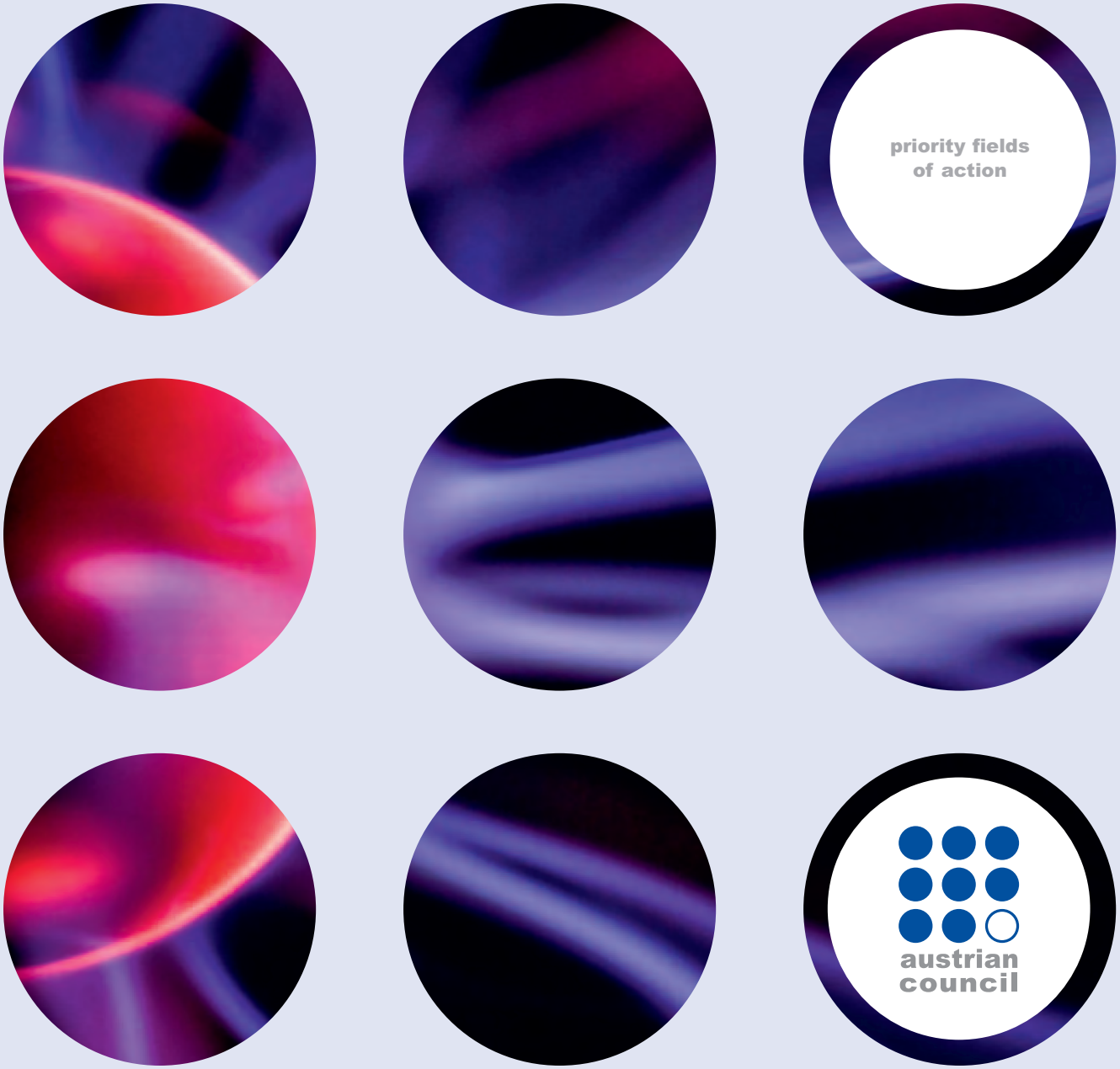
vate foundations is subject to an "interim tax" of 25 percent. If a donation is made by a private foundation to a beneficiary, capital gains tax becomes due, the amount of which, however, is offset against the interim tax that has already been paid. Donations made to the eligible non-profit organisations are not subject to capital gains tax. However, by law, "interim tax" may only be refunded if donations are subject to capital gains tax. As a result, these donations remain subject to the 25 percent interim tax rate. This holds true for all philanthropic donations and thus also for donations to research. [154]

