Austrian Research and Technology Report 2015

Report of the Federal Government to the Parliament (National Council) under Section 8(2) of the Research Organisation Act, on federally subsidised research, technology and innovation in Austria

This report was commissioned by the Federal Ministry of Science, Research and Economy (BMWFW) and the Federal Ministry for Transport, Innovation, and Technology (BMVIT). It was written by a working group consisting of the Austrian Institute of Technology (AIT), JOANNEUM RESEARCH (JR) and the Austrian Institute of Economic Research (WIFO) with the support of the Centre for European Economic Research (ZEW).

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Imprint

Owners, Authors and Publishers:
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Federal Ministry for Transport, Innovation and Technology (BMVIT), 1030 Vienna

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Translated by Young Translations LLC, Vienna

Printed by:
Gugler GmbH, 3390 Melk/Donau

Vienna, 2015

Preface

The Austrian Research and Technology Report 2015 is a government report pursuant to section 8 (2) of the Research Organisation Act (FOG), which is devoted to assessing the current challenges for national and international research and technology policy by analysing current developments and trends. Against the background of an economic environment which remains difficult, we intend to focus more heavily on trends related to expenditure for research and experimental development (R&D), along with the global trends in research funding; other specific focus areas will also be covered.

In 2015 R&D expenditure in Austria is set to exceed the €10 billion mark (€10.1 billion) for the first time, according to the global estimate produced by Statistics Austria. This represents a research intensity of 3.01% of GDP and a nominal increase over 2014 of approx. €271 million, or +2.8%. The highest rate of growth can be seen in the business enterprise sector with a projected increase of 3.9%. At around €4.76 billion, it provides 47.2% of overall R&D funding. The proportion of investments from abroad is €1.53 billion or around 15%, with the overall percentage of financing by the private sector amounting to 62%. This means further convergence with the target specified by the European Union and enshrined in the Austrian RTI strategy of two thirds private and one third public research financing. In 2015 the federal government is projected to finance €3.21 billion or around 32% of overall R&D expenditure, an increase of €44.7 million or 1.4% compared with the previous year. The public sector has increased its R&D financing heavily over the last six years since the start of the crisis, with the nominal amount for this in 2015 around 42% higher than in 2009, when the economy was in recession. On a positive note when compared to other countries, Austria's R&D intensity of 2.95% of GDP in 2013 was significantly higher than the EU average of 2.01%, and now features the fourth-highest research intensity: ahead of Germany but behind Finland, Sweden and Denmark.

These figures once again show that Austria has been investing significant amounts of money in research and innovation for several years. However, there are still barriers to becoming an Innovation Leader and further efforts are required. The federal government has therefore implemented important measures, e.g. through the latest tax reform, which provides for an increase in research grants to 12% starting in 2016, and an immigration grant for leading international researchers. Relief is also planned for non-profit foundations, with greater incentives aimed at increasing the low proportion of non-profit private investments in research. An Austrian Alternative Funding Act should also make financing start-ups and SMEs much easier and bolster the entrepreneurial spirit in Austria.

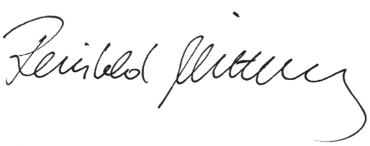
This government report provides an overview of the latest developments and measures related to the implementation of the federal government's RTI strategy, and presents specific initiatives that the federal ministries are working on at different levels and in differing contexts of political and (self) commitment, all of which are aimed at playing an essential role in achieving the targets. The Federal Ministry of Science, Research and Economy (BMWFW) for instance has developed an action plan for a "Competitive Research Area", thereby presenting a specific, albeit not exclusive, work programme for 2015 and 2016. The ministry launched the "Leading competence unit" location strategy with the aim of energising research and innovation.

Among other areas, the focus for this year's report is on priority setting at universities, the definition of research priorities and long-term objectives at universities together with increased strategic resource planning, since universities represent one of the backbones of public-funded research through their research activities. Special attention is also paid to the concept of "smart specialisation" driven by the European Commission for knowledge and innovation-managed regional growth and development strategies, and the role and impact of universities in the region. The increasing importance of third-party funding for R&D at universities and the implications of this trend on the universities' research portfolio, on university management and also on developments in the economic environment and the public research budget are also discussed, along with the financing and control of research infrastructures.

In the realm of applied research and technology among business enterprises, the report also examines the potential for new production and communication technologies. For instance, the Federal Ministry for Transport, Innovation and Technology (BMVIT) is encouraging funding for the broadband infrastructure along with initiatives for Industry 4.0 in conjunction with the Federal Ministry of Science, Research and Economy (BMWFW). The Technology Ministry supports production technologies and ICT with a particular focus on mechatronics, robotics, new materials, big data and the interplay of humans and machines. This has been successful in enshrining the theme of Industry 4.0 even further in the Austrian research landscape. Together with the TU Vienna, the Federal Ministry for Transport, Innovation and Technology (BMVIT) is setting up the first Industry 4.0 pilot factory and awarding endowed professorships for Industry 4.0 to Austrian universities. Seven professorships will have been established at Austrian universities by the end of 2015 as a result of this programme.

In order to raise SMEs' awareness of Industry 4.0, the Federal Ministry of Science, Research and Economy (BMWFW) also carried out a regional survey of demand as part of an information campaign via the national cluster platform. A total of four funding programmes have been implemented by the Federal Ministry of Science, Research and Economy (BMWFW) via Austria Wirtschaftsservice (aws) and the Austrian Research Promotion Agency (FFG). They focussed on increasing employee qualifications which are relevant for Industry 4.0, on optimising business strategies as regards process, product and operational innovations, and on entering new markets.

The energy and environmental technology industry is a further focus area which for decades has been one of the sectors with the highest level of research and innovation in Austria, and has made a crucial contribution to the efforts to limit climate change. The complex relationship between innovation and employment was also subject to analysis. The conclusion was that product innovation has increased employment not only among innovative firms but in the sector as a whole. It can also be shown that increased use of ICT and progressive digitalisation need not result in job losses. Equal opportunities and gender along with the increasing importance of public procurement as a tool used in innovation policy are also discussed in this report.



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Executive Summary

The Austrian Research and Technology Report 2015 is a report by the federal government to the Parliament (National Council) in accordance with section 8 (2) of the Research Organisation Act (FOG) on the status and requirements related to research, technology, and innovation in Austria. It was compiled by the Federal Ministry of Science, Research and Economy (BMWFW) and the Federal Ministry for Transport, Innovation and Technology (BMVIT). The report looks at current data, analyses and findings to describe significant trends in development and key themes in Austria's system of innovation and examine them in an international context.

In addition to presenting the latest global estimate by Statistik Austria on trends in R&D expenditure in Austria for 2015 and Austria's position in international rankings as well as the current implementation status of the RTI strategy, it also discusses current developments in the area of universities and the business enterprise sector. Other sections outline the relationship between innovation and employment, the status of equal opportunities and gender in RTI and the options for making public procurement more innovation-friendly.

Global estimate of R&D expenditure in 2015

According to Statistics Austria's current estimate from April 2015, expenditure for research and development carried out in Austria in 2015 is projected to grow nominally by around €271.36 million or 2.76% compared to 2014, thereby exceeding the €10 billion threshold for the first time (€10.10 billion). As a result of the revised version of the European System of Accounts (ESA) 2010, which came into force in September 2014 and is used to calculate gross domestic product (GDP), the basis used to calculate the R&D intensity (gross domestic expenditure for research and development compared with GDP) for 2015 differs from the one used for 2014, which was still based on the ESA 1995. A recalculation of the R&D intensity based on the ESA 2010 was carried out back to 1995, so that the trends can be depicted over time. The projected nominal GDP 2015 is €335.33 billion, a 1.92% increase on 2014. The resulting R&D intensity is therefore expected to be 3.01%, which would be a slight increase over 2014 (2.99%) and 2013 (2.95%). The revised values for the global estimate for 2014 and 2013 also incorporate revisions of GDP based on the latest available data.

The highest rate of growth in 2015 was seen in the business enterprise sector, with a projected increase of 3.9%. This sector funds an estimated €4.76 billion, thereby contributing around 47.2% to financing Austrian research and development, thus representing the highest proportion of the funding. A comparatively steep increase in the funding from the business enterprise sector since 2011 (as compared with the crisis years 2009–2011) could be observed.

The federal government is providing €3.21 billion in funding in 2015, approximately 32% of overall expenditures on research and development in Austria. In absolute figures, this represents a rise of some €44.7 million or 1.4% compared to 2014. Overall the public sector, which includes the regional governments, local governments, professional associations and social insurance institutions, is expected to provide funds of €3.77 billion in 2015, or around 37.3% of total R&D expenditure, with the federal government responsible for the overwhelming share of this. Since the crisis the public sector has sharply increased its R&D financing, which in 2015 is expected to be around 42% higher than it was during the recession year 2009. Foreign sources of funds (primarily foreign-owned firms that co-finance the R&D of their Austrian subsidiaries and, to a lesser extent, returns from EU research framework programmes) account for €1.53 billion or 15% of the funds for Austrian research and development, which continues to be a high proportion in international comparison.

Overall, Austria was well above the EU average of 2.01% in 2013 (the last year for which comparative international figures are available) with 2.95% of GDP and thus ahead of Germany (2.85%), though still behind Finland (3.31%), Sweden (3.30%) and Denmark (3.06%).

Austria's position in international innovation rankings

The federal government has set itself the target to increase Austria's performance in research and technology so that Austria will become part of the group of innovation leaders. Innovation rankings are one tool which can be used to evaluate progress in this direction. They compare the innovative capacity of economies or regions using indicators which record various aspects of innovation in industry and society. Their aim is to illustrate the strengths and weaknesses of innovation systems and at the same time to identify need for action related to innovation policy. Austria's innovative capacity is assessed in an international comparison using four different innovation rankings, namely the Innovation Union Scoreboard of the European Commission, the Global Innovation Index, the innovation-related indicators of the World Competitiveness Index, and the Innovation Indicator of the Deutsche Telekom Stiftung.

The rankings show that Austria's innovation performance has increased considerably since the early 2000s. In the Innovation Union Scoreboard of the European Commission, Austria was able to increase its index score from below 0.5 between 2002 and 2004 to 0.6 in 2013. The index score also increased markedly from 0.41 to 0.54 in the Innovation Indicator of the Deutsche Telekom Stiftung. Since the countries which lead these rankings only show a small increase in index scores, Austria has been able to narrow the gap to the group of innovation leaders. Nevertheless the gap still remains a considerable one. The catching-up process over the past decade therefore has meant that Austria is now somewhat closer to the average value of the highly developed industrialised countries. However, greater efforts will be required in order to reach the federal government's target of catching up with the leading innovation nations.

The dynamic development in the Austrian research and innovation system over the past decade is also recognised by the European Commission in the Innovation Union Progress Report from Autumn 2014. An analysis of 14 individual indicators on efficiency in science and industry highlights the balance of the system and shows that Austria only scores below the EU-28 average for two of the 14 indicators: EC Framework Programme funding and R&D expenditure in Higher Education and Government institutions financed by the business enterprise sector. Compared with a reference group set out by the European Commission (Belgium, France and the UK), Austria does better in nine of the 14 indicators.

Despite the noticeable increase in the index scores, Austria was unable to improve on its position in the innovation rankings, and has even lost ground in some of the rankings over the past few years. Within the comparison group of 23 highly developed industrialised countries, Austria is currently in the bottom half of the rankings (ranked at 13, 14 or 17 depending on the individual ranking). Austria fell to position eleven among the EU member states in the current Innovation Union Scoreboard. This development is due to the fact that most other countries have also intensified their innovation efforts, and some of them have been able to improve their position in relation to Austria. This process indicates that there has been a competitive push to increase innovation among highly developed industrialised nations (and a few larger, fast-growing emerging economies). But it is also simply an expression of a long-term economic shift in which the importance of knowledge-based activities (and thus innovation) is eclipsing that of traditional activities.

Even though criticism related to the methodology behind these innovation rankings may be justified (see details in Chapter 4.3 of the Austrian Research and Technology Report 2014), increased efforts will be required in the RTI-policy area in light of the noticeable weakening in Austrian dynamics and the intensifying international competition.

Austrian RTI strategy and its implementation

The RTI strategy adopted by the federal government in 2011 represents the central frame of reference for the formulation of Austrian RTI policy. Its main objective is to move the country into the group of European innovation leaders by 2020. The RTI strategy is implemented at multiple levels with a broad-based and systemic approach to organising and supporting the system of innovation. The "RTI Task Force" functions as an important coordinating tool for implementing the strategy, as it supports the strategic and systems-oriented coordination efforts between RTI ministries. Led by the Federal Chancellery, it includes representatives of the Federal Ministry of Finance (BMF), the Federal Ministry for Transport, Innovation and Technology (BMVIT), the Federal Ministry of Science, Research and Economy (BMWFW), and the Federal Ministry of Education and Research (BMBF). Intense and regular contact and exchange of information at a higher administrative level has made a crucial contribution to increasing cooperation between the RTI ministries over the last few years.

Alongside the development and implementation of different RTI-related measures, projects and programmes, specific initiatives which are amined at achieving the targets of the RTI strategy have also been designed and developed by various ministries. These have been established at different levels of government and in differing contexts of political effectiveness and (self) commitment. In the Performance Report 2015 of the Council for Research and Technology Development, the Council makes reference to the fact that further sustained efforts are required in spite of the latest improvements in order to implement the RTI strategy and achieve the targets set.

The development of the Austrian higher education landscape and university priority setting based on regional priorities

Austria essentially has one of the oldest university systems in Europe. In addition to the early establishment of the universities in Vienna, Graz, Salzburg and Innsbruck, the number of universities continued to rise from the middle of last century. In the 1990s the admission of universities of applied sciences, establishment of medical universities, accreditation of private universities and the founding of university colleges for teacher education tripled the number of Austrian universities within a short time. In 2015, the Austrian higher education landscape consists of 22 public universities (including the University for Continuing Education Krems), 21 universities of applied sciences, twelve private universities and 14 university colleges for teacher education. Research and experimental development amounting to 0.72% of GDP were carried out at Austrian universities in 2013. This makes Austria the country with the highest level R&D expenditure for universities in Europe in 2013 after Denmark, Sweden, Estonia and Switzerland (EU-28 average: 0.47%).

From a legal perspective the Universities Act in 2002 was one of the most far-reaching changes to higher education in Austria, establishing universities as independent bodies from federal administrative control. Aside from establishing the public universities as legal entities of public law with full legal capacity, performance-based university funding was also introduced in part, with planning and implementation also initiated for longer-term strategy and priority-setting. The global budget provided by the federal government for a period of three years and made up of two components remains the most important financial instrument for universities. The majority of this is allocated via a basic budget based on three-year performance agreements which set out specific measures and objectives aimed at fulfilling the universities' mission statements. The second financing component (since 2013 the higher education structural funds, "Hochschulraum-Strukturmittel") covers the granting of a defined proportion of the global budget based on quantitative performance indicators and a competitive proposal for start-up financing for cooperation projects. The increased importance of efficiency and performance indicators in university financing presents university management with new challenges. This must be viewed in the context of the other challenges and trends in university operations, such as the Bologna process, the associated broadening of the teaching process and the efforts to cope with a general increase in student numbers.

The universities' priority-setting process, initiated in the previous performance agreement periods by defining research priorities and longer-term objectives in association with increased strategic resource planning, was continued in the 2013–2015 period. An important component of this is the European Commission's concept of "smart specialisation", which is a set of strategies to promote regional growth and development through knowledge and innovation. The focus here is on regional and location-specific effects and the strategic importance of the higher education sector, particularly universities. The "Lead Institution Initiative", launched by the Federal Ministry of Science, Research and Economy (BMWFW) within the scope of the 2013–2015 performance agreement period, addresses the strategic goal of solidifying universities' understanding of themselves as locally embedded research institutions. Universities should become actively involved in regional RTI-strategic processes and play a role in designing and setting regional priorities. Additionally universities are asked to put greater emphasis on their regional environment and its inherent potential for the development of specific profiles, by the creation of respective location concepts. Linking universities' academic excellence with the knowledge and skills of other partners, such as local firms and other higher education establishments, ought to support the development of "critical masses", thereby making an important contribution to the international visibility of Austrian universities. More than two-thirds of Austrian universities have already incorporated the development of location concepts and the involvement in regional RTI strategies as milestones in their performance agreements.

Third-party financing of R&D at universities and research infrastructures

The increased importance of efficiency and performance indicators is directly reflected in the financing structure of Austrian universities. Income from third-party funding of R&D projects or projects for the development and inclusion of the arts by universities are one of the five components based upon which the higher education structural funds are allocated. Income from third-party funding increased from €406.2 million to €597.5 million between 2007 and 2013 (+47.1%). However, third-party funding for R&D only rose slightly as a proportion of total revenues for universities in the same period, i.e. from 15.5% to 16.5%. The number of third-party financed staff also rose as a proportion of the entire university staff, from 17.3% (2007) to 20.6% (2013).

The greatest proportion of university income from third-party funding for R&D is attributable to public funds. In 2013, about €142.3 million came from Austrian Science Fund (FWF) funding, €51 million from the Austrian Research Promotion Agency (FFG), €24.3 million from the federal government, and €33.4 million from the regional governments (including their foundations and grant institutions). EU funds amounted to €83.2 million. The proceeds from Austrian and foreign firms as clients amounted to €155.4 million in 2013, which represents around a third of total third-party funding income. The remainder of the third-party funding for R&D (approx. 16% of overall income from third-party funding for R&D) comes from the Academy of Sciences (ÖAW), the anniversary fund of the Austrian National Bank, other public and private institutions and international organisations. In relation to overall revenues, income from third-party R&D funding is of especially great importance for technical and medical universities, as well as for the University of Natural Resources and Life Sciences (BOKU) and the University of Linz. The effects, potentials and implications of increased third-party funding for R&D are subjects of intense controversy. For instance, raising and utilising third-party funds for R&D projects incurs indirect costs that must then be covered by global budgets.

As of 2014 the investments in research infrastructure that were reported in the research infrastructure database by the Austrian universities, the ÖAW and IST Austria amounted to €548 million. More than half of the acquisition costs (54% or €281 million) are financed from the global budget, with a further 28%, or €146 million, financed from funding programmes run by the Federal Ministry of Science, Research and Economy (BMWFW). The shares of financing types differ quite considerably in some cases among the individual fields of science. R&D third-party funding also represents a further relevant source of funding, particularly in the technical sciences. Horizon 2020 and the European Social and Investment funds, particularly the European Regional Development Fund (ERDF), provide additional financing opportunities for research infrastructures. A total of €2.5 billion has been budgeted for this in Horizon 2020 over the entire support period. However, funding is only provided on a highly selective basis in the form of priority projects for the European Strategic Forum for Research Infrastructures (ESFRI).

Research and innovation in the business enterprise sector

There is a trend in manufacturing towards digitalisation and an integration of the entire industrial value chain: this development is often labeled as "Industry 4.0". The potential added value and benefits include customerization, flexibility and dynamisation of business processes, optimised decision-making, increased resource productivity and efficiency, value added through offering innovative services, as well as the creation of new markets. Greater efforts, especially those which provide versatile and multi-dimensional policy support, are required if the related potential is to be realised, change instituted and negative effects avoided. One requirement, for example, for implementing intelligent production systems is a fail-safe supply of modern broadband networks which is as comprehensive as possible, and "next generation access" networks. In international comparison, Austria has average levels of broadband usage rates. The federal government has responded by specifying a target for expansion of 100 mbps across the board by 2020 in its "Federal broadband strategy", implementation of which ought to promote greater use of "Industrie 4.0".

The emergence of global value chains has considerably increased the challenges for start-up firms in gaining access to transnational sales channels and resources (human and financial capital). Strategic cooperation with large firms may provide some relief here, since these already have existing sales channels, the required financial flexibility and experience in managing intellectual property. A current survey reveals that Austrian technology start-ups see improved conditions for market development, integration in global value chains and joint research and development initiatives as the principal motives for cooperation with major firms. There is a diverse choice available in terms of the legal structure for the cooperation (franchising, joint venture, cooperation agreements, etc.), depending on the desired length of cooperation and the rights and obligations the cooperation partners wish to assume. The lack of contacts in major firms, differing interpretations of the potentials for the technology used and poor protection for intellectual property are cited as the greatest obstacles.

The energy and environmental technology industry has been one of the sectors with the highest level of research and innovation in Austria for decades. Far-reaching innovations, such as those which play a role in limiting climate change, are very important here. The novelty of the innovation both on Austrian and international markets is one indicator of this scope. In a recent survey 79% of Austrian firms stated that their innovation is new to the Austrian market, while this was the case for 66% on international markets. A further 80% of innovative environmental technology producers also believed that their competitiveness on the market had improved as a result of their innovations. A positive connection can be identified between a firm's level of research intensity and growth in employment. The industry's high propensity for research along with the economic risk in environmental-related innovations, which is viewed as a major barrier by firms, suggest further development for appropriate research and technology instruments which support these types of innovation activities.

Innovation and employment

The relationship between innovation and employment is the subject of constant controversy, not least in the wake of new manufacturing technologies. This relationship is a complex one in reality: different types of innovation have different effects on employment, which may also affect competitors, customers and suppliers in addition to the innovative firm itself. The results of a survey among European firms show that product innovations make a significant contribution to employment. Firms with new products create more jobs than non-innovators, both in periods of recovery, boom and downturns. During periods of recession, such as the one in 2008–2010, innovative firms lose fewer employees than firms that have introduced no innovations. Process innovation and organisational changes, on the other hand, have predominantly negative effects on employment, although these are compensated by the positive employment effects of product innovations. Analyses also show that the role played by product innovations in generating jobs is greater in manufacturing than in services and is greater in the high-tech sectors than in low-tech sectors, but is less in SMEs than in large firms.

Another important result is the fact that employment rises in the sector as a whole as a result of product innovations and not just in innovative firms. There is evidence of this correlation for Austrian industry data during 2002–2010. It can also be stated that increased use of ICT applications in Austrian industry does not entail reductions in employment. There was even a positive relationship in most cases for the ICT and Internet diffusion indicators. Fears that increased use of ICT and progressive digitalisation would involve job losses appear to be unfounded. On the contrary, it can be assumed that increased use of ICT applications leads to greater demand for engineers and natural scientists. In fact, employment in this professional group rose by 3% per year during 2008 to 2013. The rise for this occupational group in manufacturing of material goods is particularly dynamic, with growth rates of between 5 and 6% per annum.

Equal opportunities and gender in RTI

This chapter deals with the topic of equal opportunities and gender in RTI at different levels in Austria. Trends in representation in non-university natural science technical research in Austria are considered and discussed along with the issue of the extent to which aspects of gender are considered in research content in the research projects supported by the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF). Efforts to implement equal opportunities and gender in Horizon 2020 are also illustrated.

Austria has made progress at both levels, not least based on a consistent funding policy. The proportion of women who are scientists is rising slowly as a whole in Austria; in non-university research this rose for instance from 20% to 25% between 2004 and 2013. The COMET Centres have made a crucial contribution to this increase in the share of female researchers, as the funders insist on measures being implemented aimed at promoting equal opportunities. A look at IST Austria and the ÖAW shows that these institutions also endeavour to promote equal opportunities between the genders by actively recruiting women and through compatibility measures. However, in order to increase the proportion of women in R&D in Austria as a whole, more effective measures in the business enterprise sector in terms of equal opportunities are required and they need to be regularly monitored.

The Austrian Science Fund (FWF) and the Austrian Research Promotion Agency (FFG) have included the consideration of gender and equal opportunities in their application and reporting guidelines in order to emphasise the gender aspect more effectively in research. Taking gender and diversity aspects into consideration, the Austrian Research Promotion Agency (FFG) also makes it possible for female researchers to gain initial experience in technological research through its funding scheme FEMtech research projects. This has allowed experience to be gained in gender-specific research over the past few years in a wide range of scientific disciplines. Austria occupies an internationally pioneering role with its funding policy. This funding policy furthermore provides support to researchers as they work towards achieving the goals set by Horizon 2020.

Public procurement as an instrument in innovation policy

Innovation-friendly public procurement has become permanently established in Austria over the past few years as a result of a large number of measures and initiatives. Examples here include the amendment to the Federal Procurement Act (Bundesvergabegesetz), the establishment of an innovation-friendly public procurement office along with associated competency/contact points, the implementation of pilot projects for pre-commercial procurement and financial incentives to stimulate commercial procurement for innovation.

As the results of the Community Innovation Survey (CIS) show, the Austrian economy offers some inroads for providing targeted support for innovation activities via targeted demand for the associated innovation solutions: The share of enterprises that receive public procurement contracts in Austria is very high in European comparison. The public sector's demand for goods and services affects nearly every area of the Austrian economy, albeit in varying degrees. However there is room for further expansion for the specific demand for innovations of public procurement orders. This holds true in particular for SMEs. The existing political commitment to this tool should be maintained and deepened for the purposes of the RTI strategy. One option would be to set specific targets related to innovation-promoting public procurement (e.g. dedicating a certain percentage of public procurement volumes for innovation-friendly projects). Such targets have already been implemented in other European countries (France, Spain, the UK and the Netherlands).

1 Current Trends

1.1 Trend of R&D expenditures based on new global estimate

In accordance with the latest global estimates from Statistics Austria as of April 2015, total Austrian R&D expenditures for 2015 are expected to exceed the €10 billion threshold for the first time (€10.10 billion), representing a €271.36 million or 2.76% increase on 2014. As a result of the revised version of the European System of Accounts (ESA) 2010, which came into force in September 2014 and is used to calculate gross domestic product (GDP), the basis used to calculate the R&D intensity (gross domestic expenditure for research and development compared with GDP) for 2015 differs from the one used for 2014, which was still based on the ESA 1995. For the present version of the global estimate a recalculation of R&D intensity based on the ESA 2010 was carried out, which permits a comparative time series analysis of the growth of R&D intensity from 1995.

Based on the current forecast, in 2015 the R&D intensity would exceed the 3-percent mark for the first time with 3.01% (based on the revision in accordance with ESA 2010), which would correspond with a slight increase on 2014 (2.99%) and 2013 (2.95%). The revised values for the estimate for 2013 and 2014 include, in addition to the conversion in terms of the European System of Accounts, revised GDP figures based on the latest available data.

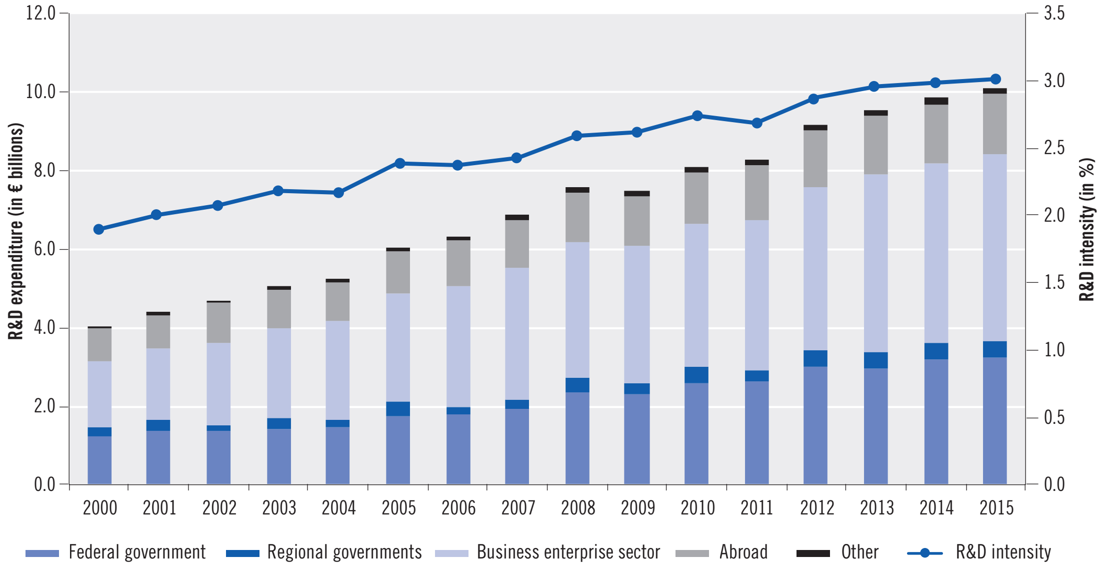
The development of research intensity along with the absolute contributions of the individual sources of funds are shown in Fig. 1-1. In an EU comparison for 2013 (the latest year for which international comparative figures on national research intensity are available), Austria is behind Finland, Sweden and Denmark, but is ahead of Germany and, at 2.95%, is also well above the average for the EU-28 of 2.01%.[1]

With the introduction of the ESA 2010 expenditure for research and experimental development are now classified as an investment, directly affecting GDP as part of gross fixed capital formation. Previously, applying ESA 1995, it was recorded as intermediate consumption, internal costs or non-market consumption, and therefore only affected GDP indirectly via the value added that was created by R&D-based goods and services. As a consequence of the reclassification of R&D expenditure, gross fixed capital formation increased and therefore GDP, either directly added or via the investments in R&D by market and non-market producers, at the same level of expenditure. This in turn has an impact on the R&D intensity, which is related to GDP, and may lead to revisions following a recalculation in accordance with ESA 2010.[2] For instance the R&D intensity in 2011 is 2.68% in accordance with ESA 2010 and 2.77% in accordance with ESA 1995.