The Austrian Council therefore welcomes the announcement in the Government programme to make improvements in this regard.[155] Germany provides a good example of what can be achieved by reforming tax law and the laws governing foundations, as massive reforms to the fiscal treatment of foundations have led to a substantial increase in funds for this area (see Fig. 23).[156]

[154] 154 Cf. Leo, H. (2012): Strategien zur Erhöhung der privaten F&E-Ausgaben. Study on behalf of the Austrian Council for Research and Technology Development.

[155] Work Programme of the Austrian Federal Government 2013–2018, p. 8.

[156] Tax benefits for donors in Germany: Tax deductibility of endowments up to EUR 1 mn. (over 10 years); gifts 20 % of taxable income p.a.; Tax benefits for foundations in Germany: Exempt from gift and inheritance tax, corporation tax and income tax.



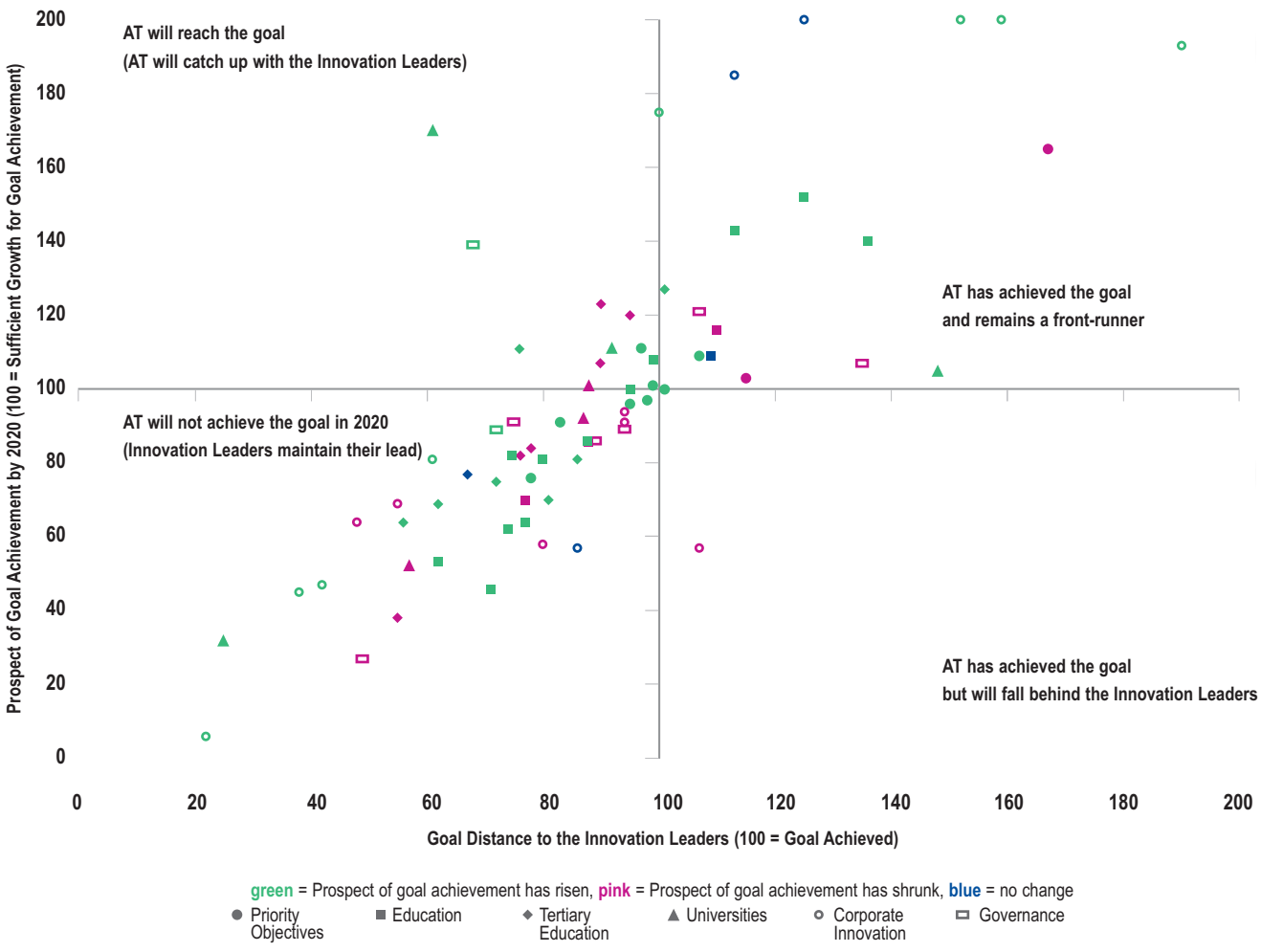
Summary and Priority Fields of Action

priority fields of action

The indicator-based analysis and evaluation of the Austrian RTI system provides a good overview of Austria's performance in all areas of the RTI Strategy (see Fig. 24 and Table 5). It shows those areas in which the RTI Strategy goals have already been achieved and in which Austria outperforms 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 Fig. 24, 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. The overview in Table 5 illustrates this even more clearly: Despite a predominance of positive trends, with some 60 percent of indicators showing an improvement in goal distance and goal achievement prospects compared to the previous year, performance has deteriorated in 36 percent of cases. The average goal distance to the Innovation Leaders (=100) across all areas remains considerably below target

Fig. 24: Overview of Performance in all Areas of the RTI Strategy



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 in 2020.

at 89. At 97, the prospect of goal achievement falls just short of the momentum needed to achieve the targets. It is therefore clear that the pace of progress is still too slow and that there is some catching up to do in respect of overall innovation performance. Positive developments can be observed above all in respect of the priorities set out in the RTI Strategy and in the educational system (without the tertiary sector). In both these areas, there has been an improvement in goal distance or the prospects of goal achievement in 80 percent of the indicators. However, this improvement in the educational system 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.

Table 5: Overview of Average Goal Distances and Prospects of Goal Achievement and Changes Compared to the Previous Year

	Average Goal Distance (GD)	Average Prospect of Goal Achievement (PGA)	Increase in PGA or GD in %	PGA or GD shrunk in %	Change GD	Change PGA
Total	89	97	58	36	3.70	7.95
Priority Objectives	95	96	80	20	0.84	3.14
Educational System (excl. Tertiary Sector)	87	83	80	13	8.30	22.40
Tertiary Education Sector	77	81	53	40	0.52	-6.71
Universities and Basic Research	73	82	57	43	9.81	9.81
Corporate Research and Innovation	92	106	44	39	3.31	4.96
Political Governance	81	85	25	75	-0.56	3.21

Sources: see Appendix 1, WIFO presentation. Raw data see Appendix 2. Note: Average Innovation Leaders = 100

In respect of the priority objectives, Austria trails only very slightly behind the Innovation Leaders, both in terms of goal distance and the goal achievement prospect. The performance deficit vis-à-vis the leading innovation nations can be observed above all in relation to the environmental indicators and, to a lesser extent, with regard to life expectancy and quality of life.

The area "Corporate Research and Innovation" has the second smallest distance-to-goal and the greatest prospect of goal achievement. At the same time, it is the only area in which overall goal achievement is deemed to be within reach by 2020 – provided the trends continue to develop as they have in the past.

The area "Universities and Basic Research" has seen the greatest reduction in goal distance compared to the previous reporting year. However, it should be noted that together with the "tertiary education sector" 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.

Measured by the change in goal distance compared to the previous year, the area "Political Guidance" emerges as the clear loser with a performance that was negative in every respect. Furthermore, with 75 percent 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 public attitudes to science and research.