Regarding the estimated development of R&D financing by sources of funds, the following picture could be displayed (see Fig. 1-2 and Fig. 1-3): Is estimated that the public sectors

1 Value for Austria according to the latest global estimate. Figures for the comparison countries and EU-28 according to Eurostat.
2 See Federal Ministry of Science, Research and Economy (BMWFW), Federal Ministry for Transport, Innovation and Technology (BMVIT) (2014); http://www.bmwfw.gv.at/rtr

Fig. 1-1: Expenditure on research and development in Austria by sources of funds



Source: Statistics Austria, Global Estimate as at 21 April 2015, nominal values.

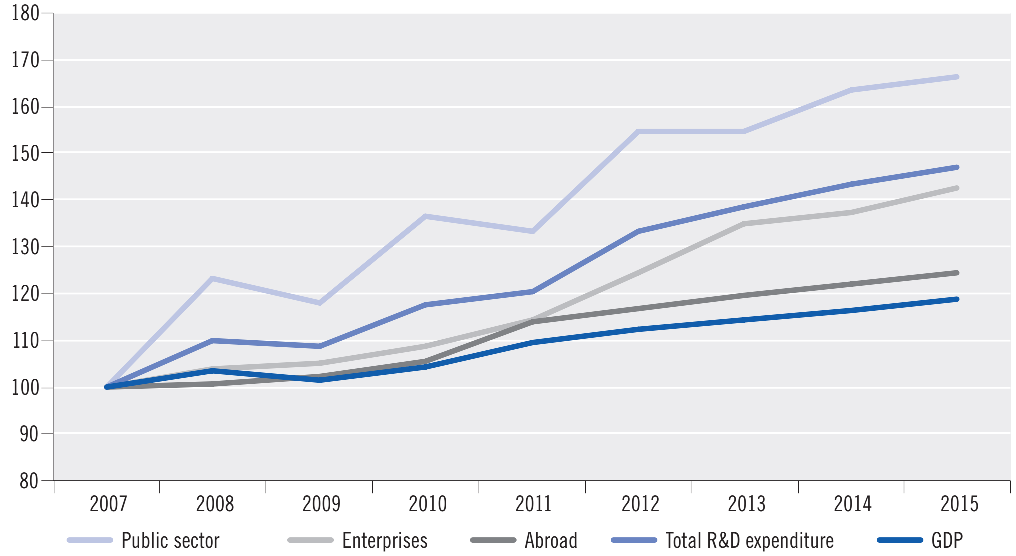
will finance €3.77 billion or 37.3% of total research expenditures in Austria in 2015. The federal government accounts for the greatest proportion with €3.21 billion (approx. 32% of R&D expenditure), representing an increase of 1.41% by €44.69 million. The financing proportion attributable to the regional governments is expected to be €443.23 million (+3.45%).

Other public institutions (local governments, professional associations, social insurance institutions) are estimated to contribute 1.1% (€110.29 million) to overall research funding in Austria. The estimated increase amounts to around €2.3 million or 2.1% on the previous year. At €42.71 million the private non-profit sector finances around 0.4% of total R&D expenditure projected for 2015, with an estimated increase of 1.96%.

The biggest individual contribution to R&D financing of €4.76 billion is once again attributable to the business enterprise sector, representing 47.2% of total projected R&D expenditure for 2015 (2014: 46.6%). This means a projected increase in business enterprise financing for overall R&D expenditure of 3.9% (€178.85 million) as compared with 2014. Compared with the 2009–2011 period thus there has once again been a comparatively steep increase in the funding from the business enterprise sector since 2011. This is therefore also above the projected growth in nominal GDP for 2015 of 1.92%

In an international comparison a high proportion of funding for Austrian R&D expenditure continues to come from abroad. For 2015 funding from abroad is expected to amount to 15.1% (€1.53 billion), which corresponds with a 2% increase (approx. €30 million) in funds from abroad for R&D as compared with the previous year. This essentially relates to direct investments by multinational firms in their Austrian subsidiaries and to a lesser extent returns from the EU research framework programme. The fact that the foreign financing largely originates from firms means that when this is added to the proportion of national business enterprise financing for R&D this results in an overall percentage of financing by the private sector of approx. 62%. This means further convergence with the target formulated by the European Union and enshrined in the Austrian RTI strat-

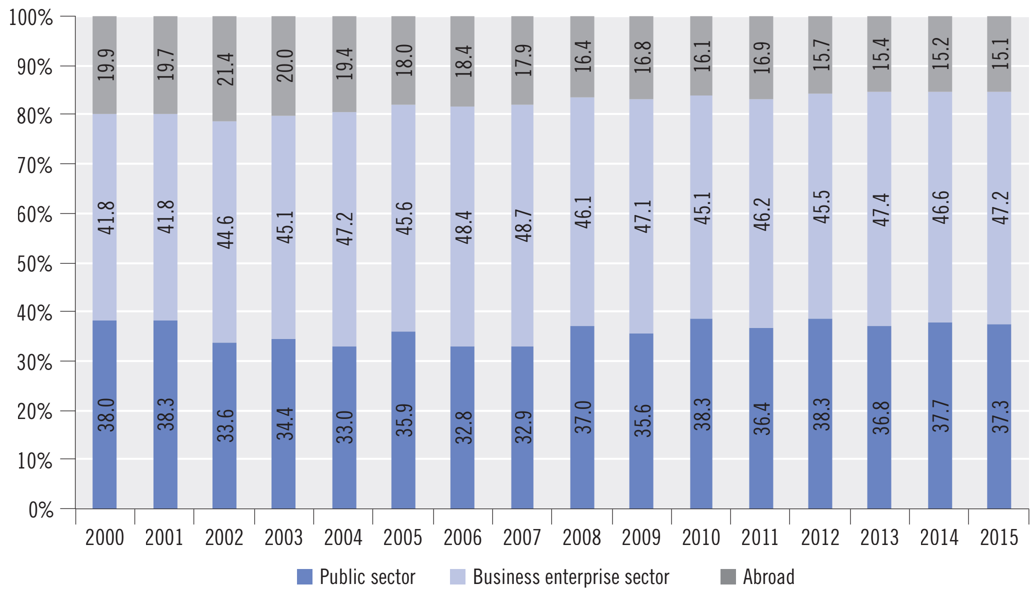
Fig. 1-2: Development of R&D in Austria by sources of funds (Index, 2007=100)



Note: The funding source "Other" (which includes the municipalities and the social insurance institutions) as well as the private non-profit sector was counted under the "Public Sector" here.

Source: Statistics Austria, Global Estimate as at 21 April 2015.

Fig. 1-3: R&D funding shares in Austria by sources of funds (in %)



Note: The funding source "Other" (which includes the municipalities and the social insurance institutions) was counted under the "Public Sector" here. Remainder to 100% = private non-profit sector

Source: Statistics Austria, Global Estimate as at 21 April 2015.

egy of two thirds private and one third public financing.

1.2 Structures and trends in international comparison

1.2.1 Austria's position in international innovation rankings

Today, innovation rankings are a widespread approach used for comparing the innovation capability of economies or regions. Their aim is to illustrate strengths and weaknesses of innovation systems and at the same time to identify the need for action related to innovation policy, using indicators which record various aspects of innovation activity in industry and society. One crucial characteristic of most innovation rankings is the consolidation of various indicators of innovation into one single value. This is intended to facilitate the communicability of the multi-faceted phenomenon of "innovation" and make it easier to draw comparisons between countries and over time.[3] Various innovation rankings are used in this chapter in order to assess the development of Austria's innovation performance in an international comparison and to evaluate the progress in achieving the federal government's objective of making Austria one of the world's leading centres for innovation.

Several innovation rankings have been introduced to the market over the last decade which are updated annually and are therefore relevant in terms of monitoring countries' innovation performance. The methodologically advanced and internationally established rankings include the following four in particular:[4]

- the *Innovation Union Scoreboard* (IUS) of the European Commission, which has been in place since 2001 (and was originally known as the *European Innovation Scoreboard*),
- the *Global Innovation Index* (GII), which is published by Cornell University, INSEAD, and WIPO and was first put forward in 2007,
- the *Global Competitiveness Index* (GCI) of the World Economic Forum, which includes several elements related to innovation and has been published since 2004,
- the *Innovation Indicator* of the Deutsche Telekom Stiftung (II-DTS), which has been in use since 2005.

What all these innovation rankings have in common is the fact that they derive relevant individual indicators based on a theoretical understanding of innovation, bring these individual indicators to a uniform measurement level and consolidate them into a composite index.[5] The rankings are based on the innovation system approach[6] and measure innovative capacity along different phases and steps of an integrated process – typically ranging from education and science to legal, political, and social conditions and the research and innovation activities in the industrial sector, while also depicting the interactions between individual stakeholders within the innovation system. The number of individual indicators that are considered vary widely among the rankings (25 – or twelve on a global comparison – for the IUS, 81 for the GII), relying on both quantitative indicators (based on statistics) and qualitative indicators (based on expert

3 See Chapter 4.3 of the Austrian Research and Technology Report 2014 for a critical discussion about the informative value of such indicator systems and their limitations. Federal Ministry of Science, Research and Economy (BMWFW), Federal Ministry for Transport, Innovation and Technology (BMVIT) (2014); http://www.bmwfw.gv.at/rtr

4 There are also numerous other innovation rankings that have been published either once or sporadically but that are of limited use for the Austrian research and technology policy to draw conclusions from, due to their methodical approach. A few examples are the innovation ranking done by the Economist Intelligence Unit (2009), the Innovation Index of the Boston Consulting Group (Andrew et al., 2009), the Innovation Index of Bloomberg L.P. and an Innovation Indicator Survey for the Transatlantic Economic Council (Atkinson, Andes, 2009).

5 All four rankings weight individual indicators equally.

6 See Freeman (2005); Patel, Pavitt (1994); Lundvall (1992); OECD (1999).

assessments). The GCI features an especially high number of qualitative indicators (24 of 31 innovation-related indicators), while the IUS only uses quantitative indicators (with some of the indicators recorded via questionnaires, meaning that they include subjective components).

In addition to these innovation rankings there are also numerous studies which examine the innovation capabilities of countries based on indicators, without consolidating the individual indicators into a composite index and ascertaining a country's ranking. The results of the individual indicators are generally merged into a verbal synopsis instead. These indicator-based analyses of countries' innovation performance include the Science, Technology & Innovation (STI) Scoreboard of the OECD[7] and the European Commission's progress report on the Innovation Union[8], which was published for the third time in 2014. Since the European Commission's report is of particular interest in evaluating Austria's position in terms of research, technology and innovation, its central results are presented subsequently in a separate chapter.

Austria in the Innovation Union Scoreboard 2015

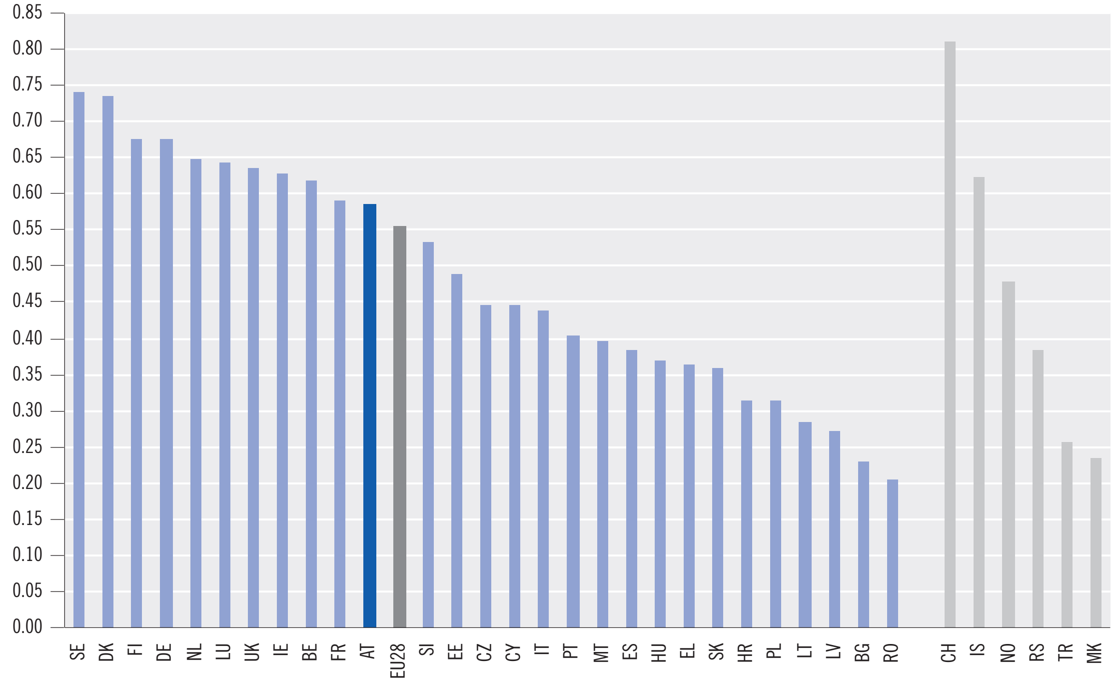
The *Innovation Union Scoreboard* (IUS) of the European Commission is of particular significance among the innovation rankings, as it is an important tool of the European Commission in evaluating progress in achieving the targets of the Innovation Union and of Europe 2020. The IUS is therefore also an important benchmark for the Austrian federal government for the purposes of evaluating the development of Austria's innovation performance as compared internationally. In the IUS published in 2015, Austria is ranked eleven among the 28 EU Member States, and is ranked 13 out of all European countries considered in the IUS (see Fig. 1-4). With an index score of 0.585, Austria belongs to the country group of "*Innovation Followers*" and is above the average figure for the EU-28 (0.555). Austria was ranked one place lower compared with the previous year's ranking, as France – which was ranked below Austria in 2014 – managed to improve its index score from 0.586 to 0.591. On the other hand Austria's index score fell compared with 2014 (0.597) by 0.012 points, after rising three years in a row since 2011.[9] Austria's index score in the IUS for 2015 is still its second highest since the IUS was introduced.

As compared with the previous year, Austria was able to improve on eight of the 25 indicator values in the IUS 2015, while the scores were worse for eight indicators (when examining the original indicator values). The change on the previous year's scores was negligible for six of the indicators (+/- 1%). A comparison over time is not possible for three of the indicators as a result of changes in definition. Austria was able to achieve improvements in the indicator values for the following indicators between 2014 and 2015 (see original values in Table 1-1) (in descending order, based on the level of improvement):

- Licence and patent revenues from abroad as a percentage of GDP
- Knowledge-intensive service exports as a percentage of all service exports

7 The STI Scoreboard is published every two years, most recently in late 2013.
8 See European Commission (2014).
9 However, a direct comparison between the results of the IUS 2015 and the results of the previous year is rather complicated because of a change in method. The definition and the data source of four of the 25 indicators has been changed: The indicator "contributions of medium- and high-tech product exports to the trade balance" was replaced by "exports of medium and high-technology products as a share of total product exports", at the same time they fall back on a different source of data. As of the IUS 2015, the indicator "employment in fast-growing enterprises in innovative sectors" also includes the financial sector. The indicator of "non-R&D innovation expenditure" was expanded in the IUS 2015 to include "other innovation expenditure". A different data source was used for the indicator "number of Community designs per billion GDP". Finally, the revision of the European System of National and Regional Accounts resulted in a change in the GDP levels, which also had an effect on the IUS results since eight indicators use the GDP as a reference value. The changes in method resulted in a slight improvement of the overall index for Austria. This did not, however, have an effect on the ranking.

Fig. 1-4 Ranking of the European countries in the IUS 2015



Source: European Commission (2015):

- Employment percentage of fast-growing firms in innovative industries
- Percentage of SMEs with marketing or organisation innovations
- International scientific co-publications per million of the population
- Non-EU doctoral students as a percentage of all doctoral students
- Percentage of 30 – 34 year olds in the population with a tertiary degree
- Percentage of employment in knowledge-intensive industries.

The figures were worse for the following indicators (in descending order in accordance with the level of deterioration):

- Innovative SMEs cooperating with others as a percentage of all SMEs
- Public-private co-publications per million of the population
- Percentage share of sales with product innovations
- Percentage of SMEs with product or process innovations
- Percentage of SMEs with innovations developed in-house
- PCT patent applications per billion GDP
- R&D expenditure in the public sector as a percentage of GDP
- Venture capital investments as a percentage of GDP

Three improvements and three deteriorations to the original values for indicators related to the education and science area ("enablers"), with two of the deteriorations occurring in relation to input values (expenditure or investments). In the output area, improvements can be recorded in relation to five indicators while there are two deteriorations. Three indicators have deteriorated in the "business enterprise activities" indicator group while there have been no improvements. Four of the indicators which declined in the IUS 2015 relate to data coming from the

Table 1-1 Austria indicator levels in the IUS 2014 and IUS 2015[1)]

	Original values (OV)		Normalised values (NV)		Change 2014–2015 in %	
	2014[6)]	2015	2014	2015	OV	NV
1 Enablers						
1.1.1 New doctoral graduates (ISCED 6) per 1,000 pop. 25–34 years	2.2	2.2	0.710	0.710	0	0
1.1.2 Percentage population aged 30-34 having completed tertiary education in %	26.3	27.3	0.375	0.383	4	2
1.1.3 Percentage of pop. 20–24 years with upper secondary education in %	86.6	87.4	0.757	0.772	1	2
1.2.1 International scientific co-publications per mill. population	1248	1314	0.664	0.696	5	5
1.2.2 Publications among the top 10% most cited publications	11.07	11.05	0.690	0.685	0	-1
1.2.3 Non-EU doctoral students as a % of all doctoral students	8.6	9.0	0.273	0.272	5	0
1.3.1 R&D expenditure in the public sector as a % of GDP	0.88	0.86	0.773	0.793	-2	3
1.3.2 Venture capital investments as a % of GDP	0.0179	0.0175	0.192	0.229	-2	20
2 Business enterprise activities						
2.1.1 R&D expenditure in the business enterprise sector as a % of GDP	1.95	1.93	0.835	0.841	-1	1
2.1.2 Non-R&D innovation expenditures as a % of turnover[2)]	0.353	0.458	0.150	0.212	1)	42
2.2.1 Percentage of SMEs with innovations developed in-house	36.3	31.8	0.692	0.600	-12	-13
2.2.2 Innovative SMEs collaborating with others as a % of all SMEs	20.5	15.3	0.921	0.648	-26	-30
2.2.3 Public-private co-publications per million population	86.4	71.0	0.710	0.595	-18	-16
2.3.1 PCT patent applications per billion GDP (in PPS €)	5.27	4.96	0.741	0.760	-6	3
2.3.2 PCT patent applications in societal challenges per billion GDP (in PPS €)	1.095	1.094	0.744	0.721	0	-3
2.3.3 Community trademarks per billion GDP (in PPS €)	10.01	10.07	0.756	0.792	1	5
2.3.4 Community designs per billion GDP (in PPS €)[3)]	8.39	1.65	1.000	0.830	1)	-17
3 Output						
3.1.1 Percentage of SMEs with product or process innovations	42.2	35.7	0.662	0.555	-15	-16
3.1.2 Percentage of SMEs with marketing or organisational innovations	42.3	44.7	0.609	0.686	6	13
3.1.3 Employment in fast-growing enterprises in innovative sectors (% of total empl.)[5)]	15.3	17.2	0.404	0.516	12	28
3.2.1 Percentage of employment in knowledge-intensive industries	14.2	14.6	0.601	0.627	3	4
3.2.2 Exports of medium and high-tech products as a % of total product exports[4)]	3.55	56.6	0.661	0.723	1)	9
3.2.3 Knowledge-intensive service exports as a % of total services exports	23.8	26.6	0.225	0.250	12	11
3.2.4 Turnover share of product innovations as a %	11.9	9.8	0.494	0.354	-17	-28
3.2.5 Licence and patent revenues from abroad as a % of GDP	0.206	0.245	0.338	0.379	19	12

1) Performance cannot be compared between the IUS 2014 and the IUS 2015 because the definition or data source has changed.

2) In the IUS 2014 without “other innovation expenditures.”

3) In the IUS 2014 this is based on information from OHIM, in the IUS 2015 it is based on information from Eurostat.

4) In the IUS 2014: contributions of medium- and high-tech product exports to the trade balance.

5) In the IUS 2014 without the financial sector.

6) Deviations from the values shown in Annex 1 of the IUS 2014 are because transformed values are given there for some indicators and not the original values.

Source: European Commission (2015): Calculations: ZEW.

Community Innovation Survey (CIS), while at the same time the score improved for one CIS indicator.

However, an improvement or deterioration in an original value for an indicator does not necessarily mean that Austria's index score in the IUS has also improved or deteriorated as a result. This is because as with the other three rankings considered below, the individual indicators in the IUS are brought to a uniform measurement level using the so-called “minimum-maximum” method so that they can be consolidated in an index. This method involves subtracting the value of the country with the lowest value from the individual indicator value of a country and dividing it by the difference between the highest and lowest value, so that the measured values for all individual indicators lie between 1 (= country with highest value) and 0 (= country with lowest value).[10] Through this method, the countries with extreme values have an important influence on the standardised indicator values of all countries. This means that a country's results with one indicator may worsen even if the indicator value went up because the value of the country with the lowest score went up even further.

In terms of the IUS 2015 for Austria, this method resulted in the fact that there was still an improvement in the overall index for three indicators despite declining indicator values. This related to the PCT patent applications, R&D expenditure in the public sector and most heavily, venture capital investments. There was no development in the opposite direction. Only in the case of PCT patent applications concerning societal challenges was the contribution to the overall index somewhat lower, despite no change in the indicator value.

The somewhat lower overall index score for Austria as a whole in the IUS 2015 as compared with the previous year is essentially attributable to four CIS indicators (proportion of innovative SMEs cooperating with others, share of revenue for product innovations, proportion of SMEs with product or process innovations, proportion of SMEs with innovations developed in-house) along with the public-private co-publications and the registration of community designs. In the latter case this is solely a result of a change in the data source. At the same time two of the CIS indicators (non-R&D innovation expenditure, proportion of SMEs with marketing or organisational innovations) made positive contributions to the Austrian index overall. The strongest positive effect came from a change to the definition of the indicator "non-R&D innovation expenditure". Significant positive contributions to the Austrian index were also caused by a higher employment proportion of fast-growing firms in innovative industries and by venture capital investments, although these fell slightly measured against GDP.

If one looks at the level of standardised indicator values, then four indicators feature a value below 0.3, i.e. Austria lags well behind the leading countries. These weak points are non-R&D innovation expenditure (despite a strong improvement as a result of the new definition), venture capital investments, knowledge-intensive services as a proportion of overall service exports and the proportion of doctoral students from outside of the EU. With standardised indicator values of above 0.75, the Austrian performance is particularly strong in community designs (even though Austria has lost its lead position here), R&D expenditure in the business enterprise sector, R&D expenditure in the public sector, the proportion of the population aged between 20 and 24 with a higher-quality secondary school education and in PCT patent applications.

Austria's position compared with a global reference group

The IUS results represent important evidence of Austria's innovation performance. However, they are also influenced by the specific concept of the ranking, such as the strong emphasis on globalisation of the innovation system (four indicators illustrate this aspect) or the separate consideration of innovation behaviour in SMEs (four indicators). At the same time the IUS dispenses with qualitative indicators, measurement values related to overall economic efficiency (e.g. productivity) as well as any explicit consideration of key enabling technologies (such as ICT). There is also a focus on a European comparison, while countries outside of Europe are only included via a reduced set of indicators. Other innovation rankings go in entirely different directions in some cases. As a result, a comparison of different innovation rankings can provide a more balanced picture of Austria's international position in terms of innovation competition.

If a comparison is made between the four in-

10 Occasionally extreme values are not included or are cut off.

novation rankings stated in the introduction (IUS, GII, GCI, II-DTS) based on all countries covered by the rankings, then Austria's current position is between 13 (Global Competitiveness Index) and 20 (Global Innovation Index) (see Table 1-2).[11] Given the varying number of countries considered (between 35 and 144), it does not make sense to compare placements, especially since some rankings include very small countries and countries with very specific economic structures (oil-exporting countries, small island nations, etc.). If one looks only at the 28 EU member states, then Austria is ranked between eighth position (Global Competitiveness Index) and eleventh position (Innovation Union Scoreboard). However, many highly innovative countries are outside of Europe. In order to compare the individual rankings and examine the question of Austria's prospects for joining the group of "innovation leaders," it helps to draw upon a reference group of similar, economically and technologically sophisticated countries. These countries compete primarily among themselves for innovation and try to secure a competitive edge through innovation-oriented strategies. Austria is compared with this type of reference group below. It includes all countries that have a similar level of productivity (at least half of Austria's per capita GDP) and a certain minimum size (population with at least half of Austria's population). Oil-exporting countries are excluded due to their very specific conditions. This reference group includes 23 countries – among them Austria itself – of which 14 are in Europe.[12]

Austria occupies between 13th and 17th place within the reference group in the latest versions of the four innovation rankings (see Table 1-2). Austria occupies 13th place in the innovation-related sub-indicators of the Global Competitiveness Index. The IUS as well as the Deutsche Telekom Stiftung's Innovation Indicator both place Austria in 14th place, although only 20 of the 23 comparison countries are included in the IUS. The worst ranking for Austria is on the Global Innovation Index, where it trailed in 17th place in 2014. Austria's varying positions can be explained by the different sets of indicators used by the individual rankings. The unusually low ranking in the Global Innovation Index can be attributed to the inclusion of general economic conditions and a few rather unconventional indicators of innovation to measure knowledge and technology output.

Switzerland leads each of the four innovation rankings (see Table 1-3). In addition to Switzerland, Sweden is also among the top five in all rankings. Finland makes the top five in three rankings, while the USA and the Netherlands each have two top-five placements. The top five countries in all four rankings are all in the reference group studied here.

Austria's gap to the "innovation leaders" if the top five countries are to be categorised as such is a relatively slim 5% in the Global Competitiveness Index (innovation-related sub-indicators only) and a relatively substantial 16% in the IUS (see Table 1-3, last column). In the case of the GII, the gap is still not too bad at 13%, despite the somewhat poor ranking. However, this is because the inclusion of developing countries in the standardisation of the indicator values has kept the gaps between the industrialised nations generally small. Austria would have to improve its index score by 10% in the Innovation Indicator of the Deutsche Telekom Stiftung in order to reach the level of the top five countries.

Development of Austria's position in the past ten years

For two of the four innovation rankings, i.e. the IUS and the II-DTS, it is possible to compare Austria's innovation performance with that of

11 The IUS also includes ten countries outside of Europe, however there is only a limited set of indicators (twelve out of 25 indicators) available for them.
12 These are the countries: Australia, Belgium, Denmark, Germany, Finland, France, Great Britain, Ireland, Israel, Italy, Japan, Canada, New Zealand, the Netherlands, Norway, Austria, Sweden, Switzerland, Singapore, Spain, South Korea, Taiwan and the US.

Table 1-2: Austria's ranking in selected international innovation rankings in 2014/15

Ranking	Publisher	Austria's rank			Number of countries considered		
		among all countries	in the EU-28	in the reference group[1)]	Total	EU	In the reference group[1)]
Innovation Union Scoreboard 2015 (IUS)	European Commission	16	11	14	44[2)]	28	20[2)]
Global Innovation Index 2014 (GII)	Cornell University, INSEAD and WIPO	20	9	17	143	28	22
Innovation Indicator 2014 (II)	Deutsche Telekom Stiftung and BDI	14	9	14	35	17	22
Global Competitiveness Index 2014 (GCI) – HTBI[3)]	World Economic Forum	13	8	13	144	28	23

1) Countries with at least 50% of Austria's GDP per capita (at current exchange rates) and at least 50% of Austria's population, excluding OPEC member countries (AT, AU, BE, CA, CH, DE, DK, ES, FI, FR, IE, IL, IT, JP, KO, NL, NO, NZ, SE, SG, TW, UK, US).
2) For non-European countries on the basis of a very limited set of indicators (twelve out of 25 indicators).
3) Means of the sub-indicators "Human capital and training", "Technological readiness", "Business sophistication" and "Innovation".

Sources: Deutsche Telekom Stiftung and BDI (2014), European Commission (2015), Cornell University et al. (2014); WEF (2014). Processing and calculations: ZEW.

Table 1-3: Comparison of the total index value for Austria in selected innovation rankings in 2014/15 with the five top-ranked countries from the reference group

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Austria [1)]
Innovation Union Scoreboard 2015 (IUS)	0.810 (CH)	0.740 (SE)	0.736 (DK)	0.688 (KO)	0.677 (US)	0.585% (16%)
Global Innovation Index 2014 (GII)	64.8 (CH)	62.4 (UK)	62.3 (SE)	60.7 (FI)	60.6 (NL)	53.4% (13%)
Innovation Indicator 2014 (II-DTS)	75.9 (CH)	64.7 (SG)	60.5 (FI)	57.9 (BE)	56.3 (SE)	51.4% (10%)
Global Competitiveness Index – 2014 (GCI) – HTBI[2)]	5.86 (CH)	5.83 (FI)	5.70 (NL)	5.67 (US)	5.63 (SE)	5.38 (5%)

1) In brackets: Difference between Austria and the country ranked number 5 expressed as a % of the Austrian value.
2) Mean of the sub-indicators "Human capital and training", "Technological readiness", "Business sophistication" and "Innovation".

Sources: Deutsche Telekom Stiftung and BDI (2014), European Commission (2015), Cornell University et al. (2014); WEF (2014). Processing and calculations: ZEW.

the reference countries since the early 2000s. A comparison of the rankings for the GCI and the GII only makes sense from 2007 or 2008 onwards on account of changes to the methodology. In the IUS, Austria managed to improve relative to the reference group between 2004 and 2009 and moved up to 10th place (see Table 1-4). However, in 2010 Austria dropped four places again and is now ranked at number 14 for 2015 (within the EU: number 11). In the II-DTS, Austria scored its highest ranking (8) in 2011 after coming 14th within the reference group in 2009. It fell back three places again in 2012, and in 2014 is ranked no. 14 after falling another three places. However, in the innovation-related sub-indicators of the GII, Austria moved up three places between 2010 and 2012, before falling one place again to no. 13 in 2014. Austria's position is subject to heavy fluctuation between the individual years in the GII. The country was able to move up three places again in 2014 and is now ranked at no. 17.

The different trends in the four innovation rankings reflect not only Austria's performance, but also that of the other countries considered. It is possible to win (or lose) places, after all, when other countries slide backward (or improve more quickly). Another thing to keep in mind is that most of the indicators in the IUS reflect data of one to three years before the reference year (i.e. the results for the reference year 2014 are overwhelmingly based on data gath-

Table 1-4: Austria's rank in international innovation rankings 2002–2014 within the reference group

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Innovation Union Scoreboard[1)] (IUS)	13	15	15	14	14	13	11	10	14	14	13	13	14
Innovation Indicator[2)] (II-DTS)	18	15	15	14	14	11	12	14	13	8	11	11	14
Global Competitiveness Index (GCI) – HTBI[3)]	-	-	-	-	-	13	14	15	15	14	12	12	13
Global Innovation Index[4)] (GII)	-	-	-	-	-	-	18	14	18	16	17	20	17

1) The years are the reference year of the relevant publication (i.e. 2014 for the edition that appeared in 2015). The data used in determining the indicators' values is sometimes drawn from up to three years before the reference year.

2) The years given are those of the year of publication. Change in method between 2013 and 2014.

3) The years given are those of the year of publication. Global Competitiveness Index, mean value of the sub-indicators "Human capital and training", "Technological readiness", "Business sophistication" and "Innovation"; There are no comparative values from before 2006 because of changes to the methodology.

4) The years given are those of the year of publication. Change in method between 2010 and 2011.

Sources: Deutsche Telekom Stiftung and BDI (2014), European Commission (2015), Cornell University et al. (2014); WEF (2014). Processing and calculations: ZEW.

ered for the years 2011 to 2013), while the indicators in the other rankings refer to the specified year.

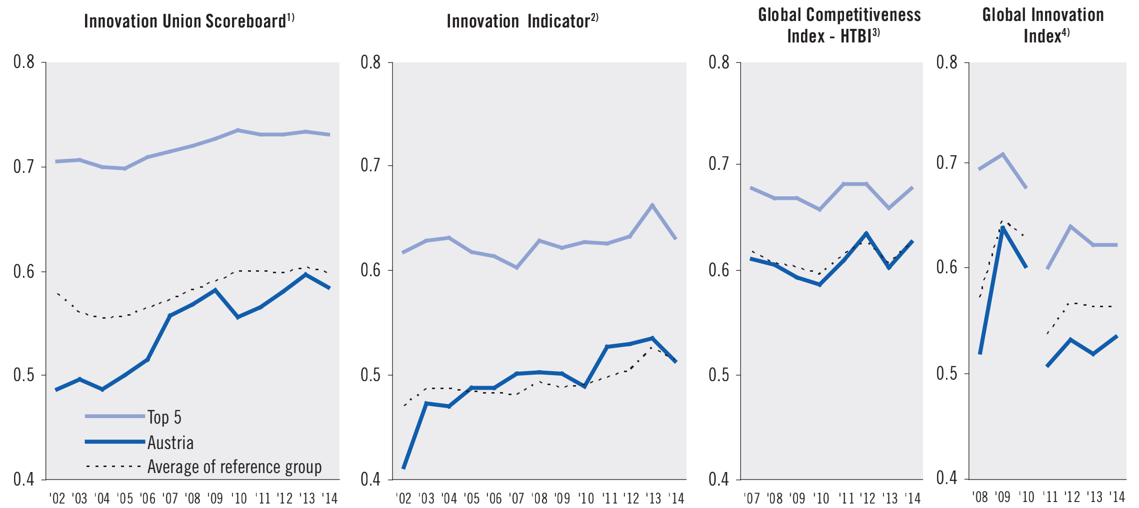
The context for the high level of stability of Austria's innovation performance relative to other countries is that the Austrian economy has greatly expanded its innovative activities and innovative orientation in the past decade. This can be seen in the noticeable rise in Austria's index scores in the rankings. In 2002, Austria achieved a score of 0.49 in the IUS (when the index series is adjusted to reflect the methodology used since 2011). By 2013, this score had increased to 0.60. This put Austria's innovation performance on average within the reference group in 2013, up from 16% below average in 2002 (see Fig. 1-5). Austria's index score in the IUS fell slightly in 2014 to 0.59, thereby following developments in the reference group. The gap to the top five countries has also been reduced considerably over the last twelve years, despite falling in the rankings in the past four years.

The picture is very similar with the Deutsche Telekom Stiftung's Innovation Indicator. Austria's index score rose sharply from 0.41 (2002) to 0.54 (2013), while the average among the reference group rose only slightly from 0.47 to 0.53. In 2014, Austria's index score along with the index scores of the reference countries fell considerably, primarily due to a change in the methodology related to measuring societal attitudes towards innovations. The gap to the group leaders narrowed considerably with this indicator also.

Austria greatly improved its index score in the innovation-related sub-indicators of the Global Competitiveness Index between 2010 and 2012, achieving a score slightly above average in the reference group. The trends have been in parallel with the average for the reference group ever since then. The gap to the five top-placed countries shrank noticeably during the same period. In the Global Innovation Index Austria is currently well below the average value for the reference group based on the methodology currently applied, with no catching-up process identifiable here.

The medium-term catching-up process identified in the IUS and II-DTS also corresponds with the trends which can be observed for overall economic R&D intensity (R&D expenditure by firms, universities and the government as a percentage of GDP – Fig. 1-6). Austria's score increased sharply from 2.00 to 2.95 between 2001 and 2013. While Austria was still 0.33 percentage points below the weighted average for the reference countries in 2001, its R&D intensity was 0.24 percentage points above the average value in 2010. This trend is considerably better than in the innovation rankings, where Austria currently only achieves the average value for the reference countries. This means that Austria's development looks less favourable when taking a broader look at innovation capability, such as that taken for innovation rankings, and which

Fig. 1-5: Development of the overall index for Austria and the reference countries in the international innovation rankings 2002–2014



1) Chain-linked indices, years refer to the reference year of the publication; 2) Index values revised on a scale from 0 to 1, all values based on the revised method applied in 2014; 3) HTBI: sub-indicators "Human capital and training", "Technological readiness", "Business sophistication" and "Innovation" (Index values revised on a scale from 0 to 1); 4) Break in the methodology between 2010–2011 (index values revised on a scale from 0 to 1).

Sources: Deutsche Telekom Stiftung and BDI (2014), European Commission (2015), Cornell University et al. (2014); WEF (2014). Processing and calculations: ZEW.

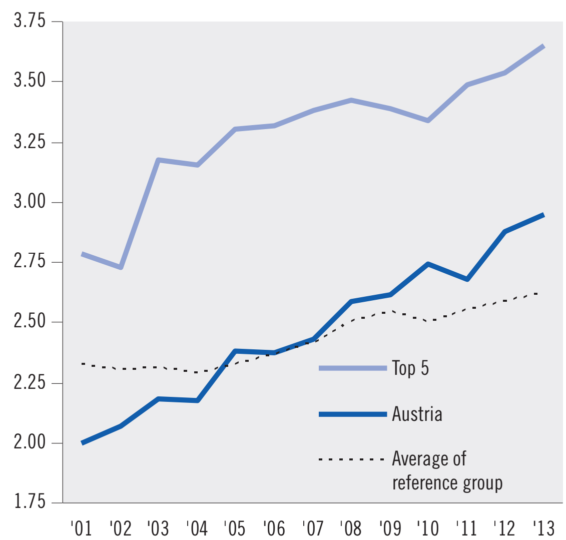
aside from R&D activities also includes the areas of education, science and society as well as the market results of R&D efforts.

If Austria's gap to the top-5 countries from the comparison group is considered, we see that it has not become smaller in relation to R&D intensity, either. This was 0.79 percentage points in 2001 and was 0.84 percentage points in 2013. The leading countries have thereby increased their R&D expenditures at a similar rate to Austria. However, it must be noted here that the group of the top-5 countries is not constant over time – on the contrary, particularly dynamic countries (such as South Korea) became new members and less dynamic countries (such as the USA) left the group.

Austria in the EU report "Research and Innovation Performance – Innovation Union Progress at Country Level 2014"

In the autumn of 2014, the European Commission published the third edition of its report on the status of research and innovation in the member states, as well as in certain other countries (Iceland, Israel, Norway, Switzerland and Turkey). The report is aimed on the one hand at

Fig. 1-6: Austria's overall economic R&D intensity and that of the reference countries 2001–2013



Source: OECD: MSTI, edition 2/2014. Values for Austria based on the global estimate of Spring 2015. Calculations: ZEW.

supporting the member states in identifying and confronting crucial challenges in the areas of research and innovation. On the other, it is supposed to document the progress made in achieving the targets of the Innovation Union. Numerous indicators are considered for this and these are consolidated into five key indicators of a country's research and innovation performance:

(1) its overall economic R&D intensity
(2) a composite indicator of excellence in science and technology (which includes the aspects of patent intensity, receipt of ERC funding, presence of leading universities as well as the proportion of frequently cited scientific publications)
(3) a composite indicator of innovation output (which includes the aspects of patent intensity, employment share of knowledge-intensive activities, employment in fast-growing firms in innovative industries, the proportion of high and medium-tech goods or of knowledge-intensive services in the overall export of goods or services)
(4) a composite indicator of structural change towards a knowledge economy (which includes the aspects of R&D intensity, the share of added value in the research & development sector, proportion of employees in the areas of science and technology, employment proportion as well as proportion of added value of knowledge-intensive activities, specialisation in patent applications in certain areas of technology, specialisation in the export of goods on high and medium-tech goods, portfolio of foreign direct investments and direct investments abroad)
(5) contribution of high and medium-tech goods to the balance of foreign trade in goods.

Most of these indicators are also included in the IUS. It is noticeable that both of the individual indicators (key indicators 1 and 5) are also used in composite indicators and that two of the individual indicators feature in several composite indicators (patent intensity, employment proportion of knowledge-intensive activities).

The study also reports on further indicators which relate, on the one hand, to the Europe 2020 targets for growth, employment and societal challenges (rate of employment, harmful emissions, proportion of renewable energies in energy consumption, proportion of the population in danger of poverty or of social exclusion) and which illustrate aspects such as productivity and student performance (PISA results) on the other. One special feature of the report is the analysis of patterns of specialisation in the area of science and technology. Specialisation indices are calculated for 16 areas of science and technology based on scientific publications and patent applications.

In terms of the five key indicators, Austria is ranked between place five (R&D intensity) and place 15 (composite indicator of structural change towards a knowledge economy) within the EU-28. Austria ranks ninth in each case for three of the indicators. Austria's score is only above the EU average for two of the indicators: R&D intensity and S&T excellence. The gap to the top-5 countries from the EU-28 is considerable for two of the indicators, i.e. structural change towards a knowledge economy and contribution to foreign trade of high and medium-tech goods at 34% and 37% respectively, while Austria is already in the top 5 for R&D intensity. Between 2007 and 2012 Austria was able to make improvements in all four key indicators for which a time comparison over the longer term is possible, with growth higher than the EU average in each case. However, the meaningfulness of three of the five key indicators can be considered limited as a result of methodological weaknesses. The indicator "Contribution to foreign trade of high and medium-tech goods" may assume a lower value with these goods despite a country's high level of competitiveness, if the country also features a high level of competitiveness in the area of low-technology goods. Countries with a trade deficit in high and medium-tech goods may also have better scores at times than countries with a surplus. As a result, this indicator was re-

Table 1-5: Austria's position on the five key indicators for research and innovation in the European Commission's report "Research and Innovation Performance 2014"

	R&D intensity	S&T excellence	Innovation output	Structural shift knowledge economy	Contribution to foreign trade of HMT goods
Value for Austria (2012)	2.84	51.9	100.1	45.3	3.5
Value for the EU-28 (2012)	2.07	47.8	101.6	51.2	4.2
Austria's ranking in EU-28	5	9	9	15	9
Growth in Austria 2007–2012 (%)	2.5	3.6	n.a.	1.7	10.0
Growth in the EU–28 2007–2012 (%)	2.4	2.9	n.a.	1.0	4.8
Difference between Austria and the Top 5 (%)	0	22	16	34	37

S&T: Science and technology; HMT: High and medium-technology; n.a.: not available.

Source: European Commission (2014). Processing and calculations: ZEW.

placed with a more meaningful foreign trade indicator in the current IUS. As this indicator is part of the composite indicator of innovation output and – in a slightly amended form – of the composite indicator of structural change towards the knowledge economy, it also influences the results of both of these indicators. The innovation output indicator also uses an indicator of the proportion of knowledge-intensive services in the overall export of services, which views some service activities such as water transport as knowledge intensive, which is difficult to understand. The composite indicator of structural change towards the knowledge economy includes two indicators with the proportion of employees in the "research and development" sector along with the GDP proportion of foreign direct investments and of direct investments abroad, the interpretation of which as "the higher the better" is dubious at least.

The report speaks positively of the above-average dynamic development in the Austrian research and innovation system over the past decade. An analysis of 14 individual indicators on efficiency in science and industry[13] highlights the balance of the system and shows that Austria only has a score below the average for the EU-28 for two of the 14 indicators. Compared with a reference group set out by the European Commission (Belgium, France and the UK), Austria does better in nine of the 14 indicators. This good result contrasts with the rather poor result for three of the five key indicators and illustrates the difficulty in evaluating the efficiency of research and innovation systems using individual indicators.

Summary

Austria's innovation performance has increased considerably since the early 2000s. This is also evident from the results of international innovation rankings. In the IUS of the European Commission, Austria was able to increase its index score from below 0.5 between 2002–2004 to 0.6 in 2013. The index score also increased sharply from 0.41 to 0.54 in the Innovation Indicator of the Deutsche Telekom Stiftung (DTS). Since the countries which lead the rankings only showed a small increase in index scores, Austria was able to narrow the gap to the group of innovation leaders in relation to index scores. The catching-up process over the past decade therefore has meant that Austria is now closer

13 Number of university graduates in the area of STEM, number of doctoral graduates, number of researchers in the business enterprise sector, employment in knowledge intensive industries, number of frequently-cited scientific publications, volume of funds from EU-RP, number of foreign PhD students, number of patent applications, proportion of business enterprise R&D financed from abroad, number of public-private co-publications, proportion of R&D expenditures financed by the business enterprise sector in the area of universities and government, share of SMEs with product or process innovations, share of SMEs with marketing or organisational innovations, R&D intensity of the business enterprise sector. All absolute figures have been normalised to reflect the size of the country (using population or GDP).

to the average value for the highly developed industrialised countries. Nevertheless the gap remains a considerable one. Greater efforts will therefore be required in order to reach the federal government's target of catching up with the leading innovation nations.

Despite the noticeable increase in the index scores, Austria was unable to improve on its position in the innovation rankings, and even lost ground in some cases. Within the comparison group of 23 highly developed industrialised countries, Austria is currently in the bottom half of the rankings (ranked at 13, 14 or 17 depending on the individual ranking). This is because most other countries have also intensified their innovation efforts, and some of these have been able to improve their position in relation to Austria as a result. This process indicates that there has been a competitive push to increase innovation among highly developed industrialised nations (and a few larger, fast-growing emerging economies). But it is also simply the expression of a long-term economic shift in which the importance of knowledge-based activities (and thus innovation) is eclipsing that of traditional activities.

In any case it makes sense for Austria to continue along the path toward greater knowledge and innovation. This offers the greatest relative benefits in the international marketplace. The result does not necessarily have to be an improved position in innovation rankings. It is more important for the structural shift toward research and knowledge-intensive sectors and the increase in R&D intensity across all industries and for all stakeholders to take advantage of their innovative potential. Determining whether Austria is on the right path means looking at comprehensive indicators which go beyond the position in rankings. Innovation rankings can provide points of reference for RTI policy, but are never enough in terms of justifying it. There are many important areas that are inadequately reflected in innovation rankings or are not even reflected at all, such as the multi-faceted interaction between science and industry, the degree of innovation in (so-called) low-technology industries and non-knowledge intensive services, the application of new (key) technologies to boost productivity in a wide array of sectors, and the effectiveness of the use of resources provided by the state for research, technology and innovation. More extensive analyses of developments and evaluations of policy measures are needed in order to assess these aspects. This Austrian Research and Technology Report by the federal government is one of the factors which makes an important contribution here.

1.2.2 R&D globalisation and the crisis

Globalisation of research and development (R&D) has become highly important over the past few decades.[14] Both the home countries as well as the host countries generally benefit from the transfer of knowledge and technologies (spill-over). In Austria, R&D investment by foreign firms (inward R&D) has grown most of all, with a direct impact both on the expansion of innovative capacity in industry as well as an indirect impact through spill-over to domestic firms. Against this background, this chapter deals with the impact of the global financial crisis of 2008–2009 on the globalisation of research and development in the domestic business enterprise sector. As Austria is one of the most heavily globalised countries in the OECD[15], this question is particularly relevant for Austrian technology policy.

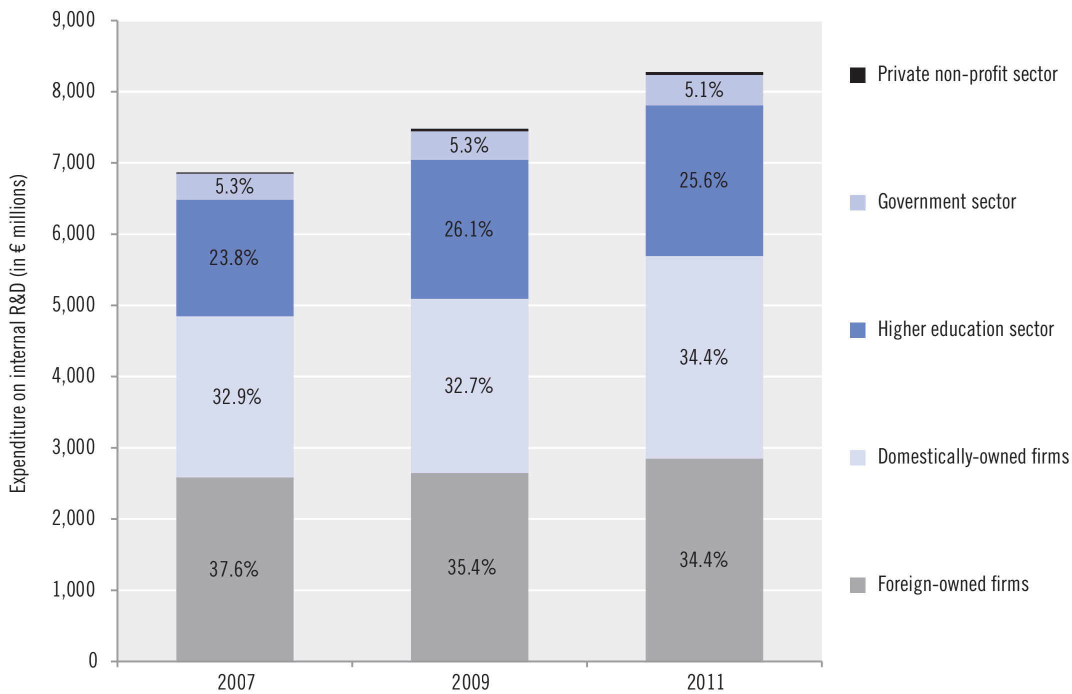
For Austria, there is data available from Statistics Austria until 2011 in relation to internal R&D expenditure by foreign-owned firms. An analysis of the expenditure by foreign-owned firms during 2007–2011 (Fig. 1-7) reveals that

14 See Hollenstein (2013).
15 See Dachs et al. (2014).

this has increased from €2,585 million to €2,849 million, i.e. by approx. 10%. However, this increase was considerably lower than the corresponding increase in internal R&D expenditure by firms controlled in Austria (+26%), or by the higher education sector (+29%). As a result, the proportion of foreign-owned firms fell slightly both in relation to overall R&D expenditure (from 37.6% in 2007 to 34.4% in 2011) as well as in relation to R&D expenditure by the business enterprise sector (from 53.3% in 2007 to 50% in 2011). The international contribution to funding for Austrian firms' R&D has also declined. As a result the essential driver for increasing R&D intensity since the mid-1990s has disappeared. In the absence of any reversal in this trend, over the next few years the dynamism for R&D expenditure in the business enterprise sector will presumably also continue to be below the levels of before 2007.

Total R&D expenditure by foreign-owned firms in the crisis year of 2009 remained largely stable as compared with 2007, and subsequently rose by around €200 million between 2009 and 2011. However, this general finding hides some significant changes at the level of individual sectors. For instance, this expenditure fell in the pharmaceutical industry from €261 million in 2007 to just over €150 million in 2011. Despite moderate increases in other sectors of material goods manufacturing, in total this meant that R&D expenditure by foreign-owned firms involved in the manufacturing of material goods (an important part of the overall business enterprise sector) in 2011 were still below the pre-crisis levels from 2007. This means the increase we observed in total R&D expenditure from foreign-owned firms is thereby entirely the result of growth in the services sector. However, it can be noted that this increase in R&D expenditure

Fig. 1-7: Intramural R&D expenditure by sectors of performance, 2007/09/11



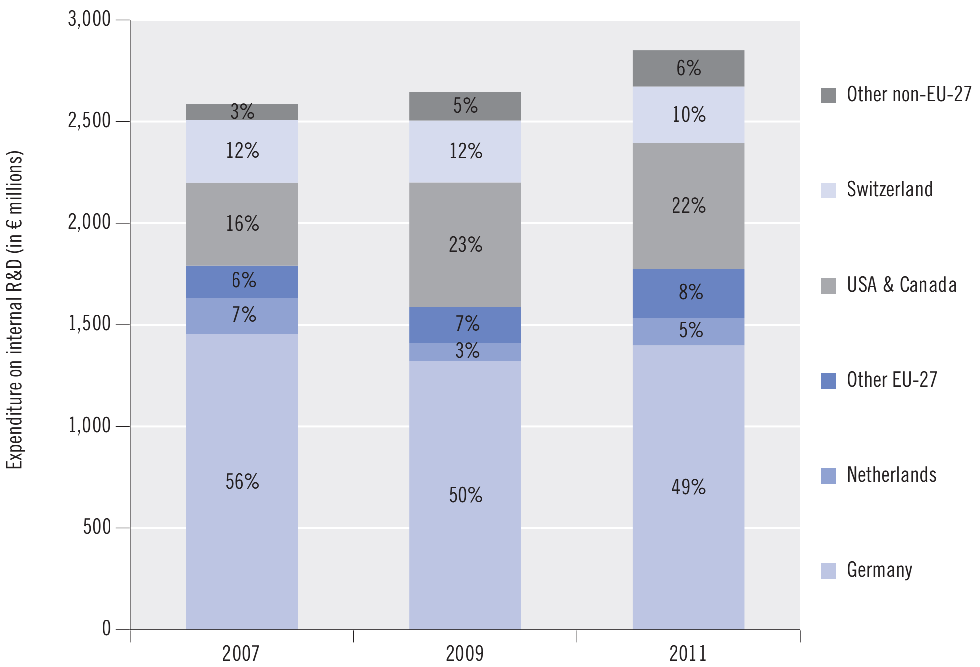
Note: The statistics of Austrian business units controlled from abroad includes those (active) economic entities that are more than 50% under foreign control (equity stake). The cut-off date for recording the majority shareholdings for the reporting year 2011 was 31 December 2011.

Source: Statistics Austria Inward-FATS. Calculations: AIT.

controlled from abroad in the service sector is almost entirely due to increases in the services segment of research and development. In the "Research and development in biotechnology" sub-sector in particular, the R&D expenditure by foreign firms tripled from €83 million to €282 million within just four years. It can therefore be assumed that at least a part of the above-mentioned drop in R&D controlled from abroad in the pharmaceutical industry is the result of reclassification and/or reorganisation from manufacturing to the services sector. The growing significance of the services sector that we observed is thus not only due to the establishment of new R&D-intensive firms, but also to the increase in significance of research service providers as compared with the manufacturing of material goods within related technologies.