The Austrian Council has therefore come to the following conclusion: The Austrian catch-up process is not sufficiently dynamic at present. Carrying on as in the past is not an option, as other comparable countries, and the Innovation Leaders in particular, are developing more dynamically. If Austria does not wish to fall further behind in global competition and lose any

priority fields of action

prospect of catching up with the leading group, it must accord the highest priority to education, research, technology and innovation as well as provide the necessary funding and also make structural adjustments.

Based on this analysis by the Austrian Council, the following priority fields of action have been identified. Despite changes since the previous year and improvements in a number of areas, these are still largely identical with those of the 2013 report:

- Performance of the education system (quality, social selectivity)
- Financing of basic research via competitive procedures
- Start-ups (start-up dynamics, company growth, financing)
- Private-sector R&D funding

Recommendation 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 recommends that to overcome early-age selection in the education system, there be a commitment to, and appropriate implementation of, comprehensive full-day secondary schools, alongside ability differentiation and talent development.

The Austrian Council recommends that the goal set out in the Government programme, 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 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

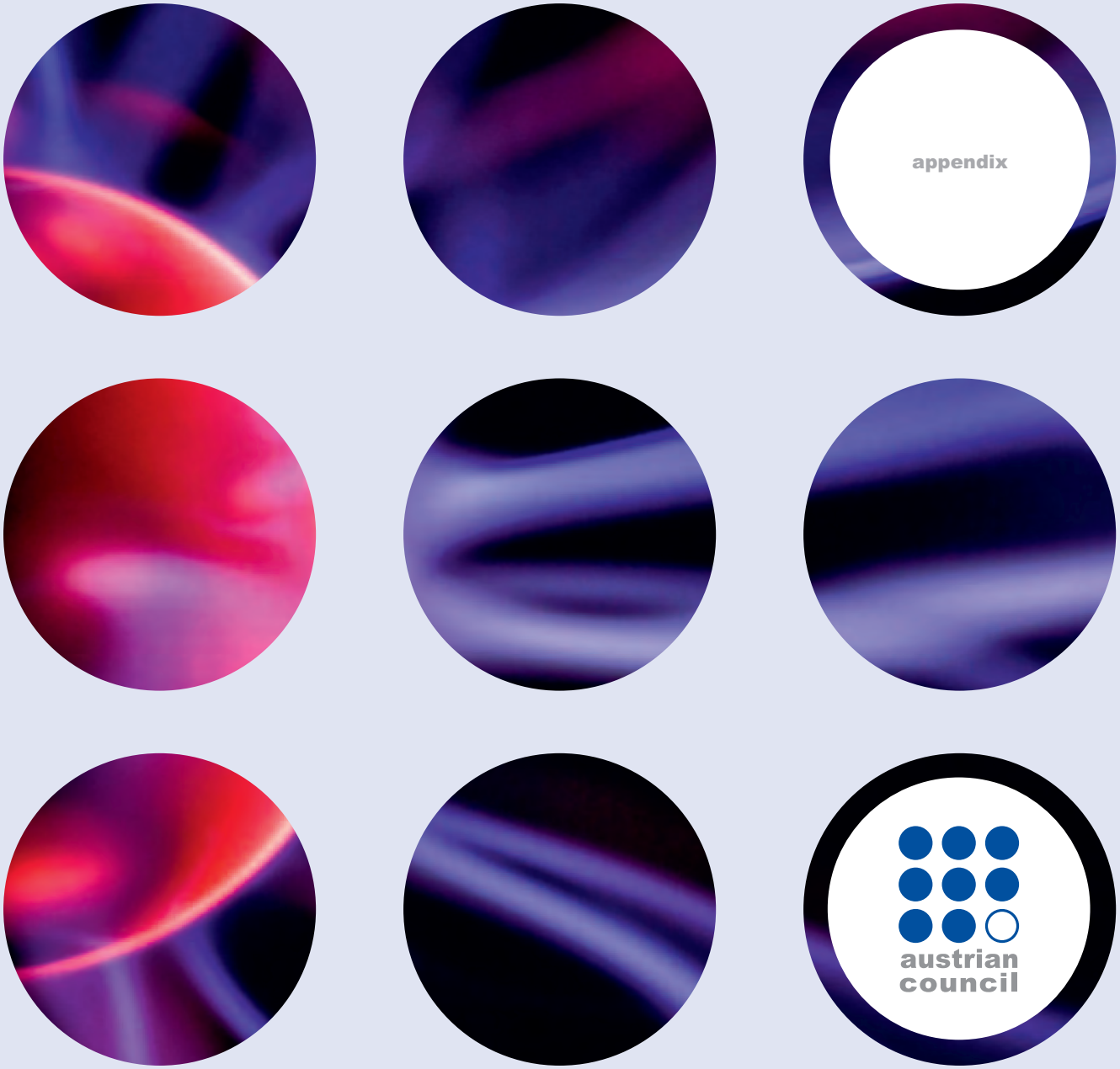
The Austrian Council urgently recommends a substantial and sustainable increase in competitively allocated funds for basic research to expand the numbers of those engaged at the top of excellent research and to improve the research conditions of Austria as a location for science. Failing this, both the 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 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 rates in excess of ten percent for such businesses, should therefore be considered and, if and where necessary, developed and implemented in detail.