The trends described at a sectoral level, in particular the increased importance of the services sector, were relatively stable during 2007–2011. In contrast clearly different trends can be identified at the level of the home countries between the periods 2007–2009 on the one hand and 2009–2011 on the other (Fig. 1-8). In 2009, R&D expenditure by firms from EU countries in Austria fell by around 11%, or €200 million. In contrast to this the expenditure by firms from non-EU countries in Austria rose in the same period by around the same level, resulting in the largely constant R&D expenditure in 2009 as compared with 2007. The R&D expenditure by firms from EU countries rose again in the subsequent period until 2011 to approximately the level it was at in 2007, while the proportion attributable to non-EU countries remained stable at the 2009 level. Fig. 1-8 also clearly shows that the crisis has not led to any increase in the commitment by Asian firms to R&D in Austria, whose home countries were far less affected by the crisis than Europe. Nor does the data allow

Fig. 1-8: R&D expenditures of foreign-owned firms by home country, 2007/09/11



The statistics of Austrian business units controlled from abroad includes those (active) economic entities that are more than 50% under foreign control (equity stake). The cut-off date for recording the majority shareholdings for the reporting year 2011 was 31 December 2011.

Source: Statistics Austria Inward-FATS. Calculations: AIT.

us to infer that US firms withdrew R&D activities from Austria in any large amount as a result of the crisis.

The significance of firms from other EU countries fell overall over the course of the global crisis 2008/2009, particularly in relation to Germany, in favour of activities from firms from non-EU countries. Despite these changes, German firms continue to be of prime importance in the Austrian R&D landscape. In 2011 they were responsible for 49% of R&D expenditure by firms controlled from abroad, or 17% of total Austrian R&D expenditure. By contrast, firms from all the non-EU countries together only accounted for 38% of R&D expenditures of foreign-owned firms, or 13% of the total R&D expenditure in Austria, despite their increased significance in 2011.

The relatively low decline in significance of R&D activities of foreign-owned firms that was seen in Austria relative to overall R&D in the business enterprise sector can also be observed in a similar form in two-thirds of OECD countries during 2007–2009. Half of the OECD countries even show an absolute decline in R&D activities by foreign-owned firms in this period. One reason for this decline is the stronger international focus of foreign-owned firms. Foreign enterprises have a greater focus on exports[16], and exports as well as foreign direct investments were more heavily affected by the crisis than activities within Austria. The projected lower market growth is subsequently a decisive factor in lower R&D expenditure[17] and may lead to a greater reduction (or slower growth) of R&D expenditure by foreign-owned firms as compared with their Austrian competitors. Furthermore, multinational firms may reduce their R&D expenditure abroad more than in their offices at home, in order to reduce coordination efforts in a phase where their R&D expenditure as a whole is sinking. A reduction in R&D expenditure in the home country is also frequently more difficult to explain politically.

1.3 Global trends in R&D expenditure

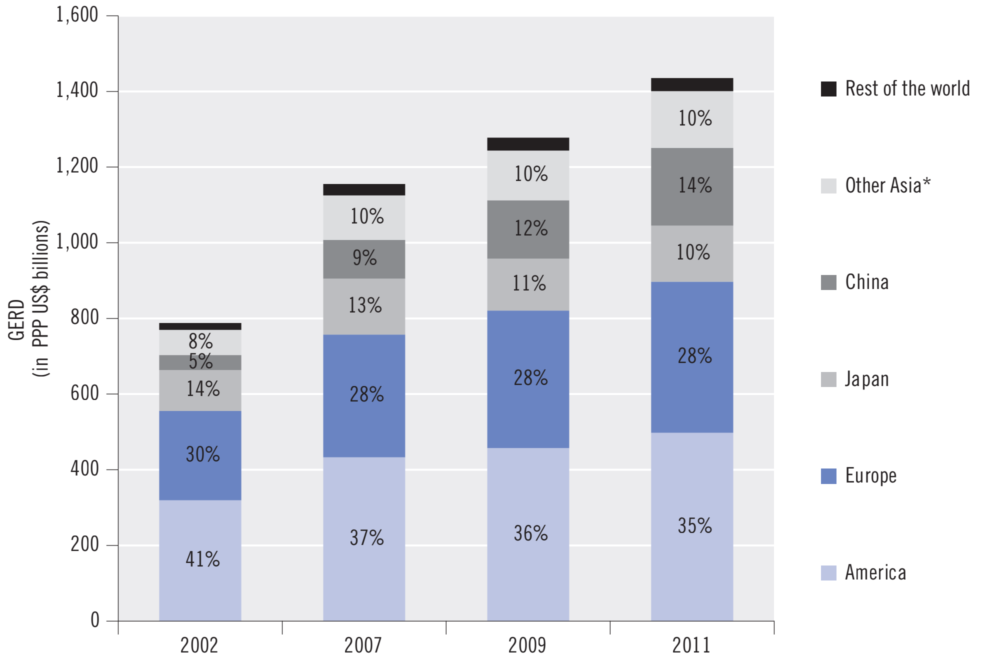
The following chapter begins by examining more closely how the global distribution of R&D expenditure changed in the world's major regions between 2002 and 2011. In the ten years from 2002 to 2011,[18] global R&D expenditure rose approximately 82%, from US$ 788 billion (PPP) [19] to US$ 1,435 billion (PPP).

Looking first of all at the data for 2011 (see Fig. 1-9), i.e. the most recent year for which we have complete global data, global R&D expenditure is almost split into three equal parts between North America (32.2%), Europe (27.8%) and Asia (35.1%). South America, Africa and Oceania play a comparatively minor role, with an overall share of only 4.9%. Since 2002, we can clearly see growth in absolute terms in all global regions. However, the scale of this growth was extremely varied, leading to a shift in the shares of global R&D expenditure for the countries and regions under consideration, primarily away from North America and Europe towards Asia.

With five-fold growth in R&D expenditure, China has by far the highest relative growth of the larger economies. Other developing markets in Asia such as India and Korea also have above-average growth, while another Asian country, Japan, has the lowest relative increase (+37%) for the period under observation. In addition to increased importance for Asia, there was also a clear shift within Asia itself. In contrast, at +60% the relative increase in R&D expenditure in the European Union was below the global value, even though it was clearly above the comparison value for Japan, as well as that for North America (+55%).

16 See Bellak (2004).
17 See Cohen (1995).
18 Complete data on global R&D expenditure by country and region is only available for 2002, 2007, 2009 and 2011.
19 PPP US$: Purchasing power parity in US dollars at current prices.

Fig. 1-9: Global R&D expenditures (GERD), 2002/07/09/11



* Hong Kong, Indonesia, Malaysia, Philippines, South Korea and Singapore.

Source: UNESCO. Calculations: AIT.

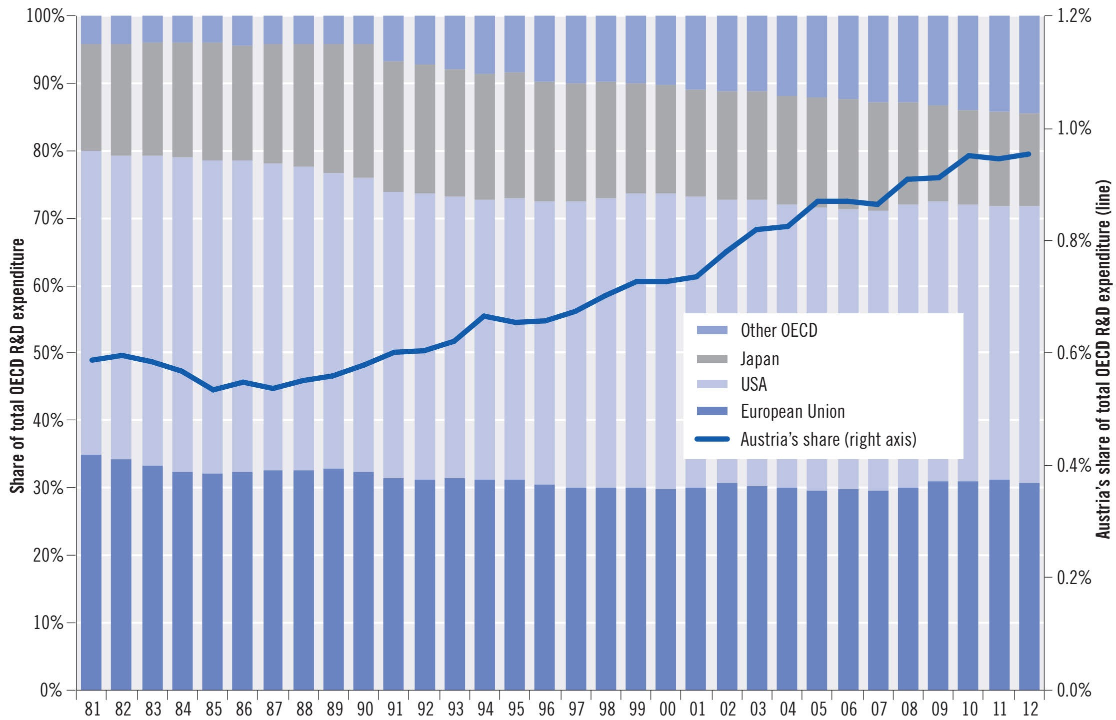
The high relative growth in China is also partly caused by the comparatively low starting level. Looking at absolute growth, the value in North America of US$ 164 billion (PPP) is almost as high as China's US$ 166 billion (PPP). The European Union is in third place with US$ 123 billion (PPP). With a total of US$ 163 billion (PPP) in growth, Europe (incl. European countries which are not EU members) is in the same range as China and North America in absolute terms.

As a result of the high level of growth in Chinese R&D expenditure, China's share of global R&D expenditure rose from 5% in 2002 to 14.3% in 2011. This increased importance of China and other Asian economies (not incl. Japan) initially led to a drop in the shares of global R&D expenditure between 2002 and 2011 in North America (of 5.6 percentage points), the EU (3.2 percentage points) and Japan (3.4 percentage points). Despite the notable rise of the significance of China in the figures, R&D expenditure in the EU-28 countries in 2011 was still about 60% above China's level measured in US$ (PPP).

1.3.1 Long-term development of the OECD

If a distinction is made between OECD and non-OECD member states when analysing global R&D expenditure, then the OECD countries had a 74% share of global R&D expenditure in 2011. This represents a decline in relation to 2002, when OECD countries had an 85% total share, and is due to the increased importance of China and other economies outside the OECD experiencing high growth. Analysis of developments in R&D expenditure before 2002 and until 2012 are only possible for the OECD member states due to data availability and improved comparability of the survey methodology (see Fig. 1-10).

Fig. 1-10: Share of Austria, the EU, the US, Japan and the other OECD in total R&D expenditures of the OECD countries (in US$ PPP), 1981–2012



Source: OECD. Calculations: AIT.

The EU's share of R&D expenditure in the OECD has remained very stable over the entire observation period at between 30% and 35%. While a slight downward trend is discernible in the 1990s, the share rises again slightly from the year 2000 onwards. With 30.8% in 2012, this share is, in the last year of observation, only marginally below the same level as in 1982 (31.4%).

With a 41.0% share in 2012, the US was the country with by far the largest share of overall R&D expenditure in the OECD and of overall global R&D expenditure. This share was somewhat higher in the 1980s at approx. 45% and then declined slightly in the 1990s in the same way as in the EU. However, in contrast, the US managed to increase its share again around 2000, although only on a short-term basis, and is now back at the same share as in the early 1990s. Over the entire 30-year period, therefore, the US's share within this relatively narrow range was between 41% and 46% of the OECD R&D expenditure.

Bigger changes in significance were recorded for Japan. Japan's share of overall R&D expenditure in the OECD initially rose continuously from 16.0% to 19.7% between 1981 and 1990. This was followed by a period of equally continuous decline to just 13.7% most recently.

The importance of the other OECD countries has increased significantly over the last 30 years. This group includes the large traditional industrialised nations such as Canada and Australia on the one hand, as well as emerging economies such as Korea and Chile on the other. In some cases these countries had only just joined the OECD observation period and were only considered in the data from this relevant date. A slight overestimation in the growth for the other OECD countries can therefore be assumed.

The simultaneous increase in Austria's share is worth noting against the background of the slight decrease in the EU's share in R&D expenditure of the OECD countries. While Austria only accounted for approx. 0.6% of R&D expenditure in the OECD in the 1980s, this share has risen continuously since the 1990s to around 0.95% most recently. Between 2002 and 2011, Austria's share of global R&D expenditure (incl. non-OECD countries) rose from 0.66% to 0.69%. In absolute figures, Austrian R&D expenditure grew from US$ 5 billion (PPP) in 2002 to more than US$ ten billion (PPP) in 2012. As such, R&D expenditure in Austria grew well above the averages for the OECD or the EU and was therefore able to keep up with the high global growth rates.

1.3.2 R&D expenditure in the European Union

In the period during 1999 to 2013,[20] the R&D expenditure of the entire EU-28 increased from €158 billion to €273 billion, a rate of 73% or total increase of €115 billion (see Table 1-6). While all member states significantly increased their R&D expenditure, there were some heavy shifts within the EU-28 in country shares for overall R&D expenditure. With a growth of 141%, Austria was one of the countries with a significantly above-average relative growth in R&D expenditure. As a result, Austria's share of total R&D expenditure for the EU-28 rose from 2.4% in 1999 to 3.2% in 2013, a 0.9% percentage point increase. Only one EU-28 country – Spain – reported higher growth with regard to its share of the entire EU-28 R&D expenditure.

Alongside Austria and Spain, a series of further, smaller and medium-sized EU countries, including the *innovation leader* Denmark (+0.6 percentage point share of the EU-28's R&D expenditure), but also Belgium (+0.4 percentage points), Ireland (+0.3 percentage points) and the Czech Republic (+0.7 percentage points) significantly increased their share of EU-28 R&D expenditures. Finland (also an *innovation leader*)

Table 1-6: R&D expenditures, rise and share of total R&D expenditure in the EU (in € billion), 1999/2013

	1999 (€ billions)	2013 (€ billions)	Rise 1999–2013 (in %)	Share 1999 (in %)	Share 2013 (in %)	+/- % points
European Union (28 countries)	n.a.	273.5	73	100	100	0
European Union (15 countries)	154.8	261.9	69	98.1	95.8	-2.3
Belgium	4.6	9	95	2.9	3.3	+0.4
Czech Republic	0.6	3	367	0.4	1.1	+0.7
Denmark	3.6	7.7	118	2.3	2.8	+0.6
Germany	48.2	82.5	71	30.5	30.2	-0.4
Ireland	1.1	2.7	155	0.7	1	+0.3
Spain	5	13.1	161	3.2	4.8	+1.6
France	29.5	47.2	60	18.7	17.2	-1.5
Italy	11.5	20.2	75	7.3	7.4	+0.1
Netherlands	7.6	12.7	67	4.8	4.7	-0.2
Austria	3.8	9.1	141	2.4	3.3	+0.9
Poland	1.1	3.4	216	0.7	1.3	+0.6
Finland	3.9	6.7	72	2.5	2.4	0
Sweden	8.7	14	61	5.5	5.1	-0.4
United Kingdom	25.7	32.8	28	16.3	12	-4.3
Other EU (14 countries)	2.9	9.4	225	1.8	3.4	+1.6

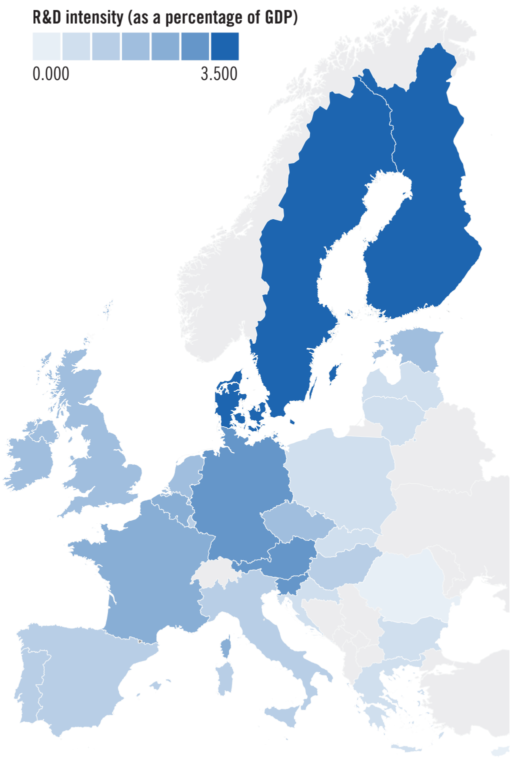
Rounding differences not compensated for.

Source: Eurostat. Calculations: AIT.

20 Data for total R&D expenditures of the EU-28 is only available for the period during 1999–2013.

Fig. 1-11: Rise in R&D expenditures (in €), 2008–2013

Fig. 1-12: R&D intensity (as a percentage of GDP), 2013



Source: Eurostat. Calculations: AIT.

was, on the other hand, only able to raise its share of EU-28 R&D expenditure until 2009 and subsequently fell back to its initial level of 1999 by 2013. Although there was a small shift from the larger to the smaller EU states, in 2013 some 59% of EU-28 R&D expenditure was still concentrated in the three largest economies, Germany, France and the UK. 96.6% of the total R&D expenditure for the EU-28 states was concentrated on 14 countries, compared to a higher value in 1999 of 98.2%.

Looking at the current development since the start of the financial crisis in 2008 (see Fig. 1-11), the EU countries are showing extremely different trends with some substantial declines in R&D expenditure, as well. Austria had a marginally above-average relative growth of 20% in R&D expenditure during this period compared to the entire EU-28 (14%). Austria's growth rate is only surpassed markedly by a few Central and Eastern European countries, although Austria has a considerably higher R&D intensity (see Fig. 1-12). Compared to the *innovation leaders* Germany, Denmark, Finland and Sweden, Austria trails only Germany (+24%), with the second-highest growth rate over the past five years.

So not only was Austria able to increase its share of EU-28 R&D expenditure over the long term but, compared to several other countries, Austria also increased its expenditure in the past few years and consequently its share of EU-28 R&D expenditure. Based on the current global estimate for 2015, the Austrian R&D intensity for 2013 (the most recent year for which the international comparative figures are available) was, at 2.95% of the GDP, significantly higher than the EU average of 2.01% and thus ahead of Germany (2.85%), although still trailing Finland (3.31%), Sweden (3.30%) and Denmark (3.06%).

1.3.3 Summary

While from a global perspective it is the fast-growing Asian economies, and in particular China, that have been able to increase their shares in overall global R&D expenditure at the expense of the US, Japan and the EU-28, Austria was one of the few EU countries that was able to keep its share at a stable level. The stability of Austria's share meant a considerable absolute increase in expenditure, since this occurred in an environment where global R&D expenditure increased hugely. Austria's share in R&D expenditure of the EU and of the OECD increased significantly as a result. This long-term positive growth of Austrian R&D expenditure in international comparison has also continued in the most recent years.

Europe and North America were still responsible for 60% of global R&D expenditure in 2011, despite the shifts in the global breakdown of R&D expenditure towards Asia. A decline in the share of the four largest economies was evident within the EU, but over 60% of EU-28 R&D expenditure was attributable to Germany, France and the UK in 2013.

1.4 Austrian RTI strategy and its implementation

The following chapter offers a systematic overview of the strategic focus and the perspectives of Austrian RTI policy. The framework in this regard is set by the RTI strategy of the federal government, whose implementation status will be discussed, in particular, in Chapter 1.4.1, followed by a short presentation of Austria's national reform programme (NRP), which is based on initiatives that are part of the RTI strategy (Chapter 1.4.2).

Current developments of selected RTI-relevant measures of functional departments that support the implementation of the RTI strategy are presented in Chapter 1.4.3, alongside a summary of further strategic initiatives of the ministry in Chapter 1.4.4. This overview and discussion is complemented by chapter 1.4.5, which outlines key findings from the report of the Council for Reserach and Technology Development, which is tasked with documenting the implementation of the RTI strategy.[21]

1.4.1 2014 Task force report

The RTI strategy adopted in 2011,[22] which is also central to the working agenda of the Austrian federal government for the 25th legislative period, continues to form the main point of reference for formulating domestic RTI policy. The objective is to move the country up into the group of European innovation leaders by 2020. Detailed plans in this mid- to long-term framework for orientation include the following activities:

- Ensuring public funding of research for outstanding basic research, applied research, technology development and knowledge transfer through research funding regulations that allow for long-term planning security,
- Introducing measures to trigger more private research investments,
- Mobilising private endowment funds to spread the extra-budgetary basis for RTI,
- Developing measures for expanding support for young talent and women,
- Promoting research to solve social challenges while taking into consideration the potential of the humanities, social sciences and cultural studies,
- Establishing measures to increase the number of innovating enterprises,
- Realising efficiency improvements, needs-oriented development of research infrastructures as well as implementing knowledge transfer centres,

21 As the Research and Technology Report was being prepared only draft versions of this year's report by the Council and the reform programme (2015) were available.
22 See The RTI strategy of the Austrian federal government (2011).

- Improving the international scientific network and scientific field offices,
- Modernising the research funding laws and reducing bureaucracy, in order to facilitate access to funding for small and medium-sized enterprises (SMEs) to obtain funds,
- Encouraging start-ups, e.g. through venture capital measures,
- Developing a national strategy for intellectual property.

Implementation of the RTI strategy takes place at several levels and is aimed at a broad, systematic approach to supporting and structuring the innovation system.[23] The interconnection of relevant policy fields (transportation, energy, environment, etc.) should make it possible to tap into the best-possible potential of research, technology and innovation in industry and society. The need for a more comprehensive and coordinated policy approach to better and more efficientely tackle future challenges is considered to be high, particularly in light of developments at the European level (the "grand challenges" of the research funding programme Horizon 2020).

The RTI Task Force functions as an important coordinating tool for implementing the strategy, and it supports the strategic and systems-oriented coordination efforts between RTI ministries. Led by the Federal Chancellery, it includes representatives of the Federal Ministry of Finance (BMF), the Federal Ministry for Transport, Innovation and Technology (BMVIT), the Federal Ministry of Science, Research and Economy (BMWFW), and the Federal Ministry of Education and Research (BMBF). Following intensive and regular communication and information sharing at a high administrative level, it has been possible to further strengthen cooperation between RTI ministries in recent years. In 2014, the following topics and materials were addressed and discussed:

- Basic considerations regarding research funding laws,
- Mobilisation of alternative funding sources (incl. private non-profit foundations such as the national foundation), in order to increase the share of private research funding,
- Evaluation of indirect research funding,
- Effective use of resources from the European Fund for Regional Development (EFRE),
- Role of Austrian representatives for international science,
- Updating the statistics law with the aim of improving the availability of micro data for R&D.

Specific action areas for RTI strategy are discussed in working groups (WG). The mandate of the WGs used by the RTI Task Force was cross-checked against the federal government's working agenda and adjusted appropriately at the start of 2014. In addition, it was clarified in the WGs whether and which projects could be pursued despite budgetary restraints. In the following chapter, we will provide a short overview of the ongoing work and progress of the individual WGs this year.

- The **WG 1** on "Human Potential" is working on issues related to STEM (science, technology, engineering, mathematics). Beginning with preschool and school aged children and stretching to university education, measures are designed to increase interest and further training of girls/women and boys/men for employment, in order, for instance, to counteract a shortage of skilled workers. The WG sees a major value add in the concept of "learning from each other" about shaping political activities. There were detailed presentations on projects such as "aws First," "Jugend Innovativ," "IMST (Innovations Make Top Schools)," "Laura Bassi Centres of Expertise," "Research Expertise for Industry" and "Sparkling Science".

23 For a description of such a broad, systemic approach, see: Polt et al. (2014).

- A main focus of the **WG 2** group on "Climate Change and Diminishing Resources" was to define interdisciplinary intersections for the projects of the different federal ministries and the instruments for cooperation. In 2014, a stakeholder workshop on the topic of "Power-to-Gas" was held.
- In **WG 3** on "Quality of Life and Demographic Change," the pilot initiative "Mobility and Quality of Life in the Context of Demographic Change" was completed with extensive involvement by stakeholders; the initiative served as a basis for developing a common RTI roadmap. In addition, a catalogue of measures for improving access to funding data in the area of "Quality of Life and Demographic Change" is being prepared.
- **WG 4** on "Research Infrastructure" developed an action plan on the issue of research infrastructures, which examines the international role of Austria in major research infrastructures. The WG is also studying the type and necessity of funding instruments for research infrastructures and the potentials for cooperation.
- The **WG 5** on "Knowledge Transfer and Start-ups" supported the cross-ministry Intellectual Property Agreement Guide (IPAG) with the aim of facilitating and/or accelerating the transfer of technology to the economy through modular sample contracts. It also managed the implementation of the new programme "Knowledge Transfer Centres and IPR Exploitation", brought in relevant European expertise and took further steps to maintain a sound, consistent definition of RTI-related start-ups and corresponding data.
- Based on the consultations in **WG 6** on "Corporate Research," last year questions on the function of future university funding for research and development in the business enterprise sector were discussed – in conjunction with service agreements with universities.
- **WG 7a** on "Internationalisation and RTI-related Foreign Policy," as well as **WG 7b** "Action Plan Austria and the European Science Area 2020," are working on the implementation of the detailed strategy documents they presented in 2013.[24] By sharing information in a structured manner between all the relevant RTI institutions, as well as through strengthened cooperation and coordination of internationalisation measures for the ministries and the RTI stakeholders, internationalisation of the Austrian RTI system is being actively pursued. The RTI Task Force is being updated continuously[25] regarding the implementation of the EU action plan.
- **WG 8** on "International Rankings" meets on an occasional basis to analyse and discuss the international RTI rankings and critique the methodology behind them.

Looking beyond the WGs, 2014 was marked by a structured sharing of information between ministries and stakeholders. With the aim of dealing with and addressing various topics more deeply, several experts were included in the RTI Task Force meetings. The RTI Task Force was also advised by the Austrian Council for Research and Technology Development.

1.4.2 National Reform Programme

As part of the European growth strategy Europe 2020, Austria defined five national goals starting in 2011. Alongside the RTI-relevant objectives to achieve an R&D intensity of 3.76% and a university graduation rate of 38%, these are additional goals in the areas of employment, poverty and the environment. Each year Austria proposes a national reform programme (NRP) to

24 See WG 7a of the RTI Task Force (2013).
25 See https://www.bka.gv.at/site/7463/default.aspx

define measures that can be used to achieve these objectives. In doing so, own measures are not developed, rather the initiatives pointed to are essentially part of the RTI strategy (see Chapter 1.4.1). The NRP 2015 includes an excursus on the measures for the desired completion of the European Research Area (ERA), in which six ERA priorities are listed in brief.

- Effective national research systems (comparative study with leading countries, e.g. Denmark, Sweden – in order to derive lessons for Austrian RTI policy),
- Research infrastructures and grand challenges (focus is currently on the "alignment" of national strategies, programmes and other RTI funding measures: this also includes, alongside strategic transnational cooperation, efforts to improve the compatibility of national research funding systems in the EU),
- An open labour market for researchers (transparent job offers via EURAXESS, structured doctoral programmes, integration of the European Charter and Code for Researchers in the performance agreements),
- Taking into consideration the issue of equal opportunities in research (2015 amendment to the Company's Act, anchoring of equality objectives in performance agreements),
- Optimal exchange, from access and transfer of scientific findings (establish knowledge transfer centres, founding of the Open Access Network Austria).
- International cooperation (implementation of internationalisation strategy "Beyond Europe"[26]).

1.4.3 Measures for implementing the RTI strategy

This chapter provides an overview of the latest developments in RTI-relevant measures of the RTI strategy, as well as the implementation of new projects and programmes in the past year.

Research infrastructures

The federal government has also committed itself in the RTI strategy to the issue of research infrastructures and has formulated measures. In order to ensure the competitiveness and innovative strength of the scientific location, incentives must be put in place for integration and cooperation by research infrastructures in procurement, in operations and as a basis for joint research.