Promoting 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.



Appendix 1: Indicator Set

Appendix 2: Indicators' Raw Data

Appendix 3: Explanatory Notes for Interpreting the Figures and Indicators

Appendix 4: List of Abbreviations

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)	IUS Index	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 heathy 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

Objective target of the strategy	Indicator to track target achievement	Abbreviation	Numerator
Education System – Secondary Level			
		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)
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	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 1,000 researchers	ERC Grants per 1,000 researchers	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
	Number of academic researchers /1,000	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

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 candidats	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

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	Current Value Inno. Lead.	Goal Distance	Growth AT	Growth Inno. Lead.	Productive Growth	Prospect of Goal Achievement	Time Series
IUS Index	0.60	0.72	83	2.17	0.94	3.57	91	2006–2013
GDP/per capita	131.00	122.25	107	0.35	0.15	-0.70	109	2001–2012
Employment-to-Population Ratio	75.60	76.38	99	0.48	0.27	0.41	101	2000–2012
Unemployment rate	4.30	7.18	167	1.49	0.67	8.01	165	2000–2012
Better Life	7.68	7.90	97	1.99	-0.22	0.46	111	2012–2013
Healthy Life Years (F)	74.70	74.03	101	0.20	0.08	0.18	100	2004–2012
Healthy Life Years (M)	76.80	78.28	98	0.08	0.02	0.48	97	2004–2012
Greenhouse gases	107.57	84.00	78	0.34	-0.97	-2.71	76	2000–2011
Energy Intensity	126.10	145.15	115	-0.23	-1.45	0.13	103	2000–2011
Resource Productivity	1.43	1.51	95	1.53	1.41	2.01	96	2000–2011
Early childhood care	94.30	95.00	99	0.99	1.38	0.08	108	2000–2011
Student-teacher ratio early childhood	14.01	9.95	71	-2.88	-4.77	-11.01	46	2002–2011
Student-teacher ratio in primary education	12.10	13.28	110	-1.66	-0.97	0.01	116	2001–2011
Early school leavers	7.60	9.50	125	-2.42	-1.16	2.83	152	2000–2012
Secondary School Graduates	41.30	55.00	75	1.03	n.a.	3.65	82	2000–2012
Early school-leavers migrants	81.37	60.00	136	0.38	n.a.	-3.74	140	2011–2012
Inheritance of Education 1	42.01	36.90	88	-0.44	-0.72	-2.26	86	2000–2012
Inheritance of Education 2	15.29	11.71	77	-0.69	-1.84	-5.07	70	2000–2012
PISA Risk – Literacy	19.49	15.00	77	2.42	0.97	-3.22	64	2000–2012
PISA Risk – Numeracy	18.65	15.00	80	-0.07	2.70	-2.69	81	2003–2012
PISA Risk – Science	15.78	15.00	95	-0.58	2.73	-0.63	100	2006–2012
PISA Risk – Science	5.52	8.94	62	-3.84	-2.15	4.09	53	2000–2012
PISA Top Students – Numeracy	14.29	12.67	113	0.00	-4.03	-4.35	143	2003–2012
PISA Top Students – Science	7.85	10.58	74	-3.90	-1.62	2.10	62	2006–2012
Skill Mismatch	89.20	82.00	109	n.a.	n.a.	-0.76	n.a.	2009
University Graduates	26.30	42.15	62	3.62	2.21	8.49	69	2005–2012
University Graduates (incl. ISCED 4a)	38.25	38.00	101	2.93	2.21	-0.08	127	2004–2012
Staff-Student Ratio	16.58	9.27	56	2.76	0.96	-2.14	64	2002–2011
Percentage of GDP spent on Higher Education	1.52	2.00	76	3.83	1.26	2.78	111	2000–2010
University Expenditure per Student	15,007.11	18,417.63	81	3.30	4.88	7.09	70	2000–2010
Researchers	9.20	12.14	76	3.67	2.20	6.11	83	2002–2012
Doctorate Holders STEM	0.90	1.15	78	3.75	2.93	5.78	84	2000–2011
STEM graduates	16.10	17.80	90	7.59	3.96	5.14	123	2000–2011
Share of female researchers	28.99	32.28	90	3.81	1.86	3.00	107	2002–2011
Share of women in science	35.43	41.31	86	0.06	0.58	2.45	81	2000–2011
Share of women in engineering	19.62	27.23	72	2.54	1.78	5.92	75	2000–2011
Glass Ceiling Index EU	1.90	1.81	95	-3.75	-1.89	-1.99	120	2004–2010

Indicator	Current Value AT	Current Value Inno. Lead.	Goal Distance	Growth AT	Growth Inno. Lead.	Productive Growth	Prospect of Goal Achievement	Time Series
Highly-qualified Immigrants	17.73	26.46	67	2.82	1.49	5.34	77	2000–2009
Doctoral Candidates Non-EU	8.60	15.50	55	1.99	6.45	13.58	38	2004–2011
Lifelong Learning	14.10	22.68	62	4.51	3.08	9.39	69	2000–2012
Basic research (expenditure as a percentage of GDP)	0.53	0.57	92	3.96	-17.28	2.79	111	2002–2011
Publication Quality	11.07	12.57	88	1.86	0.48	1.78	101	2002–2009
International Co-Publications	1,247.84	1,428.16	87	7.15	6.28	8.30	92	2005–2012
ERC Grants per 1,000 Researchers	1.71	1.16	148	8.23	10.23	7.47	105	2009–2013
University Ranking Research Performance	16.54	27.04	61	15.81	-1.19	8.39	170	2011–2012
Competitive Funding	16,182.11	28,561.81	57	0.02	1.32	9.87	52	2007–2013
Employed Doctoral Candidates	24.76	100.00	25	3.43	n.a.	19.06	32	2010–2012
Knowledge Intensity Business	14.20	16.10	88	0.72	1.03	2.66	86	2008–2012
Knowledge Intensity Exports	3.55	2.24	159	6.49	0.03	-3.57	221	2005–2012
Knowledge-Intensity Services Exports	61.74	65.55	94	0.29	0.28	1.09	94	2004–2012
R&D Intensity Industry	0.48	0.87	55	-2.47	-27.16	1.71	69	2009–2011
Export Quality	88.05	93.47	94	-0.35	0.04	0.79	91	1999–2012
R&D Performers	3,384	3,375	100	6.36	n.a.	-0.03	175	2002–2011
Innovative SMEs	42.20	49.23	86	-2.58	1.18	3.05	57	2004–2010
Foreign-Funded R&D	15.24	8.02	190	-2.18	4.94	-9.90	193	2000–2012
Foreign-Owned Patents	25.10	23.52	107	-2.71	3.15	3.56	57	2000–2011
Innovation revenue	8.54	10.64	80	3.47	0.14	9.23	58	2004–2010
Business-Science Links LCU	54.62	48.25	113	7.11	1.75	0.70	185	2004–2010
Business-Science Links SMEs	29.78	23.86	125	13.66	3.07	1.13	322	2004–2010
Technological Significance Patents	5.27	8.59	61	2.65	-0.37	4.87	81	2003–2010
Venture Capital Intensity	0.08	0.38	22	-23.94	-11.51	7.77	6	2007–2012
Start-Ups Material Goods	4.56	3.00	152	43.59	n.a.	n.a.	3,947	2010–2011
Start-Ups Services	-5.64	3.00	42	1.41	n.a.	n.a.	47	2010–2011
Start-Up Regulation	138.00	66.75	48	9.31	14.61	2.48	64	2006–2013
Competition Policy	0.35	0.13	38	-10.00	-6.51	-19.57	45	2003–2013
Priority: Patents	1.20	1.76	68	5.60	-1.61	2.21	139	2003–2010
Returns Ratio	125.00	117.25	107	1.69	-0.49	-1.10	121	2002–2013
Participation in FP	127.00	94.25	135	-3.05	0.11	-4.02	107	2012–2013
Personal Interest Science to Society	9.20	18.81	49	-24.06	-19.17	-8.61	27	2010–2013
Economic Benefits of Science	63.63	67.62	94	-2.16	-1.55	-0.59	89	2010–2013
Positive Attitude to Science	44.52	61.90	72	2.37	-0.70	4.06	89	2010–2013
R&D Intensity	2.81	3.76	75	2.92	0.55	4.26	91	2000–2013
Private-Sector R&D	58.81	66.00	89	-0.55	n.a.	1.66	86	2000–2013