As a basis for strategic research infrastructure planning by universities and non-university research facilities, a database has been available for the past five years at the Federal Ministry of Science, Research and Economy (BMWFW), in which research infrastructures with a value of at least €100,000 are recorded. This allows, on one hand, monitoring of steps taken as part of the RTI strategy and the implementation of the Austrian and European Research Area. On the other hand, it supports the objective of integration and cooperation by setting up an information portal for the participating university and research institutions. Here, participating universities and research institutions,[27] can also view information on the individual research infrastructures, providing a basis for better coordination. In order to further develop the research infrastructures and scientific services offered, the database will be made public at some point in 2015.

A further important step in setting incentives for better use of research infrastructure is provided by establishing a funding instrument for application-oriented research infrastructure investments in the new (effective as of 1 January 2015) research funding guidelines of the federal

26 See WG 7a of the RTI Task Force (2013).

27 Currently, these are: the Austrian universities and universities of applied sciences, the Austrian Academy of Sciences, the Institute of Science and Technology Austria, the Campus Science Support Facilities GmbH, the Ludwig Boltzmann Gesellschaft, the Central Institute of Meteorology and Geomagnetism and the Geological Survey of Austria (GBA).

government (RTI guidelines and Austrian Research Promotion Agency (FFG) guidelines). This instrument is being used for the first time based on the corresponding expansion of the government-aid provisions of the EU. Because this is a new type of instrument, experience is lacking with regard to specific implementation steps and monitoring requirements. For this reason, the implementation of this funding should be tested in an initial step based on a few pilot projects.

Knowledge transfer centres

The new East, South and West university knowledge transfer centres, as well as the thematic Life Sciences knowledge transfer centre, were launched on 1 August 2014 as part of the "Knowledge Transfer Centres and IPR Exploitation" funding programme, with an investment of €11.25 million until 2018. The coordination points for the regional centres are at the University of Innsbruck (Transfer Centre West), the Medical University of Vienna (Transfer Centre East) and Graz University of Technology (Transfer Centre South). Overall, 20 Austrian universities are involved in the regional knowledge transfer centres, with 16 joint projects to improve and accelerate the commercial and social exploitation of scientific inventions. The projects are recommended by an international jury and should help to identify, pool and deliver more rapidly the knowledge of universities as quickly as possible to the best strategic exploitation channels (e.g. patents, spin-offs),

At the thematic Life Sciences knowledge transfer centre, 17 consortium partners are involved, coordinated by the University of Vienna, alongside nine universities, six non-university research institutions, and two technology transfer centres. The centre's aim is to develop a complete virtual Austrian infrastructure and expertise network for the field of medical and diagnostic development. It will serve as the main point of contact for questions about preclinical and clinical tests according to international benchmarks in line with industrial quality standards for research institutions and new enterprises in the Life Sciences field. A further development is being prepared in a transrelational research centre, which conducts its own independent development projects.

As part of funding for patent expenses of a total of €5 million by the end of 2018, approximately 150 requests from universities were submitted in the first year 2014, utilising over 80 % of the funds in the first year of the programme. As part of the prototype funding PRIZE 2014, an international jury of experts selected 13 of the most promising projects from 30 applications for proposed funding. Overall, the Federal Ministry of Science, Research and Economy (BMWFW) provided more than €1.44 million to develop patentable prototypes.

ERA Observatory Austria

Austria shapes the European RTI policy at two levels: on one hand, through research funding in the context of Horizon 2020, on the other hand, through structural reforms to develop the European Research Area (ERA) as a "domestic market for knowledge." Both the provision of an optimal participation in Horizon 2020, as well as support for necessary structural reforms of the European Research Area, require the strategic cooperation of a differnt range of services, which are provided by the federal government. The "ERA Observatory for Austria" is the umbrella organisation where the central Austrian RTI activities for the EU are coordinated. The observatory is intended to have a five-fold effect:

- The best possible information, communication and analyses for Horizon 2020 & ERA,
- Strategic and operational implementation of Horizon 2020 in Austria,
- Political and strategic advice for ERA,
- Effective monitoring of RTI structural change for regional / national / EU.
- Effective monitoring via participation in Horizon 2020 & ERA.

To implement these objectives, tailor-made instruments (e.g. "ERA Portal Austria" website, network of international contacts for Horizon 2020 and the advisory committee "ERA Council Forum Austria") were developed and given clear guidelines.

The "ERA Observatory Austria" was created in 2014 by the Federal Ministry of Science, Research and Economy (BMWFW). The quality of the merger of individual activities under a single roof will become apparent in the years ahead, in terms of how successful it is in creating reciprocal effects and mutual benefits between the five areas of the observatory, so that Austria can leverage the funding opportunities of Horizon 2020 is the best possible was, and procure the targeted returns of at least €1.5 billion by 2020.

Responsible science

Responsible science stands for a socially open science that evolves in a continuous process of exchange, reflection and interaction with society. The concept that has recently gained enormous importance at the European level as part of the research policy strategy development, was established as part of the Horizon 2020 programme under the title of "Responsible Research and Innovation" (RRI) as a cross-section material.

The operational implementation of the concept of responsible science occurs by consistently taking into consideration the following principles in the development and realisation of research plans:

- Participation of the public and stakeholders,
- Funding for gender equality,
- Engagement in the area of science education,
- Comprehensive compliance in case of ethical issues,
- Free access to data and results – open science policy,
- Integration in the governance processes.

In Austria, the "Action plan for a competitive research area" (see Chapter 1.4.4) also makes anchoring responsible science on Austrian scientific institutions a prioritised field of action. The corresponding institutional development processes will be encouraged in the years ahead through targeted integration and funding measures.

Public procurement promoting innovation (PPPI)

In implementing the PPPI action plan of the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Science, Research and Economy (BMWFW), in 2014 several PPPI events were conducted at which buyers and suppliers of innovative products could share information about trends and developments in technology. As part of one PPPI project competition, innovative buyers were presented who want to implement innovative products in public institutions, in particular. In addition, PPPI training, as for example at the federal government's management academy, was held and PPPI strategy plan monitoring, as well as its own website, were launched[28].

At the end of 2014, the research results from the pilot call for tenders for *pre-commercial procurement* (PCP) was published in the field of traffic infrastructure research. In addition, the Federal Ministry for Transport, Innovation and Technology (BMVIT) and Austrian Federal Railways (ÖBB) launched a further PCP tender with the aim of developing an electrically operated hybrid locomotive. Lower energy and maintenance costs are expected, as well as reduced noise and exhaust fumes. Approximately €1.1 million is available for the project. The Federal Ministry of Science, Research and Economy (BMWFW) together with the Burghauptmannschaft Österreich (BHÖ) initiated a pilot programme in the pre-commercial sphere in 2014. The request for tenders is aimed at projects to

28 See http://www.ioeb.at

develop innovative, energy-efficient solutions for heating and particularly cooling historical, primarily landmarked buildings.

Industry 4.0

Production needs to become more efficient and smarter to compete in a global market. There is widespread consensus regarding an impending fundamental structural change in commercial and industrial production. Concepts such as smart manufacturing, advanced manufacturing, factory of the future and Industry 4.0 are used in this global discourse. The Federal Ministry for Transport, Innovation and Technology (BMVIT) has already been promoting for a few years technological research and innovation aimed at smoothing the path to integrated production in the future. The successfully run thematic focus in the programmes "production for the future" and "ICT of the Future" will continue. As an accompanying measure, the first endowed professorship was awarded in 2014 in conjunction with the Austrian Marshall Plan Foundation. The aim of this programme is to spread and strengthen the scientific basis. This year, investments were also made to purchase research infrastructure so innovations in manufacturing can be transferred into applications. The opening of the first pilot factory for Industry 4.0 is planned for 2015 at the Vienna University of Technology.

The following programmes of the Federal Ministry of Science, Research and Economy (BMWFW) also focus on Industry 4.0, specifically the Services Initiative (funding innovative service projects), the programme for Research Expertise for Industry (creating/raising the necessary qualifications) and the Austria Wirtschaftsservice (aws) programme ProTrans, which is designed to optimise business strategies with regard to innovations in processes, products and services, and help tap into new markets. In addition, low-interest ERP loans are available for investment and conversion of production facilities, and a regional survey of demand as part of an information campaign about the national cluster platform is being conducted.

Smart Cities

On a worldwide basis, the annual migration from the countryside to the city is the equivalent, or would fill, eight cities the size of New York. The makes urbanisation one of the greatest challenges of our time. In order to meet this challenge, the Federal Ministry for Transport, Innovation and Technology (BMVIT) has launched the "City of the Future" as the successor to "Building of Tomorrow". As part of its initial tendering, the Federal Ministry for Transport, Innovation and Technology (BMVIT) awarded €10 million to 31 projects in 2014. In its second tendering, €3 million was awarded in 2015. This includes research and development of new technologies, technological (sub)systems and urban services for cities. In March 2015, the Federal Ministry for Transport, Innovation and Technology (BMVIT) organised a major conference on the topic of cities in Salzburg (3rd Smart Cities Week). It showed how Austria promotes the development of integrated technologies, in order to be prepared for the urban challenges and remain a global market leader in many areas. Austria is also playing an important role in the European Union, where the Federal Ministry for Transport, Innovation and Technology (BMVIT) has taken on a key function by launching ERA-NET Smart Cities and Communities and ERA-NET Smart Grids Plus.

1.4.4 Other strategic initiatives of the Austrian federal ministries

In addition to the federal level, various ministries have also designed and developed specific initiatives which are aimed at achieving the targets for the RTI strategy that have been established at different levels and in differing contexts of political effectiveness and (self) commitment. These initiatives all reflect the common effort to re-energise research and innovations in Austria. The following chapter provides short descriptions of these initiatives.

Action plan for a competitive research area

To implement the RTI strategy, the "Action plan for a competitive research area," presented at the end of February 2015 by the Federal Ministry of Science, Research and Economy (BMWFW),[29] places the focus on the role of scientific institutions in the national innovation system, as well as on the framework conditions considered important for collaboration between publicly funded research and research by business enterprises. The action plan is backed by a study,[30] that analyses the strengths and weaknesses, as well as the competitiveness of Austria as a research location, and identifies corresponding areas of action. The individual objectives and measures of the action plan include:

- **Improve career opportunities in science and research.** This includes optimising university personnel management, taking into consideration university labour law, improving the legal and organisational framework conditions for establishing clearer career opportunities for young scientists (e.g. quality assurance for tenure track positions, scientific career model), as well as improving personnel structure planning at universities, which also aims to balance gender inequality.
- **Expand cooperation between science and industry.** To achieve this goal, the introduction of extensive property rights and commercialisation strategies, as well as a professionalisation of exploitation management at universities is planned, for instance, through guidelines for developing their IPR strategies. The topic of "entrepreneurship" will be further developed and prioritised to make it a leading principle of university activity and academic enterprise formation (spin-offs). Specific funding programmes (e.g. the funding programme "Knowledge Transfer Centres and IPR Exploitation" that was set up in 2014) should create incentives for already existing support measures (e.g. COMET Centres, Christian Doppler labs and Ludwig Boltzmann Institutes). In addition, an improved research infrastructure is intended to further improve cooperation between science and industry.
- **Enhance the dialogue between science and society.** The plan is to achieve this by expanding existing scientific communication, as well as by establishing responsible science, e.g. as part of service level agreements with domestic science institutions. The dialogue between science and society will be reinforced structurally by taking responsible science into account in funding programmes, bundling existing initiatives, and honouring successful concepts and projects. Innovative approaches to participative research such as "citizen science", crowdsourcing, and open innovation should be implemented more.
- **Strengthen the commitment of civil society to science and industry.** By reforming the legal framework conditions, such as federal laws on foundations and funds, promoting patronage as a matter of course in civil society, and professionalising fundraising in science and research, e.g. through training workshops and definition of principles, the commitment of civil society will be strengthened.
- **Strategic development of humanities, social sciences and cultural studies.** A separate strategy will be developed as the framework for the sustainable development of humanities, social sciences and cultural studies in

29 See Aktionsplan für einen wettbewerbsfähigen Forschungsraum. Maßnahmen des Bundesministeriums für Wissenschaft, Forschung und Wirtschaft zur verstärkten Umsetzung der FTI-Strategie der Bundesregierung in ausgewählten Themenfeldern (2015); http://wissenschaft.bmwfw.gv.at/fileadmin/user_upload/wissenschaft/publikationen/forschung/Forschungsaktionsplan_web.pdf

30 See Stärkefelder im Innovationssystem: Wissenschaftliche Profilbildung und wirtschaftliche Synergien. Stärkefelder im Innovationssystem (2015); http://wissenschaft.bmwfw.gv.at/fileadmin/user_upload/wissenschaft/publikationen/forschung/AT_Forschungsraum_Endbericht.pdf

Austria. It will be accompanied by the establishment of a social sciences data archive, the expansion of the existing centre for digital humanities at the Austrian Academy of Sciences, and the creation of incentives to use the current European research infrastructures (SHARE, CESSDA, ESS, CLARIN, DARIAH). The integration and internationalisation of the humanities, social sciences and cultural studies will be implemented by strengthening participation in the European joint programming initiatives, the "Knowledge Transfer Centres" mentioned previously, as well as in pilot projects, e.g. in the area of tourism.

- **Strengthen the competitiveness of the Austrian research area.** This includes measures to strengthen international cooperation (ERA dialogues, calls for tenders for platforms for mission-oriented research topics in Horizon 2020, as well as EU performance monitoring by the Austrian Research Promotion Agency / FFG), in addition to increasing efficiency in the European Research Area, which should be supported incrementally through implementation of the EU action plan and on the basis of evidence through studies. An improvement in the "welcome culture" should, as is discussed in the following chapter on location strategy, be achieved and the topic must be more firmly established for the long term by taking into consideration different aspects such as the further development of the red-white-red card and better transparency with regard to researchers from non-EU countries.

Location strategy "Leading competence unit"

Leading competence units[31] are an important factor for growth, employment and innovative potential, and they have a major influence on a country's future competitiveness. Against this background and in light of the heightened international conditions for competition and growing competition between locations, approx. 40 directors of the board at leading Austrian firms, coordinated by the Federal Ministry of Science, Research and Economy (BMWFW) and with the support of scientific experts, developed a location strategy, which was presented in October 2014. The aim of this strategy is to further develop the business location Austria, in order to make it more attractive and fit for competition.[32] The recommendations have in common that they have already been addressed in this or a similar form in the federal government's RTI strategy, which can be considered an affirmation of the measures developed at the time. The Federal Ministry of Science, Research and Economy (BMWFW) will monitor the implementation of strategy at regular intervals.

Building on a comprehensive analysis of the current situation, concrete measures will be discussed and formulated in the different thematic fields. In the following, the measures specially relevant to the RTI area will be presented in brief.

- In a separate chapter on *Knowledge, Research and Innovation Basis*, an argument is made on behalf of the consistent implementation of RTI strategy and provision of the necessary, long-term financing. This calls for rapid provision of financial resources to achieve the declared expenditure targets of the federal government (3.76% research intensity, 2% of GDP for the tertiary sector) and an accompanying planning security. The recommendations also include an intensification of cooperation between enterprises and excellent universities, a priority-setting of universities, as well as improvement of their financing, the funding of STEM education and training, as well as the creation of internationally rec-

31 The term "leading competence unit" (LCU) is also sometimes referred to as "industrial frontrunners". Most important characteristics of leading competence units are: Control, planning and management competence based in Austria, overall economic value added intensity, high market share, international orientation and location flexibility. See Schneider und Lueghammer (2005), Industriellenvereinigung (2009), Schneider et al. (2013).

32 See Leitbetriebe Standortstrategie (2014); http://www.bmwfw.gv.at/Wirtschaftspolitik/Documents/StandortstrategieLeitbetriebe.pdf

ognised "Excellence and Innovation Clusters". The preparation of corresponding framework conditions such as, for example, a high-quality infrastructure for communication and energy, would help to make the innovation system higher-performing overall.

- High priority has been given to developing the "Industry 4.0" theme further (see Chapter 4.1.1). Proposed actions include, in particular, establishing a national network initiative, setting up theme- and region-specific showcase and demo factories, as well as incentives for investment. To redesign the innovation system to be more high-performing, framework conditions are required such as high-quality infrastructure for communication and energy, and better use of the innovation potential of public procurement (see Chapter 5.3). The marketing of Austria abroad as an RTI location should be intensified and RTI internationalisation activities "Beyond Europe" should be supported more strongly.

Additionally, in the other chapters important RTI policy issues are discussed, such as the call to formulate a pan-European strategy for funding renewable energies, the creation of a uniform European energy market, and the promotion of R&D and further development of relevant future technologies to create *fairer competitive conditions at the international level* and against the background of the disadvantaged position of Austria and Europe.

In the area of *climate, energy, environment & resources*, measures are also being encouraged to improve energy efficiency and intensify energy research, for which revenue from emissions trading could be earmarked. Further recommendations range from better integration of funding agencies, the development of a national storage strategy and coordination of commodities policy, to the strengthening of technology-friendly policy and support for rollouts of environmentally-friendly mobility technology.

In terms of *skills and international top scientists*, it is important to focus on the need for qualification measures, starting with basic education in school, as well as early promotion of young talent in research and innovation. Cooperation of industry with (vocational) schools should be pushed. To recruit and retain experts and top scientists (i.e. "brain gain"), a "welcome culture" should be established, which should include consistent laws of recognition, efficient recognition processes, an attractive tax system for top scientists and/or researchers and, along with this, an improvement of the red-white-red card. This measure is also included in the research action plan.

In the area of *financing and regulatory framework*, bundles of measures for strengthening capital markets, for tax relief, for deregulation and for legal security have been formulated, which should strengthen the capital market overall in Austria and thus also be relevant at least indirectly for the RTI activities of enterprises.

In summary, the location strategy holds that, despite the well-advanced development, numerous challenges are still to be found in the current situation in particular for leading competence units but also for innovation processes and economic development in general. These call for a rapid and decisive response by the government.

1.4.5 Monitoring the implementation of RTI strategy

The Austrian Council for Research and Technology Development prepares, in accordance with its legal mandate, an annual performance report, which is intended to document the implementation of RTI strategy. In addition, the Council has developed a set of indicators, which are divided into individual areas of RTI strategy (education [from early childhood to higher education], basic research and university and/or non-university research, business enterprise innovation as well as governance of the RTI system). Austria's performance in the different target areas is measured based on either the national target (if available) or in comparison with the leading innovation countries, as the overarching goal of RTI strategy is to attain innovation leader status.

In the 2015 performance report, the Council has determined that, based on the current status, the developments in the target areas are insufficient to achieve the strategic objectives. There have been improvements in approximately half of the indicators; however, there are also declines in performance in the other half, partially through relative deteriorations (other countries have developed more dynamically compared to Austria) and partially through deteriorations in absolute terms.

As a result, and in light of the remaining five years of the RTI strategy, the Council is calling for an intensified focus on the implementation of the RTI strategy, whose analysis of the fundamental problem areas in the Austrian RTI system continues to be relevant. To reinforce its implementation, a new reform process should be initiated and promoted at the highest political level and great efforts should be made in the following RTI strategy areas:

- Intensify the reforms of the education system
- Increase the resources for competitive financing of basic research
- Further optimise the legal and financial framework conditions for enterprise formation and growth
- Improve the governance structures for implementing the RTI strategy
- Promote measures to increase the private share of R&D financing.

2 Major Federal Funding Agencies in Austria

The three major funding agencies – the Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung – FWF), the Austrian Research Promotion Agency (Forschungsförderungsgesellschaft – FFG) and Austria Wirtschaftsservice (aws) – are the primary institutions responsible for achieving the objectives of the federal government's research, technology and innovation (RTI) strategy in Austria. These agencies basically cover all the components of the innovation chain: basic research (Austrian Science Fund – FWF), applied research and experimental development (Austrian Research Promotion Agency – FFG) and the transition of technological developments to corporate growth (Austria Wirtschaftsservice – aws).

Basic research is an important focus for the federal government's RTI strategy. It represents a key element with regard to Austria's attractiveness as a location on an international level and thus has a significant impact on the human potential of the Austrian research area. The main role of basic research in the Austrian innovation system is reflected in the strategic focus of the Austrian Science Fund (FWF). The Austrian Science Fund (FWF) is dedicated above all to strengthening and developing the science system and the attractiveness of Austria as a location for research, technology and innovation. Through targeted projects, it supports Austrian research institutes in international competition for top researchers. The strategy of strengthening competitive funding of university research and its international focus is pursued by taking into consideration overhead costs as well as by working closely with foreign partners (in particular, from Germany, the US and the UK). In addition, by working to selectively shape ERA-Net initiatives and through involvement in Science Europe, the Science Fund aims to better coordinate the national research and funding activities of the European Research Area (ERA) and promote an international focus within the Austrian research landscape, which is also an objective of RTI strategy.

The RTI programmes of the Austrian Research Promotion Agency (FFG) include instruments designed to support the objectives formulated in the RTI strategy of substantially improving the level of innovations developed and implemented in Austria. The mix of instruments here includes both direct support for stand-alone projects in industrial research (FFG general programmes) as well as industry-oriented structural programmes, which offer more and more Austrian companies opportunities within their sector for cooperative R&D projects aimed at helping companies compete globally and become market leaders, and thus to create economic growth and jobs. In order to achieve a "critical mass" of research in strategically-important fields for the future, also internationally, special emphasis has been placed on specific, thematically-oriented programmes.

One instrument that reflects the measures called for by RTI strategy to stimulate innovation through demand-side incentives, particularly through increased efforts to promote innovation in procurement, is the approach known as pre-commercial procurement (PCP). With a focus on "internationalisation" that extends beyond active participation in ERA-NETs and the support of Austrian stakeholders in the European Research Area, the Austrian Research Promotion Agency (FFG) pursues the priorities of the government programme, as well as the concept "Beyond Europe" and the work of WG 7a of the RTI Task Force, to implement the federal government's RTI strategy.

On the path to becoming an innovation leader, it is important not only to promote R&D but also to ensure the implementation of R&D in innovation activities and entrepreneurial success in terms of growth and increased employment. The percentage of new, rapidly growing firms, particularly in knowledge- and technology-intensive sectors, that contribute heavily to the impact from the growth of R&D, is relatively low in an international comparison. Accordingly, active support and strategic bundling of measures to promote corporate innovation activities, particularly of small to medium-sized enterprises (SMEs), the use of potential for creative industries and the mobilisation of private equity and venture capital is a key component of RTI strategy. The programme of the Austria Wirtschaftsservice GmbH (aws) focuses purposely on funding SMEs and start-up firms. The Austria Wirtschaftsservice (aws) has also launched selective initiatives for mobilising private venture capital for founders, including in the form of equity investment platforms (e.g. for crowd funding). The Austria Wirtschaftsservice (aws) thus supports the aim of the government's RTI strategy to focus more attention on service innovations and new business models.

In the following section, you'll find an overview of the development and current situation of the federal government's three major funding agencies.

2.1 The Austrian Science Fund (FWF)

The objective of the Austrian Science Fund (FWF), the main institution for promoting basic research in Austria, is to strengthen and develop the science system and the attractiveness of Austria as a location, as well as to further promote communication between the scientific, cultural and commercial interests that are in constant interaction with each other. In conjunction with systematic public relations efforts, consistent application of peer-review principles to the selection of projects that merit funding, and targeted funding of top research, this approach aims to ensure the competitiveness, international orientation and independence of Austrian research.

In 2014, the application volume rose slightly by approx. 2% to €795.5 million. The amount of

Table 2-1: Austrian Science Fund (FWF): Total funding by programme, 2014

Funding programme	Applications decided		New approvals		Approval rate			Total grants awarded	
	in € millions	% women	in € millions	% women	Rate (in %)	Women	Men	in € millions	% women
Stand-alone projects (incl. clinical research)	348.3	26	89	29	25.5	28.2	24.6	90.8	29.1
International programmes	138.5	22	27	24	19.5	21.5	18.9	27.2	24.4
Priority Research Programmes (SFB, NFN)[1/2]	35.8	13	29.3	13	81.7	80.5	81.9	31.1	13.1
START Programme[3] and Wittgenstein Award	147.5	22	10.5	34	7.1	11.1	6	10.7	34.5
Doctoral Programmes (DKs)[2]	36.1	8	23	-	63.7	-	69.3	24.8	1
International Mobility	37.4	41	12.7	39	34	32.3	35.2	14.1	38.1
Career Development for Female Researchers	34.3	100	9.6	100	27.9	28.2	-	9.9	100
Programme for the Development and Inclusion of the Arts (PEEK)	16.7	48	2.5	39	15.3	12.6	17.6	2.6	39.6
Communication of Sciences Programme	0.9	56	0.2	67	17.3	20.8	13	0.2	66.7
Total	**795.5**	**28**	**203.7**	**27**	**25.6**	**25.3**	**25.7**	**211.4**	**27.2**

1) Sub-projects, 2) 2014 extensions only, 3) only new requests, the 2014 extensions are not included here.

Source: Austrian Science Fund (FWF).

funding approved remained once again above the €200 million mark, at €211.4 million, and rose compared to the previous year (2013: €207.7 million) by approx. 2% (see Table 2-1). The number of new applications also increased by approx. 2% to 2,432 applications (2013: 2,386).

The number of approved projects (691) increased in 2014 (approx. 9%) (see Table 2-2). However, a direct comparison of the 2014 approval rate with the previous years' rates is not possible, as proposals for the doctoral programmes (DK) and special research areas (SFB) of the focus programmes were suspended in 2014.

With regard to the total number of approvals, the majority of the funding was awarded to stand-alone projects (approx. 43%) and the focus programmes special research areas (SFB) and national research networks (NFN) (approx. 15%). By working to actively shape ERA-NET initiatives and Science Europe, the Austrian Science Fund (FWF) focuses on coordinating the national research and funding activities of the European Research Area (ERA) and the internationalisation of Austrian science. This is reflected in the fact that more than 50% of the Austrian Science Fund (FWF) projects currently running are carried out in cooperation with foreign partners (in particular, from Germany, the US and the UK). Between 2013 and 2014, the research funding to promote the international area increased by more than 75% (2013: €15.5 million; 2014: €27.2 million), which is particularly due to the increased funding requirements of ERA-NET proposals (see Table 2-1). In addition, the offering of the Austrian Science Fund (FWF) was expanded through a collaboration with the US National Science Foundation (NSF) to fund research abroad by US doctoral students, with the objective of strengthening bilateral research partnerships.

It is the job of the board of trustees of the Austrian Science Fund (FWF) to process (new) applications. The board of trustees consists of the executive committee of the Austrian Science Fund (FWF) and the subject matter experts. Promoting gender equality is firmly anchored in the guidelines of the Austrian Science Fund (FWF). Over the past decade corresponding changes have also been clearly evident in the choice of personnel that make up the committees of the Austrian Science Fund (FWF). In the current IV Functional period (October 2014–2017), the percentage of female specialists ex-

Table 2-2: Austrian Science Fund (FWF): Number of grants, 2014

Funding programme	Applications decided		New approvals		Approval rate		
	Number	% women	Number	% women	Rate (in %)	% women	% men
Stand-alone projects (incl. clinical research)	1,138	26	300	28	26.4	28.2	25.7
International programmes	553	21	125	24	22.6	25.6	21.8
Priority Research Programmes (SFB, NFN)[1/2]	93	14	84	13	90.3	84.6	91.3
START programme and Wittgenstein Award	121	21	9	33	7.4	11.5	6.3
Doctoral Programmes (DKs)[2]	13	8	11	0	84.6	0	91.7
International Mobility	309	42	112	42	36.2	36.2	36.3
Career Development for Female Researchers	136	100	38	100	27.9	28.4	-
Programme for the Development and Inclusion of the Arts (PEEK)	50	46	8	38	16	13	18.5
Communication of Sciences Programme	19	53	4	50	21.1	20	22.2
Total	**2,432**	**31**	**691**	**32**	**28.4**	**29**	**28.1**

1) Subprojects, 2) 2014 excluding extensions.