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: 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 Figs. 1, 7, 10, 11, 13 and 16 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.[157] 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 instead.[158] 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 above 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 past annual growth rate) 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 average past growth rates)[159] 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. 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, assuming 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 incor-

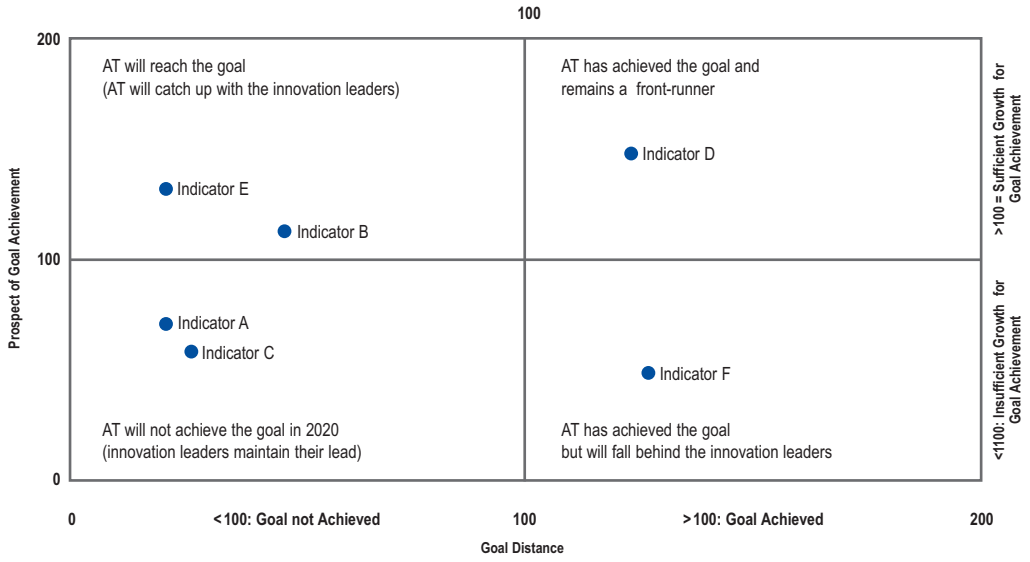
[157] At the suggestion of the then BMUKK, target values from the independent Education and Training 2020 Strategy were adopted for a number of indicators for the education system.

[158] The term Innovation Leaders refers to the countries classified as the Innovation Leaders by the Innovation Union Scoreboard (IUS) of the European Commission.

[159] The underlying argument is that it is unlikely that the Innovation Leaders will stagnate at their current level. 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 the assessment of priority measures would be distorted.

porated 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 Fig. 25). 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 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.[160] 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-left 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.