Source: Austrian Science Fund (FWF).

ceeded 40% for the first time. In addition, the average age of the experts was lowered. The objective of these measures is to ensure equal treatment of the research applications, as well as to keep the approved topics up-to-date.

The targeted support of young research scientists is a major concern for the Austrian Science Fund (FWF). For instance, in 2014 the career programme Elise Richter was expanded to form the Elise Richter PEEK programme. This programme focuses directly on the artistic and/or scientific activities of women and aims to promote their university careers. In the area of new approvals, measured in € millions, the proportion of women compared to the previous year remained relatively stable at €55.6 million (2013: € 55.9 million). Considering the number of funding grants, the percentage of women whose new projects were approved was increased from about 28% to approx. 32%. Overall, the approval rate for women, i.e. the ratio of the number of approved projects to applications submitted, was approx. 29% (25.3% of the approved funding amount in € millions) compared to an approval rate for men of 28.1% (25.7% of the approved funding in € millions). The proportion of project applications from female scientists is relatively low at approx. one-third in view of the considerably higher number of female university graduates. The funding of scientific personnel and hence the development of scientific human capital is currently a main focus of the Austrian Science Fund's objectives. In 2014, some 3,973 persons working in science, approx. 44% women, received funding (see Table 2-3). Half of this amount are pre-doctoral students. The percentage of women in technical personnel is particularly high at approx. 77%. For other personnel, the amount is about 50% women. In contrast, among pre- and postdocs, only some 43% and 41% of the funded positions are filled by women. The challenge for the Austrian Science Fund (FWF) is thus to increase the percentage of women active in science.

In view of the age structure of the employees in all the funded projects of the Austrian Science Fund (FWF), the largest group is made up of 27 to 31-year-olds. Promoting the next generation of research scientists is a key concern of the Austrian Science Fund (FWF) and was implemented primarily via the START programme, the Schrödinger programme and the Doctoral Programme (doctoral college plus, DK-plus). Nevertheless, in this area the number of new applications decreased by €1.6 million (2014: €10.5 million) compared to the previous year. When compared to the number of grants, this represents a reduction from ten to nine approved projects.

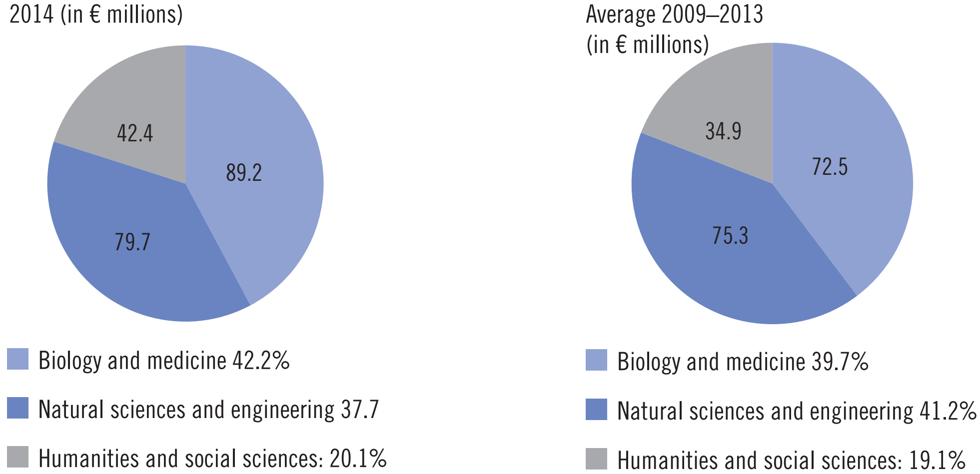
With regard to the division into different scientific disciplines, there was little change compared to previous years. Overall, a total of €89.2 million (2013: €80.2 million) went to the area of biology and medicine, €79.7 million (2013: €82.8 million) went to the area of natural sciences and engineering, and €42.4 million (2013: €39.7 million) went to the area of humanities and social sciences (see Fig. 2-1). Compared to the average between 2009 and 2013, at the expense of natural science and engineering a 2.5 percent-

Table 2-3: Research personnel funded by the Austrian Science Fund (FWF), 2011–2014

	2011		2012		2013		2014	
	All	% women	All	% women	All	% women	All	% women
Postdocs	1,229	46.8	1,288	40.1	1,351	38.4	1,392	40.5
Predocs	1,771	42.1	1,935	42.3	1,967	42.7	1,955	42.7
Technical staff	137	71.5	173	68.2	170	72.4	158	76.6
Other staff	405	52.6	456	47.1	476	48.7	468	49.1
Total	**3,542**	**46**	**3,852**	**43.3**	**3,964**	**43.2**	**3,973**	**44**

Source: Austrian Science Fund (FWF).

Fig. 2-1: Approvals by scientific discipline (complete overview of all Austrian Science Fund (FWF) programmes)



Note: Biology and Medicine: human medicine, veterinary medicine and biology; natural science and engineering: natural sciences without biology, agriculture and forestry, without veterinary medicine or engineering.

Source: Austrian Science Fund (FWF).

age point rise could be observed in the areas of biology and medicine, and a 1.0 percentage point rise in humanities and social sciences. In mid-2014, a partnership was launched between the Austrian Science Fund (FWF) and the "Dr. Gottfried und Vera Weiss Wissenschaftsstiftung" foundation. It aims to promote the next generation in the areas of meteorology and anaesthesia.

Since 2011 the Austrian Science Fund (FWF) has been able to fund overheads for stand-alone projects, projects for the development and inclusion of the arts (PEEK), as well as the programme for clinical research (KLIF), which was established in 2014. As a result, 20% of the project costs go additionally to the research institutions where the Austrian Science Fund (FWF) projects are running. A total of €13.6 million was paid out to cover overhead costs at Austrian research institutions. This represents a 21% increase compared to the previous year. A new financing option was offered in 2013 through what is known as the matching funds model. This model already enabled the funding of seven projects in 2014 and overheads in the amount of €500,000 were paid to research facilities in the federal states. The model is based on the complementary financing of research initiatives, in order to generate greater leverage: every euro funded by the regional government is doubled by the Austrian Science Fund (FWF) from assets of the National Foundation.

2.2 The Austrian Research Promotion Agency (FFG)

The Austrian Research Promotion Agency (FFG) is the national agency for promoting application-focused, business-relevant research and development in Austria. It offers a portfolio of sophisticated and targeted monetary and non-monetary instruments for funding research, technology and development at firms and research institutions along the entire innovation chain. The offering includes thematically open, bottom-up R&D funding, measures for strengthening human resources and optimising the structure of innovation systems, and a wide range of service offerings, such as the job bank for research and technology, evaluations for realising tax concessions for research activities (research premium), as well as partner search and advisory, training and networking measures, particularly for the research programmes

Table 2-4: Austrian Research Promotion Agency (FFG) funding statistics 2014 (in €1,000)

Programme structure	Projects	Participations	Stakeholders	Total costs	Funding incl. liability	Cash value
Aeronautics and Space Agency (ALR)	**73**	**147**	**67**	**19,631**	**14,824**	**14,824**
ASAP	73	147	67	19,631	14,824	14,824
General Programmes Area	**1,268**	**1,806**	**1,311**	**595,316**	**310,736**	**171,861**
GENERAL	779	793	612	565,294	289,307	150,432
General programme	701	714	561	416,120	239,267	106,315
Service innovations	23	24	24	9,574	4,902	4,235
Frontrunners	19	19	19	66,288	16,976	16,976
Headquarters	15	15	15	55,819	15,922	15,922
High-tech Start-Ups	17	17	17	12,785	8,946	5,141
Rare diseases	4	4	4	4,709	3,295	1,843
Bridge	59	161	136	23,829	17,075	17,075
EUROSTARS	8	8	8	2,793	1,384	1,384
Innovation Voucher	422	844	637	3,400	2,970	2,970
European and International Programmes	**10**	**10**	**7**	**775**	**581**	**581**
TOP.EU	10	10	7	775	581	581
Structural programmes	**1,519**	**2,795**	**1,751**	**412,696**	**151,279**	**151,279**
AplusB	1	1	1	94	94	94
COIN	27	114	107	21,574	13,275	13,275
COMET	25	852	739	341,209	106,124	106,124
FoKo	26	291	280	6,499	5,298	5,298
FORPA	22	22	21	4,488	2,186	2,186
Research Studios Austria	17	27	21	22,894	15,764	15,764
talents	1,401	1,488	823	15,959	8,540	8,540
Thematic programmes	**414**	**1,347**	**829**	**239,449**	**139,613**	**139,613**
AT:net	23	26	26	6,742	1,684	1,684
benefit	27	59	46	9,103	5,875	5,875
ENERGIE DER ZUKUNFT (Energy for the Future)	31	101	82	11,821	8,874	8,874
Energy Research (e!MISSION)	57	244	177	53,016	37,065	37,065
IEA	14	16	10	1,860	1,860	1,860
IKT der Zukunft (ICT of the Future)	59	111	69	51,299	19,220	19,220
KIRAS	26	136	84	9,949	7,389	7,389
Beacons for eMobility	3	33	33	7,074	3,580	3,580
Mobilität der Zukunft (Mobility of the Future)	82	263	180	27,361	17,151	17,151
NANO-EHS	4	5	5	546	546	546
Neue Energien 2020 (New Energy 2020)	2	6	6	431	304	304
Produktion der Zukunft (Production for the future)	48	173	140	38,044	24,965	24,965
Smart Cities	10	61	59	7,677	3,696	3,696
TAKE OFF	16	60	46	13,504	6,692	6,692
Technology competences	8	33	32	505	477	477
Urban Mobility	4	20	20	517	237	237
Austrian Research Promotion Agency (FFG)	**3,284**	**6,105**	**3,327**	**1,267,874**	**617,033**	**478,158**
Commissions[1]	245	245	185	3,238	3,238	3,238
Total operational funds:					**620,271**	**481,395**

1) Commissions are ancillary activities financed by operative funds from the programmes (e.g. studies).

Source: Austrian Research Promotion Agency (FFG).

of the EU (Horizon 2020) and the European Space Agency (ESA).

The Austrian Research Promotion Agency (FFG) marked its tenth anniversary in September 2014. In its first decade, more than 24,000 projects with total funding of €4.8 billion (€3.4 billion cash value) were funded by the Austrian Research Promotion Agency (FFG). In 2014, the Austrian Research Promotion Agency (FFG) provided a total of €617.0 million in funds (including liability and loans, excluding commissions), which corresponds to a cash value of €478.2 million (+32.2%). The high cash value of funding compared to the previous year is due primarily to the funds from the COMET programme, which are made available irregularly for requests for proposals and in 2014 accounted for approx. € 106.1 million in cash funding. An overview of newly approved funding in 2014 by programme area is provided in Table 2-4.

With a cash value of funding of €171.9 million (+2.4%), the highest funding volume went to the thematically open, bottom-up funding of firms in the general programmes area. The projects in this area are primarily stand-alone projects by firms or, as in the case of an innovation check intended to help SMEs launch R&D activities, a 1:1 partnership between a company and a scientific institution. With 1,268 projects funded (+0.5%) and 1,311 (-4.2%) stakeholders involved, the number of projects and stakeholders funded also remained widely steady compared to the previous year.

With a cash value of €151.3 million in funding, the structure programmes area represented the second-largest programme area of the Austrian Research Promotion Agency (FFG) funding portfolio in 2014. The programme area optimises structures and infrastructures of research for innovation projects, and enables firms with research and transfer facilities to generate new forms of collaboration, as well as knowledge, and develop new fields of strength. The main pillar of the programme area is the COMET programme for competence centres, which accounted for approved funding in 2014 with a cash value of €106.1 million. The thematic programmes area is the third quantitatively important area of funding in the portfolio of the Austrian Research Promotion Agency (FFG). This area has the role of establishing focal points in research, in order to attain internationally visible "critical mass" in strategic fields of future research. A total of 414 cooperative R&D projects (+3.2% over 2013) were funded in this area, with a cash value of funding of €139.6 million (+11.6% over 2013).

The Austrian Space Applications Program (ASAP), as well as the European and international programmes (EIP) comprise the further funding priorities of the Austrian Research Promotion Agency (FFG). As part of the currently ongoing EU Framework Programme Horizon 2020, approx. €191 million in funding went to Austria (see Table 14 in the statistical annex). With a success rate of 18.4%, Austria is above

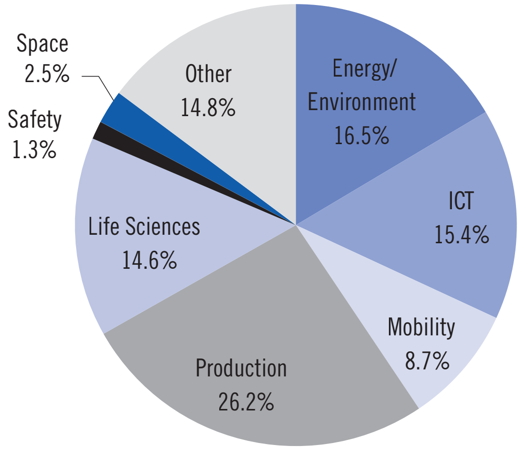
Table 2-5: Austrian Research Promotion Agency (FFG) funding by organisational type (in €1,000), 2014

Organisation type	Participations	Total funding [in €1,000]	Cash value [in €1,000]	Percentage of cash value [in %]
Business enterprise	3,393	367.79	229.16	48
Research institutions	1,026	163.03	162.82	34
Universities	1,236	80.89	80.89	17
Intermediaries	45	2.23	2.23	0.5
Other	405	3.10	3.07	0.6
Total	**6,105**	**617.04**	**478.17**	**100.0**

Source: Austrian Research Promotion Agency (FFG).

average at 16.7% of all submissions in Horizon 2020. Currently, Austrian researchers are involved in one in every ten successful projects.[1]

Fig. 2-2: Austrian Research Promotion Agency (FFG) funding by thematic fields, 2014



Source: Austrian Research Promotion Agency (FFG).

The funding of the Austrian Research Promotion Agency (FFG) by type of organisation (Table 2-5) shows that in 2014 approx. 48% (2013: 60%) of the cash value of funding went to firms. The relative shift toward research facilities is due to the effect of the competence centre programme COMET, which had already led again in the past to the share of research facilities in one year to be higher and then lower in the following year (2013: 19%). With 16% cash value of funding, the higher education sector accounted for slightly fewer funds compared to 2013, but the cash value of funding for universities rose from 67.2 million to €80.9 million (+20.3%).

With regard to the funded thematic fields, some 26% of the cash value of funding for a project went to the area of manufacturing (production technology, toolmaking and mechanical engineering, industrial processes, etc.), 16.5% went to the area of energy and environment, and some 15% to life sciences and to information and communication technologies (ICT) (see Fig. 2-2). The "Others" group includes all those areas that cannot be assigned to specific thematic fields because of their heterogeneity, the breadth of their individual fields, or because these projects are situated at the interfaces between different research areas, something that can be observed more and more frequently. Compared to the previous year, a significantly higher percentage overall went to the production area (18.7% in 2013), which is likely due to the funding of the COMET programme for competence centres.

Substantial improvements with regard to the range of activities of the Austrian Research Promotion Agency (FFG) in 2014 affected the areas of funding instruments, state aid law/RTI guidelines and internationalisation. In the following, you'll find a brief overview of the relevant developments.

New funding instruments

In 2014, the new funding instrument for "endowed professorships" was offered. This pilot tender was managed as part of the Production for the Future programme. Out of a total of eight projects submitted, three endowed professorships (two positions funded by the Federal Ministry for Transport, Innovation and Technology (BMVIT), one by the Marshall Plan Anniversary Foundation) was recommended by an international jury for funding and subsequently approved. In 2014, the University of Leoben, the University of Innsbruck and the Vienna University of Technology started to implement the endowed professorships and to took the first steps in the appointment process.

In consultation with the Federal Ministry of

1 See Overview Report for Austria in Horizon 2020. Data as per March 2015; http://era.gv.at/object/news/1776/attach/FFG_H2020-Bericht2015_web_FINAL.pdf

Science, Research and Economy (BMWFW) and the landmarks conservation entity, the Burghauptmannschaft, a pilot initiative was planned and implemented in 2014 entitled "Heating and Cooling in Historical Buildings." This pilot initiative was announced in the form of a pre-commercial procurement (PCP), a relatively new, demand-side instrument for innovation policy. The objective of the PCP is to solve a socially relevant problem, for which currently there is not an optimal solution available on the market (see also Chapter 5.3).

The new "Research Partners" programme is focused on developing doctoral students at the interface between science and industry. Funded projects include dissertations in engineering and natural sciences, in which the doctoral candidates are employed for the length of the project at a business enterprise or a non-university research institution.

State aid law/RTI guidelines

In 2014, the state aid law in the European Union and hence in Austria was revised. That also brought about changes in the Austrian Research Promotion Agency (FFG) and RTI guidelines, which in turn resulted in adaptations in the programme and instrument guidelines. The new subsidy guidelines of the Austrian Research Promotion Agency (FFG) became effective on 1 January 2015.

Internationalisation

In 2014, the Austrian Research Promotion Agency (FFG) put special focus on the area of internationalisation. The Austrian Research Promotion Agency (FFG) is thus pursuing the priorities of the government programme, as well as the concept "Beyond Europe" and the work of WG 7a of the RTI Task Force[2] , to implement the federal government's RTI strategy. As part of the internationalisation offensive, several bilateral agreements were concluded in 2014, and in this context the first tender was carried out with a Chinese university.

At the European level, the Austrian Research Promotion Agency (FFG) was also commissioned in 2014 to manage the European Cooperation in Science and Technology (COST) programme, in addition to its existing EU research programmes. COST promotions require the scientific and technical collaboration in the area of pre-competitive research.

Since 1 July 2014, the Austrian Research Promotion Agency (FFG) was also commissioned with conducting the new EU performance monitoring (previously: Proviso) by the Federal Ministry of Science, Research and Economy (BMWFW), the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW). One reason for this decision by the ministries was, alongside the data analysis competence of the Austrian Research Promotion Agency (FFG), the ability for oversight of EU funding data (particularly, framework programmes) with data from national funding programmes, as well as transnational formats.

2.3 Austria Wirtschaftsservice (aws)

Austria Wirtschaftsservice Gesellschaft mbH (aws) is the Austrian federal promotional bank that supports firms as a financing partner with a highly differentiated and target-oriented portfolio of instruments in all stages – from preseed to start-up and international growth projects. The monetary funding and financing instruments include low-interest loans, guarantees, grants, as well as increasingly equity capital financing. The latter includes, for instance, the measures with approx. €100 million endowed start-up programmes (e.g. Start-up Fund,

2 See WG 7a of the RTI Task Force (2013).

Business Angel Fund). In addition, Austria Wirtschaftsservice (aws) also offers information, consulting and services to improve the effectiveness of financial tools.

For Austria Wirtschaftsservice (aws), the strategic focus of the current multi-year programme (MJP) 2014–2016 is on prioritising the political and economic areas of action: start-ups, as well as growth and manufacturing. The theme of "start-ups" includes strategic objectives that range from boosting the founder spirit to increasing the start-up dynamic, where the focus is on innovation-oriented start-up projects and their sustainability. More recent developments such as crowd funding and social business are thus also taken into consideration. In the area of "growth and manufacturing", projects encouraging leaps in growth focus on the market of established firms. Pure replacement investment projects are largely excluded from funding. SMEs benefit from the support services of Austria Wirtschaftsservice (aws), particularly in implementing bigger projects, such as the development and modernisation of domestic locations or with internationalisation activities. The usually high levels of innovation in these projects play an important role in strengthening the Austrian business enterprise sector.

In 2014, 5,141 innovation and growth projects were funded with a total volume of €1.87 billion. The number of projects funded declined by approx. 1.1% compared to the previous year and the total volume fell by approx. 5.6%. The number of total funding approvals in 2014 was 5,991 (+3.5%), with a total project volume of €2.27 billion. Frequently, two or more instruments are used in combination to ensure, on one hand, a sufficient foundation of funding for a firm and, on the other hand, to reduce the funding allocated by the public sector. If, for example, grants are combined with guarantees, then the funding of the project has a leverage effect (e.g. on loans provided privately), which keeps down the need for grants and yet still achieves the aim of successful funding. Table 2-6 shows a breakdown of the different kinds of support according to different (funding/financing) instruments. An increase in funding approvals is evident in the areas of guarantees, grants and equity. The overall funding and financing provided declined considerably – in light of weak investment activities due to cyclical problems – to €739.8 million (-17.7%). This trend is evident in all the categories, with the exception of equity. As a consequence of the continued investment restraint and economic uncertainty in 2014, larger investment funding and demand for credit fell. For both guarantees as well as loans, 2014 was defined by the trend toward smaller projects.

Approx. one-fifth of the funding grants by Austria Wirtschaftsservice (aws) went to assuming guarantees, more than half on loans.

Table 2-6: Austria Wirtschaftsservice (aws): Funding, 2013–2014

	Funding commitments [no.]		Total project volume [€ millions]		Funding [€ millions]	
	2014	2013	2014	2013	2014	2013
Guarantees	881	837	328.7	457	157.2	196
Loans	1,141.0	1,229.0	924.0	1,196.0	483.6	593.0
Grants	3,314.0	3,270.0	911.1	1,105.0	83.5	99.9
Equity	22	13	40.4	21.7	13.3	8.3
Service and Consulting	633	437	61.9	0.8	2.2	1.3
Total result	5,991.0	5,786.0	2,266.1*	2,780.5*	739.8	898.5

Note: * Total result, multiple entries removed.

Source: Austria Wirtschaftsservice (aws).

The number of guarantees assumed (881) could be expanded by approx. 5.2% compared to the previous year, while funding approvals for loans fell by approx. 7.2%. Based on agreements with the Competitiveness of Enterprises and SMEs (COSME) programmes and EU Finance for Innovators (InnovFin), Austria Wirtschaftsservice (aws) can make additional funds available and lower costs for guarantees in the next two years. In addition, the ERP fund reduced its interest rates in November 2014. This allows Austria Wirtschaftsservice (aws) to grant loans up to €7.5 million at a fixed interest rate of 0.75% (short-term) or 1.125% (long-term).

The instruments used by Austria Wirtschaftsservice (aws) depend on the specific corporate stage that the firm is in and on its focus. Based on the programme conversion according to SME funding legislation (as of 1 July 2014), a comparison of application figures between 2013 and 2014 is available only on a limited basis. Whereas previously only young entrepreneurs who had been self-employed for at maximum three years could obtain funding, the amended guidelines now allow for funding of firms in business for up to a maximum of five years. Based on the application numbers for Austria Wirtschaftsservice (aws) Start-up guarantees (+11%), the change in the focus of funding programmes to start-up firms can already be seen. The funding by Austria Wirtschaftsservice (aws) start-up guarantees are up by 21%, the Austria Wirtschaftsservice (aws) start-up checks are up 7% compared with the previous year's figure.

With the Austria Wirtschaftsservice (aws) Start-up Fund and the Austria Wirtschaftsservice (aws) Business Angel Fund, Austria Wirtschaftsservice (aws) developed two new initiatives in 2013: The Austria Wirtschaftsservice (aws) Start-up Fund offers long-term growth capital through open and silent partnership. The offer was introduced in 2013 and was well received the following year. The number of approvals has more than doubled (2013: 3; 2014: 8). The total volume of projects as part of the Austria Wirtschaftsservice (aws) Start-up Fund increased from €1.6 million in 2013 to €26.2 million in 2014 (see Table 2-7). The Austria Wirtschaftsservice (aws) Business Angel Fund doubles the capital that angel investors provide to young entrepreneurs. In 2014, four projects were approved for the first time with a total volume of €0.6 million as part of the Austria Wirtschaftsservice (aws) Business Angel Fund. Thanks to two agreements concluded with venture capital funds, over €20 million of private equity will be available to young entrepreneurs in the next few years.

The equity brokerage platform Austria Wirtschaftsservice (aws) Equity Finder, which was launched in mid-2014 and is intended to facilitate contact to business angels, venture capital companies and crowd funding/ crowd investing platforms, had a strong start with more

Table 2-7: Austria Wirtschaftsservice (aws): Overview of performance of equity, 2013–2014

	Financing commitments [number]		Total project volume [€ millions]		Financing [€ millions]	
	2014	2013	2014	2013	2014	2013
aws SME Fund	2	2	5.0	6.0	5.0	6.0
aws Venture Capital Initiative	8	8	8.6	14.1	0.7	1.4
aws Start-up Fund	8	3	26.2	1.6	7.4	0.9
aws Business Angels Fund	4	-	0.6	0.0	0.2	-
Total	22	13	40.4	21.7	13.3	8.3

Source: Austria Wirtschaftsservice (aws).

than 400 firms participating and more the 250 investors registered. In addition, in 2014 a grant funding for capital market prospectuses was launched. With this funding programme, a 50% grant (up to €50,000) is provided for a pilot phase to cover the costs of preparing capital market prospectuses for SMEs. Austria Wirtschaftsservice (aws) i2 – Business Angels further reported dynamic growth as in recent years, with the number of funding requests increasing compared to 2013 by approx. 15% to 519 in 2014. Of the 72 projects sent to investors, 16 were successfully placed.

Overall, the Austria Wirtschaftsservice (aws) provided start-ups with a total of €192 million in funds in 2014, including all programmes.

The technology programmes Austria Wirtschaftsservice (aws) Seed financing and Austria Wirtschaftsservice (aws) PreSeed also address the pre-seed and start-up stages (see Table 24 in the statistical annex). They support companies with the commercial implementation of ideas and are intended to provide an incentive for technology-based and growth-oriented start-up firms. With an unabated high level of interest in the programme, in 2014 six Austria Wirtschaftsservice (aws) pre-seed and 11 seed financing projects with a thematic focus on ICT and physical sciences received €6.5 million in funding. The life sciences area was also supported by Austria Wirtschaftsservice (aws) Life Science Austria (LISA) with €6 million in pre-seed (4 projects) and seed financing (6 projects) in 2014. Innovative services were funded for the first time in 2014 as part of the Austria Wirtschaftsservice (aws) Innovative Service Call Programme. Of 141 applications submitted, 18 new companies received a total of €1.8 million in funding. Additionally, to promote SMEs Austria Wirtschaftsservice (aws) ProTrans was expanded in mid-2014 to include the Industry 4.0 aspects, in order to better facilitate the integration of value added chains of leading competence units.

The Austria Wirtschaftsservice (aws) impulse programmes, national funding programmes for creative industries, continue to report increasing numbers of applications. As part of the programme tracks Austria Wirtschaftsservice (aws) impulse XS and Austria Wirtschaftsservice (aws) impulse XL, 55 high-quality projects were selected with the help of a jury of international experts from different areas of the creative industries and received funding of €2.9 million in 2014. In addition, a series of training workshops and awareness-raising measures were held, e.g. presentations and workshops for entrepreneurs.

The creative industries check, which promotes the creative industry services as part of an innovation project, was awarded for the second time in 2014 and represents another equity capital instrument for start-ups. Short-term funding is provided here in the form of supplementary funding through 600 checks of €5,000 each.

Alongside the demand for loans, guarantees and grants, a high level of interest in consulting and services from SMEs is also evident. For SMEs, comprehensive measures to exploit intellectual property rights are provided and utilised. One example is the increase by approx. 40% in approvals in the area of patent consultancy and exploitation. Particularly the approvals in the area of IP advisory services rose significantly from 172 (2013) to 272 (2014). Key factors are the needs-based safeguarding of intellectual property, the implementation of patient rights, in-licensing of technology, exploitation of inventions through out-licensing, as well as support of internationalisation projects. These go hand-in-hand with market research to support strategic decision-making. Awareness and training activities provide a contemporary, needs-based offering and thus play an important role in processing of the relevant knowledge and expertise. The programme Austria Wirtschaftsservice (aws) License.IP newly implemented in 2014 as part of the patent consultancy and exploitation is used to support young enterprises and offers substantive and monetary support for in-licensing of third-party technology, preferably from university and non-university institutes.