Fig. 25: Sample Illustration to Explain the Interpretation of the Indicators



Sources: see Appendix 1. Note: The relationship between the current Austrian value to the target value defined in the RTI Strategy or current innovation leaders' values (average most recent available year DE, DK, FI, SE):
Prospect of Goal Achievement = Relationship between projected values for Austria in 2020 to target value. Values over 200 cut off. Raw data see Appendix 2

[160] As the indicator sets are updated every year, changes in trends are captured in almost real-time.

Appendix 4: List of Abbreviations

ACR Austrian Cooperative Research

AHS Secondary school of general education

AIT Austrian Institute of Technology

AUF Non-university research organisations

AplusB Academia plus Business

AVCO Austrian Venture Capital Organisation

AWS Austria Wirtschaftsservice

BHS Secondary technical and vocational high school or college

GDP Gross Domestic Product

BMUKK Federal Ministry for Education, Arts and Culture

BMVIT Federal Ministry for Transport, Innovation and Technology

BMWF Federal Ministry for Science and Research

BMWFJ Federal Ministry of Economic Affairs, Family and Youth

BRIC Brazil, Russia, India, China

BRIDGE FFG Programme for the promotion of knowledge transfer between science and business

CDG Christian Doppler Research Association

COMET Competence Centres for Excellent Technologies

CPDC Conflict – Peace – Democracy – Cluster

EFRD European Fund for Regional Development

EIB European Investment Bank

ERC European Research Council

ESFRI European Strategic Framework for Research Infrastructure

ETC European Territorial Cooperation

EU European Union

EVCA European Private Equity and Venture Capital Association

R&D Research and Development

FET Future and Emerging Technologies

RTI Research, Technology and Innovation

FFG Austrian Research Promotion Agency

FWF Austrian Science Fund

GmbH LLC Limited Liability Company

IFK International Research Centre for Cultural Studies

IMBA Institute of Molecular Biotechnology

IMP Institute of Molecular Pathology

ISCED International Standard Classification of Education

ISTA Institute of Science and Technology Austria

IUS Innovation Union Scoreboard

JEI Jeune Entreprise Innovante (France)

JITU Initiative to Build Young, Innovative, Technology-Oriented Companies

SME Small and Medium-Sized Enterprises

KICs Knowledge & Innovation Communities

LBG Ludwig Boltzmann Gesellschaft

LCU Leading Competence Units

STEM Science, Technology, Engineering, and Mathematics

MIT Massachusetts Institute of Technology

NEUFÖG New Companies Promotion Act

NMS New Secondary School

ÖAW Austrian Academy of Sciences

OECD Organisation for Economic Co-operation and Development

OST Offices for Science and Technology

PEEK Programme for Arts-based Research

PIRLS Progress in International Reading Literacy Study

PISA Programme for International Student Assessment

PCT Patent Cooperation Treaty

TIMSS Trends in International Mathematics and Science Study

TU University of Technology

UG 2002 Universities Act 2002

USA United States of America

WIFO Austrian Institute of Economic Research

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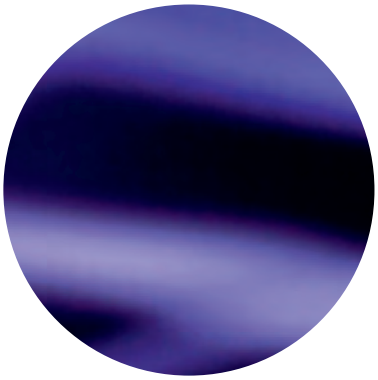
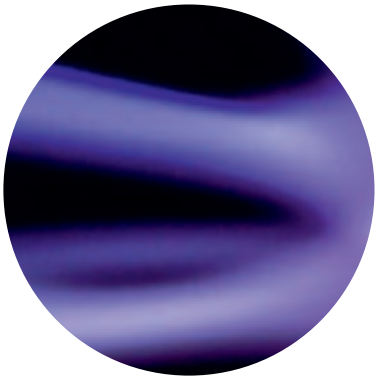


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