In order to further strengthen the transfer of academic knowledge to industry, Austria Wirtschaftsservice (aws) has managed the new programme for knowledge transfer centres and IPR exploitation on behalf of the Federal Ministry of Science, Research and Economy (BMWFW) since 2013 (see Chapter 1.4.3). Three regional knowledge transfer centres have been set up, which alongside technology transfer services also conduct cooperative projects in the area of intellectual, social and cultural sciences, as well as art. One thematic knowledge transfer centre for life sciences is dedicated to developing advanced, pre-clinical active ingredients and diagnostic products. For universities, additional patent funding is offered, in order to strategically develop patents with a high potential for exploitation. As part of the PRIZE funding for prototypes, support is provided for new patentable applications from basic research at universities or partnerships with defined research facilities with exploitation possibilities.

For 12 selected Austrian firms with strong exports and innovation potential, €5 million in support was also provided in 2014 from the Frontrunner grant programme. Combined with Austria Wirtschaftsservice (aws) ERP loans, projects with high growth and innovation potential are funded. This instrument is intended to help successful, primarily medium-sized enterprises maintain their top position in global competition.

3 Scientific Research and Tertiary Education

The RTI strategy of the Austrian federal government articulates university-related objectives that, together with the Austrian University Plan 2011[1] as an instrument of higher education planning, represents the strategic framework for the further development and coordination of universities. The performance agreements between the federal government and universities, which serve as the federal government's central instruments of management and allocation for the implementation of university and science policy objectives, are entering their fourth round with the expiration of the current 2013–2015 period. This chapter is dedicated to a few central aspects in the context of performance-based university funding that have become increasingly significant in recent years since the introduction of this instrument in the Austrian University Act of 2002. Chapter 3.1 provides a brief summary of important recent developments and changes in the Austrian university landscape. Chapter 3.2 then goes on to discuss the development of university research prioritisation and priority-setting strategies as they are shaped by performance agreements, taking into account the role that higher education institutions play in regional innovation systems ("Regional Innovation Strategies for Smart Specialisation", or RIS3), as well as other associated measures. Chapter 3.3 focuses on the increasing significance of competitive R&D financing at Austrian universities by examining the structure and development of R&D third-party funding. Finally, Chapter 3.4 relies on the 2014 research infrastructure survey to illuminate the structure and financing of research infrastructure at domestic universities, universities of applied sciences, and non-university research institutions as important foundations for excellence in research.

3.1 The development of the Austrian university landscape

Austria has one of Europe's oldest university systems. Some of its universities were founded quite early: Vienna in 1365, Graz in 1586, Salzburg in 1622 and Innsbruck in 1664. The forerunners to today's technical universities, the Vienna University of Economics and Business, the University of Natural Resources and Life Sciences Vienna, and the University of Veterinary Medicine Vienna, were founded in the nineteenth century. In the 1960s and 1970s, the expansion of tertiary education participation, accompanied by a simultaneous regionalisation, resulted in the founding of additional universities in Austria. The Art Universities were founded during this period, along with the Vienna University of Economics and Business, the University of Klagenfurt, and the University of Linz. The same period saw the implementation of co-determination rights for students and assistants, differentiation of the disciplines, and the dismantling of admission barriers by the University Organisation Act of 1975. This was associated with a strong increase in the number of students.[2]

1 See University Report 2014, Section 1.1.1 "Objectives of the Austrian University Plan" and Section 1.1.2 "Implementation in the reporting period", pp. 44-45; (Federal Ministry of Science, Research and Economy (BMWFW), 2014).
2 See Austrian Science Board (2009); Welan and Wulz (1996).

As of the mid-1990s, the Austrian university landscape changed profoundly in just a few years. For one, the universities were granted more autonomy by the University Organisation Act of 1993. The art academies were granted the status of universities by the Federal Law on the Organisation of the Universities of the Arts of 1998. On the other hand, the number of institutions of higher education in Austria tripled within a short period because of the admission of universities of applied sciences (since 1994), the spin-off of medical faculties and the establishment of medical universities (2004), the accreditation of private universities (since 1999), and the founding of university colleges for teacher education (considered universities since 2007).[3]

The Universities Act of 2002 removed the universities from federal administration, ushering in the most serious change in the Austrian higher education system in the recent past and thereby initiating a fundamental reorientation of university management and steering mechanisms. As a judicial subject with fully equal rights under public law, universities can now autonomously conclude contracts and work contracts under private law. A partially performance-based university funding system was also implemented and longer-term strategy and priority setting, both regionally and internationally, was pushed by the universities.[4] The basic budget provided by the state to the universities, which still remains the most important financing instrument, is awarded on the basis of three-year performance agreements with the Federal Ministry of Science, Research and Economy (BMWFW) and is coupled with specific measures and priorities. Furthermore, since 2013 a fixed amount of the state's university budget, which is called the higher education structural fund, is awarded on the basis of quantitative performance indicators and a competitive call for submissions for start-up financing of cooperative projects. The increased importance of efficiency and performance indicators for university financing is also presenting new challenges to university administrations. At the same time, the Bologna Process, with its distinction between Bachelor's and Master's courses of study and the concomitant expansion of teaching activities, has led to increased effort at the universities. Dealing with higher numbers of students also has presented a challenge.

Although developments in the university landscapes of European countries differ profoundly because of their heterogeneity of detail, there are still recognisable similarities. In the Netherlands, for example, reforms began in the 1980s to make the higher education sector more autonomous and performance-oriented, as in Austria. In Finland, this development also has led to full autonomy for their universities. Because Finnish university policy has a strong focus on innovation policy, the universities are positioned for greater scientific and economic competitiveness.

In most research and innovation systems, R&D activities carried out at universities are playing an ever-greater role. The share of expenditure on R&D conducted at universities, measured in terms of gross domestic product, therefore increased in all of the countries assessed (with the exception of Italy) from 2004 to 2013. In Austria, research and experimental development was carried out at universities to the tune of 0.7% of GDP in 2013. This meant that Austria, after Denmark, Sweden and Switzerland posted the highest such value in 2013 (see Table 3-1).

The establishment of autonomy for the universities and their intensified orientation towards performance has changed the structure of funding for R&D activities carried out at universities. In 2002, 91.4% of research performed

3 See Austrian Science Board (2009).
4 See Steiner et al. (2014), Universities Act 2002: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20002128

at Austrian universities was financed by the state; this figure fell to 85.8% by 2011. In contrast, increasing significance has been attributed to research funding from firms and from abroad, as is clear from Fig. 3-1. Chapter 3.3 provides a detailed analysis of the development and structure of third-party R&D funding at universities.

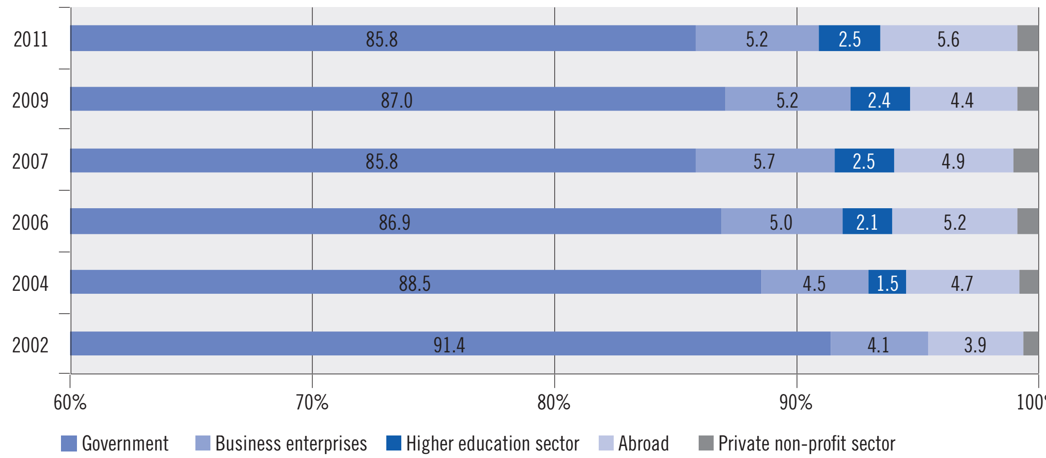
The diversity of the European university landscape becomes clear when the countries are compared (see Fig. 3-2). The share of government funding ranges from 63% in the United Kingdom to 89.5% in Italy. Austria has an 85.8% share of government financing for university research, which places it among those nations with above-average public funding. There is also broad diversity among the countries in terms of other sources of funds. In the United Kingdom,

Table 3-1: R&D expenditure in the higher education sector in selected countries, 2004/08/13

Country	In-house R&D expenditure in the higher education sector in % of GDP					
	2004	Ranking 2004	2008	Ranking 2008	2013	Ranking 2013
Denmark	0.59	5	0.76	1	0.97	1
Sweden	0.78	1	0.74	2	0.89	2
Switzerland	0.64	3	0.69	3	0.88	3
Austria	0.58	6	0.65	4	0.72	4
Finland	0.66	2	0.61	6	0.71	5
Netherlands	0.60	4	0.63	5	0.63	6
Norway	0.47	7	0.51	7	0.54	7
Germany	0.40	8	0.43	9	0.51	8
France	0.39	10	0.41	10	0.46	9
United Kingdom	0.40	8	0.45	8	0.43	10
Italy	0.35	11	0.35	11	0.35	11
Spain	0.31	12	0.35	11	0.35	11

Source: EUROSTAT (2015b).

Fig. 3-1: Financing for R&D performed in the higher education sector in Austria (by sources of funds), 2002–2011



Source: EUROSTAT (2015a).

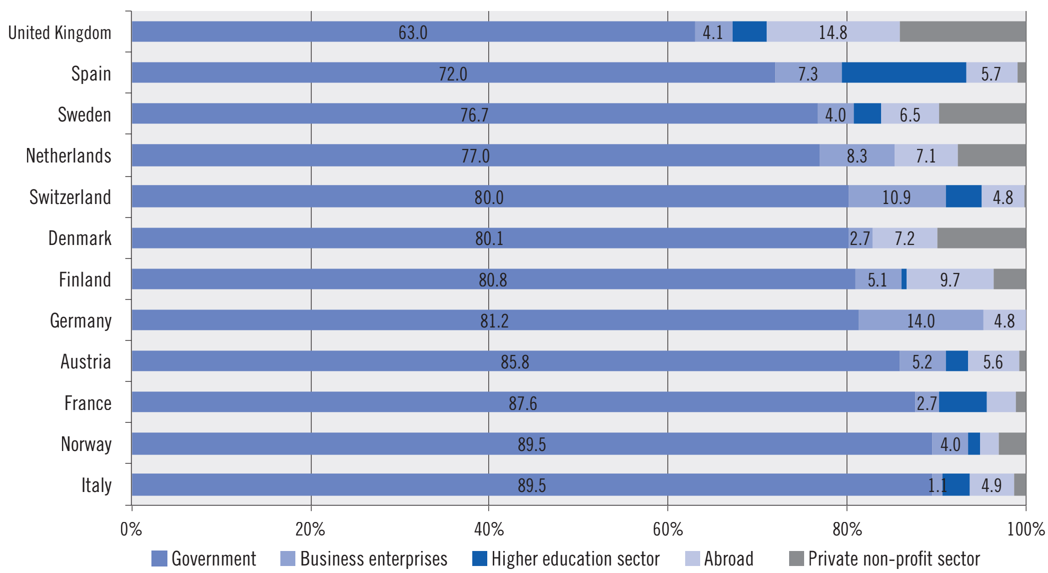
for example, research funding from abroad at universities plays a major role, while in Germany or Switzerland funding from firms is significantly above the values for other countries.

In addition to the increasing challenges brought about by the necessity of acquiring additional funds through research activities, teaching requirements have also increased due to the growing number of students at Austrian universities. There were 216,860 students enrolled in the winter semester 2002, and that number grew by 68.6% to 365,599 students in the winter semester 2013 (see he Fig. 3-3).

As has been shown before, university development in both Austria and in other European countries is clearly headed in the direction of performance orientation and autonomy. This also intensifies the demands on universities to compete for and win funding. Competitively acquired funds have therefore become an essential component of research funding for universities[5].

In this context, measures related to university priority-setting for the purpose of increasing the competitiveness of universities are also meant to contribute to the acquisition of third-party R&D funding; this is dealt with extensively in Chapter 3.2 and 3.3. The increasing importance of third-party R&D funding in the Austrian university landscape has a series of positive effects, such as the increasing orientation towards quality in research and a growing business orientation, yet it also imposes reductions in degrees of freedom, for example through the necessity to find co-financing for third-party funding. A study by the German Federal Ministry for Education and Research[6] showed that the increasing volume of third-party R&D funding increasingly ties basic funding to universities because indirect project costs that come up are often not covered by the projects being completed. Chapter 3.3 takes a closer look at this situation.

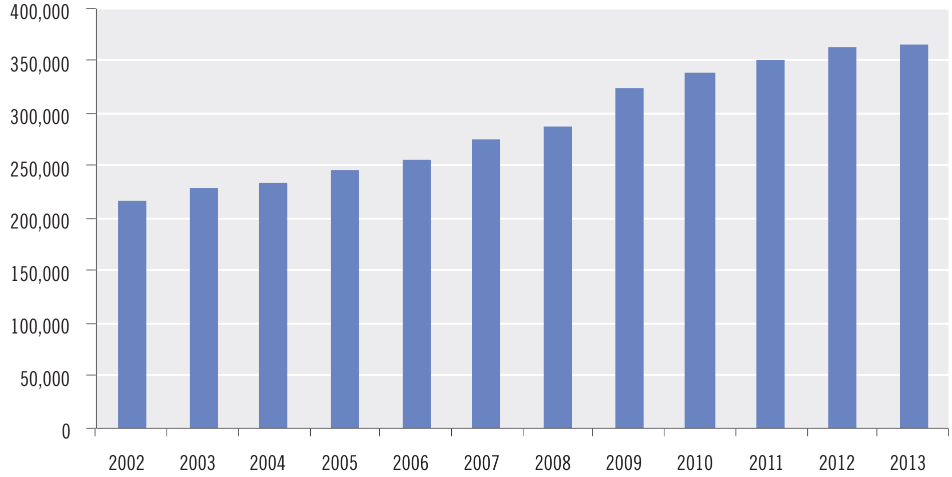
Fig. 3-2: Shares of sources of funds for R&D performed in the higher education sector in selected countries, 2012



Note: Values for 2011 were used for Austria, Norway and Sweden due to data availability limitations.
Source: EUROSTAT (2015a).

5 See Federal Ministry of Science, Research and Economy (BMWFW) (2014).
6 See Astor et al. (2014).

Fig. 3-3: Development in students at Austrian universities, 2002–2013



Source: uni:data (2015).

3.2 Setting priorities on a regional basis: The role of universities as leading scientific institutions in the context of "Smart Specialisation"

The process of intensified priority-setting among universities – which was initiated in past performance agreement periods and continues in the current 2013–2015 period – entails the definition of research priorities and longer-term objectives, as well as associated strategic planning of resource allocation.[7] Existing strengths and capacities are meant to be used in a targeted way to create "critical mass" in terms of strong research fields at individual universities that are also perceived as such in the international research field. This corresponds with the cornerstones of the Austrian University Plan approved in 2011, which aims *"...to further develop higher education in Austria, to increase international visibility, and to ensure the highest quality in teaching and research under the given circumstances and the efficient completion of achievements according to international standards"*.[8] This includes not only the refinement and development of priorities in research and teaching, but also the creation of new governance structures for aligning these priorities and bundling resources, both among universities and with RTI policy initiatives and objectives. This fits into an EU-wide trend of increasingly promoting an active role for universities in regional innovation processes and strategies.[9]

The European Commission's establishment of "Smart Specialisation" as a strategic concept for regional growth and development strategies led by knowledge and innovation throws a brighter spotlight on the regional and location-specific importance of higher education institutes, especially universities. The implementation of regional science and innovation strategies for "Smart Specialisation" as knowledge-based development concepts for regions (RIS3)[10] is an important pillar of the EU 2020

7 See Austrian Research and Technology Report (2013); http://www.bmwfw.gv.at/rtr
8 See Federal Ministry of Science and Research (BMWF) (2011).
9 See Veugelers, Del Rey (2014).
10 *„Regional Innovation Strategies for Smart Specialisation (RIS3)":* knowledge- and innovation-based regional strategies for growth and development.

strategy for intelligent, sustainable growth and is part of the European crisis management strategy. Entrepreneurial rationality, as well as discoveries from science and research, should supplement existing potential at a location in an optimal way. The cross-sectional "Smart Specialisation" concept creates a strategy-based connection between different policy fields, with a special focus on science, research, innovation, competition, regional and industrial policy. "Smart Specialisation" defines priorities and fields of action, as well as the implementation and execution of a strategy based on these definitions, thereby building on the principle of multi-level governance.[11] The strategy's foundation is a SWOT analysis[12] of a region's innovation system that includes relevant stakeholders at all (political) levels: the EU, the nation, the region, and institutions from industry, science, and society.[13] In the context of this "Smart Specialisation" strategy, universities and research institutions receive an explicit "mandate" in the design processes of industrial, competitive, and innovation policy.[14]

While universities of applied sciences, by virtue of their focus on application- and practice-oriented education and research, already *per se* have a strong relation to business and the local environment[15], the analysis and classification of interactions between universities and their immediate regional surroundings is a complex undertaking. Beyond their core functions of teaching and scientific research, universities make an essential contribution to innovation potential through the transfer of knowledge and expertise into society and the economy of their region of location. This also means that universities contribute to economic development as well as the regional solution of societal challenges and objectives. This role for the universities is also called the "Third Mission", although the interpretation of this term is not uniform and depends on the scope (regional, national) as well as the degree to which transmission mechanisms have been institutionalised. The meaning of "Third Mission" therefore relies on the applied context and, from an economic-technological perspective, includes the active commercialisation of knowledge by universities, for example through patents, licenses, and spin-offs. In an expanded sense, this term could also mean the contribution that universities make toward the innovation capacity of firms through their implicit and explicit transfer of expertise and knowledge, to the knowledge society in general, and on to societal and social needs (civic university, community engagement).[16]

Regional transmission mechanisms for university achievements are wide-ranging and diverse, and can be summarised roughly into three categories in terms of their contribution to the regional innovation system[17]: Of great significance is the knowledge transfer that occurs by highly qualified graduates joining a local firm. Moreover, cooperative ventures, such as those on the basis of the COMET programme for competence centres or the Christian Doppler laboratories, as well as contract research services at universities, constitute additional channels of direct knowledge transfer between

11 Describes the multi-level interdependence of political structures (EU, national states, regions) by supranational as well as intergovernmental decision-making levels, including other relevant national and sub-national stakeholders.
12 A SWOT analysis is an instrument for analysing situations and developing strategies. Strengths and weaknesses are typically understood as qualities of the subject under assessment. Opportunities and threats arise primarily from the surroundings.
13 See Fields of strength in the innovation system: Scientific priority-setting and economic synergies: (2015); http://wissenschaft.bmwfw.gv.at/fileadmin/user_upload/wissenschaft/publikationen/forschung/AT_Forschungsraum_Endbericht.pdf, p. 104 ff.
14 See EC (2014).
15 See also Chapter 3.5, "Austria's universities of applied sciences in the national research landscape" in the Austrian Research and Technology Report (2014); http://www.bmwfw.gv.at/rtr
16 See Lassnigg et al. (2012).
17 See Veugelers, del Rey (2014); Perkmann et al. (2012); EC (2014); Bonaccorsi (2014).

industry and science. The publication and commercialisation activities of the universities, as well as university spin-offs, also contribute to the broadening of the local knowledge base. Universities and their environment are also attractive for the highly qualified workforce. The proximity to university expertise, as well as the opportunity for local networking, are important factors for a region's economic innovation potential. Furthermore, universities produce a direct economic stimulus as an employer and by generating value added, for example through their own procurement and the spending of students and employees.[18] At the same time, universities are influenced by local circumstances and can generate development potentials based on these conditions. Universities profit from the proximity to research and business enterprise partners, clusters and networks, as well as other institutions of higher education, and from the specific conditions in a locality. Examples include the planned "Centre on the Mountain" at the University of Leoben in Styria's Erzberg mine, or the BOKU's DREAM hydraulic engineering laboratory on the river Danube. This means that the coordination of university development and priority-setting strategies with their own and regional potential, and the strategic utilisation of networks for universities, presents opportunities in terms of cooperative agreements and acquiring third-party funding. Furthermore, the integration of competences of different partners, along with university excellence, can lead to generating "critical mass" in specific areas, thereby contributing to the international visibility of universities.

The necessity of university participation in regional RTI and/or "Smart Specialisation" strategies has already been addressed explicitly in the Austrian University Plan.[19] The active awareness of their role as leading local scientific institutions in shaping strategic regional processes and prioritisation, as well as strategic capitalisation of strengths and potentials from their own environment by universities, is now being promoted by the Federal Ministry of Science, Research and Economy (BMWFW) in the current performance agreement period 2013–2015 in the context of the "Lead Institution Initiative".[20] The concept of "Smart Specialisation" therefore forms a new context for the priority-setting processes at universities that were already initiated in past performance agreement periods. This initiative is also meant to be further developed and driven forward in future performance agreements. Two specific proposals were brought to the universities as milestones in the current performance agreement period. One of these includes the creation of a so called location concept ("Standortkonzept") in which the university presents its strategic cooperation and networks with other research institutions, firms, and society in a self-defined vicinity or catchment area. Location concepts need not be standalone documents; they can also be integrated into development plans or internationalisation strategies as an independent initiative. A central element is the written articulation of multi-year strategic cooperative agreements aligned with research and/or development priorities, which should document the university's diverse effects on their location for international partners as well as active participation in regional priority-setting.[21] Furthermore, the universities were encouraged to participate actively in the next generation of RTI and development strategies in their respective regions. RTI priorities developed on the basis of regional potentials are in turn an important foundation for the efficient and transparent al-

18 See Musil and Eder (2013) for Vienna.
19 See Federal Ministry of Science and Research (BMWF) (2011).
20 See Federal Ministry of Science, Research and Economy (BMWFW) (2014).
21 Federal Ministry of Science, Research and Economy (BMWFW) (2014).

location of public funds (for example, in university research infrastructures) as well as current "ex-ante conditionality" for the recognition of co-financing funds from the European Fund for Regional Development (EFRE) 2014–2020 for research and innovation.[22] The following offers an overview of existing R&D profiles for the regional governments on the basis of R&D expenditure as well as the most recently completed RTI strategy processes for individual states.

Scientific and business R&D as the foundation of strategic R&D priorities for the regional governments

Priority-setting processes and the development of location concepts at the universities stand in the context of regional RTI strategies and prioritisation at the regional government level. Existing priorities and areas of strength at the universities are essential factors for the RTI profiles of the regional governments. At the same time, consideration should be paid to local demand and expertise, as well as future political and social priorities in the development of university profiles and priorities. This section presents the existing R&D priorities in selected regions by means of a regional analysis of R&D expenditures on the basis of the 2011 R&D survey.[23] The next section provides an overview of current and ongoing RTI strategy processes in the regional governments, as well as the first activities initiated by universities in the context of the "Lead Institution Initiative".

Table. 3-2 presents the total R&D expenditures by sectors of performance in the regional governments under review. Vienna, Tyrol and Salzburg have similarly high shares in the R&D expenditures of the higher education sector, with 38.2%, 39.6% and 32.1% of total R&D expenditures. In Styria, 25.5% of R&D expenditures came from the higher education sector and 70.7% from the business enterprise sector. Upper Austria and Carinthia had especially high concentrations of R&D expenditure in the business enterprise sector at 88.7% and 88% respectively. Higher education sector R&D expenditures were comparatively lower at 9.9% and 9.5%.

R&D expenditure by fields of science is shaped in the regional governments primarily by the higher education sector and by the universities.[24] Overall, the Austrian regional governments display major differences in their scope and priorities, both in scientific[25] and business R&D expenditures. The following presents a summary of the central features and differences.[26] A detailed presentation of R&D expenditures from the business enterprise sector by economic sub-sector (ÖNACE 2008) and R&D expenditures by fields of science (ÖFOS 2012) are located in Annex 1. [27]

As an R&D site, Vienna is shaped by a high degree of public R&D-institutions, yet in absolute terms its most comprehensive R&D activities are in the business enterprise sector. 42.8% of R&D expenditure in the business enterprise sector in 2011 were spent in the manufacturing sector ("manufacture of goods") and 56.4% in the services sector. About a quarter (23.0%) of

22 See Fields of strength in the innovation system: Scientific priority-setting and economic synergies: Fields of strength in the innovation system (2015); http://wissenschaft.bmwfw.gv.at/fileadmin/user_upload/wissenschaft/publikationen/forschung/AT_Forschungsraum_Endbericht.pdf, p. 104 ff. 23 Data selected for the universities according to Section 6 of the Austrian University Act in Vienna, Salzburg, Styria, Tyrol, Upper Austria, Carinthia, recent RTI strategy process also in Lower Austria and Burgenland.

24 Niederl et al. (2011a).

25 "Scientific R&D" here includes R&D expenditures of the higher education sector, the government sector, the private non-profit sector, and the institutes' sub-sector ("kooperativer Bereich") .

26 Statements regarding the degree to which these observable regional government profiles, based on R&D expenditures, are already based on active strategic processes and objectives, cannot be made on the basis of available data.

27 For some regional governments, R&D expenditure in specific scientific or economic sub-sectors cannot be shown due to confidentiality reasons.

Table 3-2: Total R&D expenditures by sectors of performance, 2011

	Vienna		Styria		Upper Austria		Carinthia		Tyrol		Salzburg	
	R&D expenditure in											
Sectors of performance	**€ millions**	%	**€ millions**	%	**€ millions**	%	**€ millions**	%	**€ millions**	%	**€ millions**	%
Higher education sector	1,096.9	38.2	419.5	25.5	128.1	9.9	45.5	9.5	288.6	39.6	92.3	32.1
of which universities (without univ. hospitals)	848.4	29.6	349.8	21.2	102.7	7.9	38.8	8.1	216.8	29.7	79.9	27.8
Government sector[1]	242.9	8.5	4)	4)	17.0	1.3	11.5	2.4	23.7	3.3	4)	4)
Private non-profit sector[2]	20.7	0.7	4)	4)	1.1	0.1	0.5	0.1	0.2	0.0	4)	4)
Business enterprise sector[3]	1,510.2	52.6	1,164.1	70.7	1,149.6	88.7	422.7	88.0	416.3	57.1	178.1	61.9
Total	**2,870.8**	**100**	**1,647.0**	**100**	**1,295.9**	**100**	**480.1**	**100**	**728.8**	**100**	**287.7**	**100**

1) Federal institutions (not including those combined in the higher education sector), state, local government and chamber institutions, R&D institutions of the social insurance carriers, public sector-financed and/or controlled private non-profit institutions as well as R&D institutions of the Ludwig Boltzmann Gesellschaft; not including regional hospitals; 2) Private non-profit institutions whose status is predominantly private or under civil law, sectarian, or other non-public; 3) Including The Austrian Institute of Technology GmbH and competence centres; 4) For confidentiality reasons, the data cannot be listed separately, yet are included in the final sum.

Source: Statistics Austria: Survey of research and experimental development (R&D) 2011.

R&D expenditure in the business enterprise sector took place in the "electrical equipment" economic sub-sector, and an additional quarter (24.0%) was spent for "research and development". Another 13.5% of R&D expenditure in the Viennese business enterprise sector went to the combined economic sub-sectors of "trade, maintenance and repair of motor vehicles". Comparatively high proportions of spending also went to ICT providers ("information technology services" and "information services") with a share of 9.5%. The "natural sciences" sector dominated scientific R&D activities (30.1%). Other major categories in scientific R&D expenditures were 15.5% for "technical sciences" and 17.6% for "human medicine". Despite a catching-up process in recent years in comparison to Styria and Upper Austria, "engineering" posted a below-average share of R&D expenditures. The share of R&D in the "agriculture and forestry" sector in 2011 only stood at a total of 8.6% in 2011, yet this is far above average, both in Austria and on the European level. Other major categories for R&D expenditure in Vienna were the "social sciences" (16.4%) and the "humanities" (11.7%).

In Styria, almost one-third (30.8%) of corporate R&D expenditures were made by firms that carry out "architectural and engineering activities; technical testing and analysis" in the combined sub-sectors, with an additional 15.8% coming from companies in the "research and development" economic sub-sector. In the manufacturing sector, 12.6% of R&D expenditures went to the economic sub-sector "motor vehicles, trailers and semi-trailers", which was the largest single item. Sixty per cent of scientific R&D expenditures took place in the "technical sciences" (59.7%). After the "technical sciences", R&D activities in the "natural sciences" (15.9%) and "human medicine" (12.9%) played the most important role. Other major categories in scientific R&D expenditures were 6.7% for the "social sciences" and 3.2% for the "humanities".

In Upper Austria, firms in the services sector were responsible for one-sixth (15.5%) of corporate R&D expenditures. R&D activities are broadly distributed in the manufacturing sector, with the highest shares in the "motor vehicles, trailers and semi-trailers" (19.0%), "mechanical engineering, machinery" (18.9%) and "electrical equipment" (14.0%) economic sub-sectors. Overall, more than three-quarters of scientific R&D expenditure in Upper Austria went to the "natural sciences" (39.4%) and the "technical sciences" (37.1%). The proportion of R&D expenditure in the "social sciences" (16.6%) is slightly above average.

Corporate R&D expenditure in Carinthia are highly concentrated. Six firms in the "electronic components and circuit boards" economic sub-sector were responsible for 60.8% of corporate R&D expenditure in 2011. An additional 12.2% of R&D expenditures were reported in the "mechanical engineering, machinery" economic sub-sector. About half of scientific R&D expenditures went to the humanities and social sciences ("humanities" 20.5% and "social sciences" 28.7%). This represents a high degree of specialisation. Of scientific R&D expenditures, 17% went to the "natural sciences".

In Tyrol, 13.3% of corporate R&D expenditures went to the services sector. The high proportion of expenditures in the economic sub-sectors "pharmaceuticals, medicinal chemicals and botanical products" (29.5%) and "glass, glass products, ceramics, and mineral products" (13.3%) are characteristic for business enterprise R&D activities in Tyrol. Large shares of R&D spending also went to the "electrical equipment" (14.0%) and "mechanical engineering, machinery" (10.4%) economic sub-sectors. The "human medicine" sector played an above-average role in R&D expenditures by fields of science (44.2%). The combined "natural sciences, agriculture and forestry" segment was responsible for about a quarter of scientific R&D expenditures (27.2%). 6.2% of scientific R&D expenditures went to the "technical sciences". The humanities and social sciences categories also made significant contributions to scientific R&D in Tyrol ("humanities": 7.6%; "social sciences": 14.8%).

76.9% of corporate R&D expenditure in Salzburg were posted in the manufacturing sector in a broad distribution. The highest proportion in a single category went to the "mechanical engineering, machinery" economic sub-sector (26.3%). A comparatively high proportion of R&D expenditures was made in the "computers, electronic and optical products (without electronic components and circuit boards)" sub-sector (8.1%). Within scientific R&D, expenditures in the "social sciences" (26.8%) and the "humanities" (21.5%) played a significantly above-average role. 40.3% of scientific R&D expenditures took place in the combined "natural sciences, engineering" segment in 2011.

University priority-setting in the context of the regional governments' strategic R&D priorities

The importance of universities for regional innovation systems constitutes an essential pillar of the European regional development concept of "Smart Specialisation" for a new regional policy directed at knowledge and innovation. As educational institutions, they provide highly-skilled labour power, partially in direct coordination or with consideration paid to regional priorities in business and manufacturing. As research institutions, they are leaders in knowledge production and technology transfer, and an essential factor for their region's R&D profile. The joint setting of priorities by stakeholders in science, business and policy is a new European standard in RTI policy and the foundation of strategic RTI processes in institutions, regions, and at the national and European level in the context of multi-level governance. Current and ongoing RTI strategy processes at the regional level are related at differing degrees of intensity to the concept of "Smart Specialisation" and are taking up its ideas regarding profile formation through thematic priority-setting. These foci and priorities are defined on the basis of participative policy processes, whereby the actual form of these processes, as well as the detail of thematic foci, priorities, and fields of action, differ between the various regional governments. In the context of "Smart Specialisation", universities get a strategic role in the formulation of regional fields of specialisation and investment. The following discussion aims to provide an overview of current and ongoing RTI strategies and prioritisation in the regional governments, and, to the degree it is possible to do so on the basis of the states' documentation of their strategies, to present how the universities are involved and how university priorities are referenced in priority-setting.[28]

For example, Upper Austria's RTI strategy [29] identifies five fields of action that were defined by a body of experts from the Technology Management and Regional Development Agency (TMG) and Upper Austrian Research (UAR), based on an analysis of core competences in Upper Austria. The five fields of action include the areas of industrial production processes, energy, health and ageing society, food and nutrition, and mobility and logistics. The strategic orientation of the programs within these fields of action was set with the involvement of representatives from science, research, and business. The University of Linz participated in the development of the fields of action for manufacturing production processes, energy, and food and nutrition. The Upper Austria University of Applied Sciences was involved in the fields of action for health and ageing society, as well as mobility and logistics. Annex I includes a detailed presentation of research priorities within the fields of action.

One idiosyncratic element of Styria's RTI profile development is its dual focus on a business[30] and RTI strategy[31], which emerged under the aegis of the responsible regional administrative departments. Working from an analysis of the local portfolio, three main topics were defined in the context of an economic strategy (mobility, ecotech, and health-tech). These three topics are meant to guide future development processes. The RTI strategy takes up these three main topics from the economic strategy and supplements them with what are called thematic passages in research, which in addition to economic potential are also meant to address broader social objectives and challenges. These thematic passages include key themes such as mobility, energy/resources and sustainability, materials, health and biotechnology, as well as the information society. Along with the strengths in scientific disciplines in the so-called STEM subjects at universities and technical colleges (universities of applied sciences), which are also highlighted in the economic strategy, the RTI strategy points explicitly to the importance of the humanities, social and cultural studies, and the arts, as cross-cutting fields in the discourse about social and economic developments that should be carefully observed in future. Explicit mention is made of the importance of the Styrian Higher Education Conference for local cooperation and the further development of Styria as a research area.

Lower Austria's priority-setting has a structure similar to that of Styria, pursuing both an economic and an explicit RTI strategy. In contrast to Styria, however, Lower Austria's economic strategy does not articulate any thematic priorities.[32] The development of strategic priorities in the RTI strategy[33] is based on an ongoing process that includes stakeholders and organisations relevant to RTI and scientific endeavour. A basic strategy performed an analysis of strong RTI fields in Lower Austria. These strengths include the research fields of the natural sciences, technical sciences, life sciences, humanities, social sciences, cultural studies, agricultural sciences, and veterinary science. The basic strategy identifies success factors in these areas as

28 A comprehensive presentation of the research priorities for all public universities (incl. the University for Continuing Education Krems) for the performance agreement period 2013-15 is given in the 2013 Austrian Research and Technology Report on p. 62 ff as well as in the Annex on p. 181 ff; http://wissenschaft.bmwfw.gv.at/uploads/tx_contentbox/FTB_2013.pdf.
29 See Innovative Upper Austria 2020; The State of Upper Austria 2013; http://www.ooe2020.at/files/download_programmbuch_web_low.pdf
30 See The Economic Strategy of Styria 2020, The State of Styria 2011; http://www.wirtschaft.steiermark.at/cms/dokumente/10430090_12858597/002b1fe7/WiSt%20Steiermark%202020_Wachstum%20durch%20Innovation.pdf
31 See Research in Styria, The State of Styria 2013; http://www.gesundheit.steiermark.at/cms/dokumente/11806970_96572397/d8246e6e/Forschungsstrategie_A8_07.01.13.pdf
32 See Economic Strategy, Lower Austria 2020, https://www.noe.gv.at/bilder/d83/wirtschaftsstrategie_NOE_2020.pdf?33434
33 See RTI strategy for Lower Austria, Part 1, 2012, https://www.noe.gv.at/bilder/d71/FTI_Grundstrategie.pdf

being the technology parks that are essential for creating networks between science and business, as well as proximity to and cooperation with Vienna's universities. Strengths in corporate sector R&D are identified in the areas of mechanical engineering/machinery, chemical products, ICT, and food and feed products. This provided the foundation for identifying five strategically relevant research areas in which a currently ongoing process is meant to define specific thematic areas and fields of action. The five research areas comprise: agricultural technology, food and veterinary medicine, society and culture, health and medicine, natural sciences and engineering, as well as the environment, energy, and resources.

Carinthia's RTI strategy[34] identifies four thematic priority axes to guide the further development of Carinthia's innovation system. Along with human resources, these priorities include the thematic areas of information and communication technologies, production technologies, and sustainability, which are meant to be addressed through support measures in the defined fields of action in education, research, and innovation. Additional specifications were conducted within the priority axes. In the ICT field, a focus is meant to be established on interdisciplinary networking between embedded systems technologies, cultural studies, and the social sciences. Priorities in the cross-cutting field of sustainability are supposed to focus especially on renewable energies and sustainable building. A feature unique to Carinthia's RTI strategy is that it specifically addresses development goals for the region's higher education institutes: the University of Klagenfurt and the Carinthian University of Applied Sciences. This is meant to promote the technical and natural science disciplines in university education, especially in mathematics, physics, and information science. The focus on engineering and business is also being expanded at the University of Applied Sciences. Overall, the strategy envisions intensified coordination and alignment in priority-setting among Carinthia's institutions of higher education.

Tyrol's RTI strategy[35] addresses a series of research priorities and strengths that are meant to serve as the foundation for the future development of Tyrol's RTI landscape. The strategy identifies economic strengths in the areas of life sciences, mechatronics, renewable energies, information technology, wellness and tourism, as well as timber. It also names the following fields as possibly relevant to RTI in future: creative industries, material sciences and materials technologies, and the alpine region as an important living and economic environment. These fields are supplemented by the research priorities at institutions of higher education, which are addressed explicitly in the RTI strategy. Research priorities identified at the University of Innsbruck were: the alpine region – man and the environment, cultural encounters-cultural conflicts, molecular biosciences, physics, and scientific computing. Priorities at the Medical University of Innsbruck are found in the areas of oncology, neurosciences, genetics, epigenetics and genomics, infectious diseases, immunology, and organ and tissue replacement. The private university UMIT also specialises in a complementary fashion in the health sciences, public health and HTA, nursing science and gerontology, health care technologies, and management and economics in health care. The educational foci of the three universities of applied sciences are also mentioned here. For example, the Management Center Innsbruck (MCI) and Kufstein University of Applied Sciences are specialised

34 Carinthia 2020: Future through innovation, KWF 2009; http://www.kwf.at/downloads/deutsch/Service/Buchtipps/Kaernten_2020_Zukunft_durch_Innovation.pdf
35 Tyrolean research and innovation strategy, 2013, https://www.tirol.gv.at/fileadmin/presse/downloads/Presse/forschungsstrategie.pdf

in a similar educational manner in the social and economics sciences, as well as the natural sciences and engineering. The University of Applied Sciences Tyrol focuses on education in the health professions. These assessments of current conditions will serve as the basis for involving all stakeholders in developing and implementing specific measures meant to further develop Tyrol as a location for innovation and research.

The 2014 RTI strategy[36] for Burgenland identified three priorities for RTI positioning. These include the thematic areas of sustainable technology, sustainable quality of life, and intelligent processes, technologies and products, and are based upon existing RTI fields of strength that will be promoted and developed more intensively in future. In the area of sustainability, there are existing strengths in particular in the development of new construction materials and technologies, energy efficiency and sustainable or renewable energy production, research on intelligent energy systems and grids, as well as analysis of regional structures of consumption and value added. The strategy identifies the following fields as relevant to quality of life in terms of RTI: ambient assisted-living technologies, health competence and workplace health promotion, preventive measures and recreation in relation to psychological health, technologies, services and products in health, tourism, leisure time and culture, as well as product and process optimisations in food production. Potential areas in the thematic grouping of intelligent processes, technologies and products include: optoelectronics, mechatronics and materials and their intelligent application. In future, aspects of Industry 4.0, as well as innovative services, IT, and the creative industries will be the focus of attention.

Development processes for new RTI strategies are currently ongoing in Salzburg, Vorarlberg, and Vienna. The strategy development process for the next Vienna RTI strategy for 2016–2020 is targeted for completion in the autumn of 2015. The thematic priorities of the last Vienna RTI strategy 2008–2015[37] were comprised of life sciences/medicine, mathematics, physics, ICT, and the creative industries. Because Vienna is a metropolis, interdisciplinary potentials and important questions related to future RTI policy were also located in the fields of energy supply, transportation, water supply, environmental technology, and health, as well as regional aspects of climate change. In addition, further incentives were set in place for the further development and promotion of Vienna's traditional areas of knowledge in the humanities, social sciences, and cultural studies.

In addition to being tasked with active participation in regional RTI strategy processes, the universities were instructed – in the context of the "Lead Institution Initiative" in the current performance agreement period with the Federal Ministry of Science, Research and Economy (BMWFW) – to conceive their own priority-setting measures to be more strongly rooted in the regional environment and making use of the potential of their location. Fifteen of twenty-two universities have set the development of their own location concepts as milestones in their performance agreements. The initial measures have already been implemented by some universities. When the University of Klagenfurt, for example, was developing its internationalisation strategy, they subjected their cooperation structures to an internal analysis that resulted in the definition of three "cooperation orbits", from Carinthia to the Alpine-Adriatic region to global partnerships. In Upper Austria, the Technology Management and Regional Development Agency, together with the University of Linz,

36 See The RTI strategy of the Burgenland 2025, 2014, http://www.fti-burgenland.at/fileadmin/user_upload/FTI_Strategie_2025.pdf
37 See Vienna looks to the future, City of Vienna 2007, http://www.fti-burgenland.at/fileadmin/user_upload/FTI_Strategie_2025.pdf

commissioned studies on dual-strength fields in which scientific and economic growth potential are illuminated together.[38] In a few states (currently in Salzburg, Styria, Tyrol, Carinthia, and Burgenland), regional universities have banded together into Higher Education Conferences to facilitate the best possible coordination in the strategic further development of the regional higher education environment and to utilise synergies in the formulation of joint location concepts.

An expert report[39] by the European Commission honoured the Federal Ministry of Science, Research and Economy's "Lead Institution Initiative", associated with the 2013–2015 performance agreements, as a best practice example for the implementation of the "Smart Specialisation" approach in strategic processes at universities. Progressing coordination and collaborative priority-setting among domestic universities should also be encouraged and documented in future performance agreements, in terms of interactions between related institutions and disciplinary areas, yet also between institutions with different profiles at the same location.

3.3 Significance and structure of third-party R&D financing at Austrian universities

The financing of university research by third-party funding is marked with different implications depending on the source of the funds, whether this pertains to the funding provider (public or private) or the type of funded or financed research activities. In terms of public financing, there has been a discernible international trend of increasing project- and performance-oriented financing mechanisms in public funding distribution to universities[40]. A more nuanced design of public financing mechanisms for R&D should promote scientific quality in the context of restricted budgets with the objective of increasing the international competitiveness of national scientific research.

Depending on the program's structure (top-down vs. bottom-up thematic priorities, person-based vs. project-based funding, partnership structures), research policy can address different national strategic objectives in research agendas. University research that contributes to the solution of social problems or generates knowledge relevant to an (economic) location is funded with increasing frequency. Public steering mechanisms by means of competitive forms of funding can address both applied and basic research, as well as funding for cooperative research, such as in programs like COMET or the Christian Doppler Society. External funding received for cooperative research, as well as third-party funding acquired directly from business partners or other private institutions actively performing research, are important indicators of knowledge and technology transfer between academic and non-university institutions whenever knowledge is handed on, either as a contract, as a cooperative research project in the institutes' sub-sector ("kooperativer Bereich"), or circulated among organisations. Third-party funding can serve as an instrument for internationalising research activities, for example by means of EU Framework Programmes that target international research teams and represent supplements to national funding. The promotion of university priority-setting must also be viewed in the context of third-party funding acquisition, for example as start-up funding for developing new research priorities. At the same time, acquired third-party funding can be an indicator that the formation of a new priority has been successful, both in terms of excellence in existing scientific fields as well as business enterprise demand for specific university expertise.[41]

38 See Federal Ministry of Science, Research and Economy (BMWFW) (2014).
39 See EC (2014).
40 See Niederl et al. (2011b).
41 See Brandt et al. (2012).

The increased importance of efficiency and performance indicators is mirrored directly in the financing structure of Austrian universities. University funding from federal global budgets is comprised of two components, in that the basic budget, which is awarded on the basic of performance agreements, is supplemented by a performance-oriented, indicators-based share of funding. From 2004 to 2012, this was done based on what was called a "Formelbudget", calculated on the basis of eleven differently weighted indicators, that constituted about 20% of the global budget for universities.[42] Guided by the goal of reducing the complexity of the "Formelbudget", the 2013–2015 performance agreement period saw the introduction of a new instrument, the higher education structural fund, which is based on four indicators to award a performance-oriented budget share of €387 million as well as a competitively awarded share of €63 million for start-up financing for cooperative ventures. Third-party income from R&D projects and from projects in the development and inclusion of the arts were already included in the set of indicators for the "Formelbudget". Of the higher education structural funds, 14% was awarded on the basis of this indicator in the 2013–2015 performance agreement period. This means that third-party funding, in addition to the immediate income effect for universities, also has an additional budgetary significance as leverage for public funds which serve, among other things, to cover the indirect costs of activities funded by third parties.[43]

The term third-party funding is often used in everyday language as a synonym for various sources of university income that go beyond the allocation of funds by the public purse, such as income from rentals, further education services, or commercialisation. This report only focuses on the significance and structure of research-related receipts from third-party funding[44] as it is gathered for allocation by the higher education structural fund. Only "revenues from R&D projects and from projects in the development and inclusion of the arts", as identified by the universities in the "Wissensbilanzen" indicator 1.C.2, are considered third-party R&D funding.[45] Projects are defined as research projects or projects in the development and inclusion of the arts "*…according to Section 26 Para 1 and Section 27 Para 1 Z 2 and 3 of the Austrian University Act, on which single or several people work together, in the course of which university equipment is utilised*".[46] This includes income and funding governed by contracts as "*…a monetary equivalent, to be allocated to the respective reporting period, for services rendered in connection with projects and research under Section 26 Para 1 and Section 27 Para 1 Z 2 and 3 of the University Act*".[47] This means that receipts from third parties, for example income from license receipts and patents, income from endowed professorships, or income from rentals, courses offered, and continuing education, are not included in research-related revenues from third parties.

3.3.1 The development of third-party R&D funding revenues

The development in third-party funding income from R&D and art-related projects, as well as their proportion in overall university income, can be seen in Fig. 3-4. The growing significance

42 See Federal Ministry of Science, Research and Economy (BMWFW) (2014).
43 See Austrian university structural funds directive (2012).
44 Definition of "revenues from R&D projects and projects for the development and inclusion of the arts": "revenues to be allocated to the respective reporting period, for services rendered in connection with projects and research under Section 26 Para 1 and Section 27 Para 1 Line 2 and 3 of the University Act".
45 Since the reporting year 2011, previous figure IV.2.5.
46 See WBV working aid version 2013, p. 36.
47 Ibid., p. 38.

of third-party R&D funding is shown by an absolute increase of 47.1%, from €406.2 million in 2007 to €597.5 million in 2013. The share of third-party funding for R&D and development/inclusion of the arts in total revenues for universities is reported as an indicator of its significance. Along with revenues from global budget allocations from the federal government and third-party funding for R&D and development/inclusion of the arts, total revenues also includes revenues from tuition fees and related compensation, continuing education services, as well as other income and reimbursement of costs.[48] During the period under observation, there was a slight rise by one percentage point from 15.5% in 2007 to 16.5% in 2013, with some fluctuations in between. In relation to global budget allocations by the federal government according to the financial statements, third-party funding and the development and inclusion of the arts also increased, from 1:0.18 in 2007 to 1:0.21 in 2013. Simply put, this means that in 2013 the universities collected 21 cents in third-party R&D funding for every €1 from the global budget.

Correspondingly, Fig. 3-5 presents the share of third-party R&D revenues from R&D projects/projects associated with the development and inclusion of the arts in overall revenues, as well as their absolute amounts in € millions for 2013. In relation to overall revenues, third-party R&D funding is of especially great importance for technical and medical universities, as well as for BOKU and the University of Linz.

3.3.2 Structure and distribution of third-party R&D funding

The structure of third-party funding revenue is presented in Table 3-3 by ordering client organisation. Public funds represent the largest share of third-party funding revenues at universities. In 2013, about €142.3 million came from Austrian Science Fund (FWF) grants, €51 million from the Austrian Research Promotion Agency (FFG), €24.3 million from the federal government, and €33.4 million from the regional governments (including their foundations and grant institutions). EU funds amounted to €83.2 million. Revenues from firms (domestic and abroad) as ordering clients amounted to €155.4 million in 2013, thereby comprising about one quarter of overall third-party R&D funding revenues.

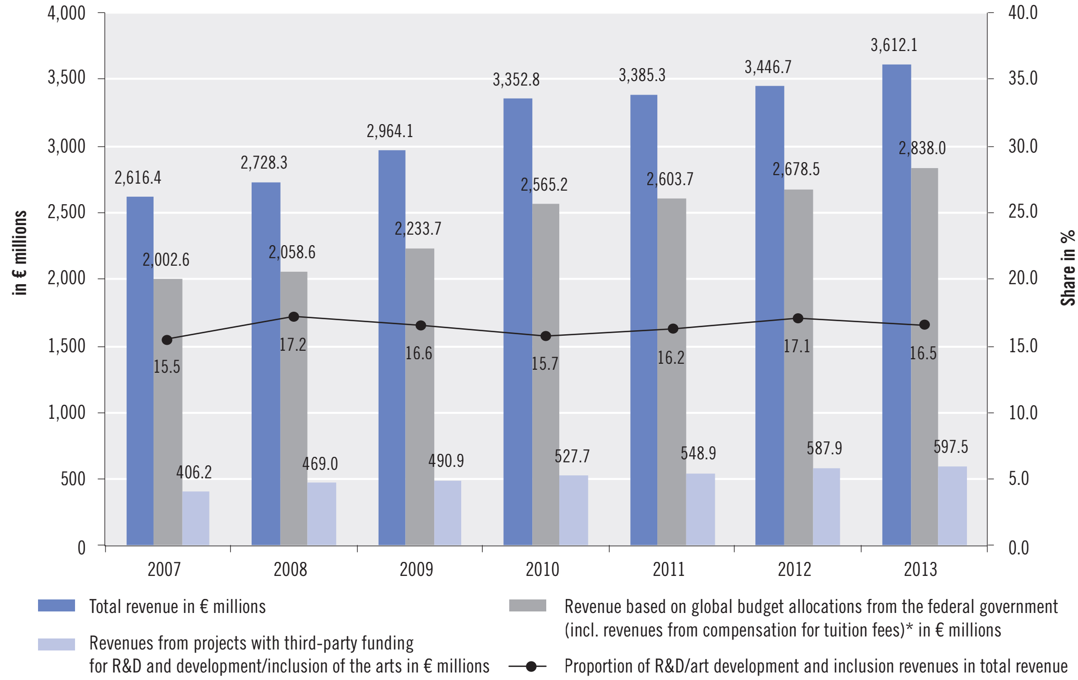
This picture was relatively stable throughout the period under observation. The strongest growth was posted in receipts from the regional governments (which grew by a factor of 1.3) and from the Austrian Research Promotion Agency (FFG) (by a factor of 1.2). Receipts of EU funds have nearly doubled since 2007, and receipts from firms have risen by half. A breakdown of ordering client firms within Austria by region of location is not possible on the basis of the "Wissensbilanzen".

The following examines the significance of individual ordering client organisations for third-party R&D funding at the level of universities in relation to their share of overall R&D revenues. Developments are a bit more uneven here (see Table 3-4). Third-party funding from firms is especially significant for medical and technical universities. Such funding constitutes 70% of total R&D revenues at the University of Leoben, followed by the Medical Universities of Graz and Innsbruck with 50% and 41.1% respectively, and the Technical University of Graz (39%) and the Technical University of Vienna (34%). Third-party corporate R&D funding also contributes about 30% of total R&D revenues at BOKU and the University of Klagenfurt.

Another significant funding channel for third-party R&D funding for most universities is the Austrian Science Fund (FWF). Over 50% of third-party-financed R&D revenues at the Universities of Vienna and Graz came from the Austrian Science Fund (FWF); at the Academy of Fine Arts, this number even exceeded 60%. At

48 See final account statements of universities.

Fig. 3-4: Development of third-party R&D funding at public universities, 2007–2013

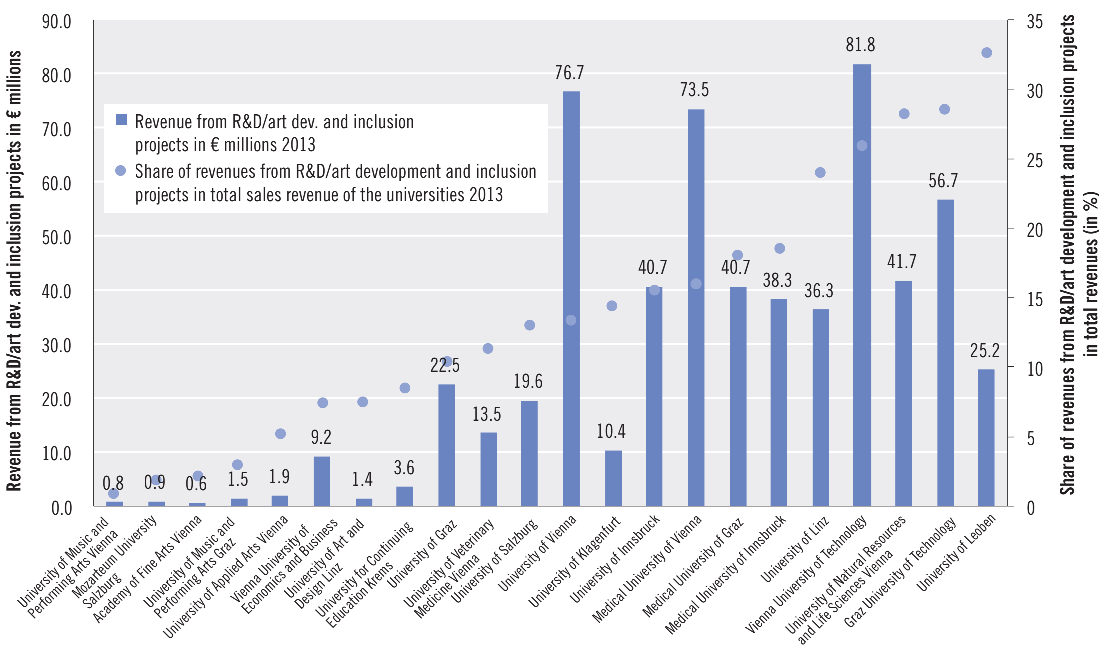


* incl. hospital overheads; 2008, 2009 incl. revenues from other federal grants.

Note: incl. the University for Continuing Education Krems (DUK), which however is a divergent form of funding among the 21 universities according to Section 6 of the University Act.

Source: Final account statements of universities. Graphic: JOANNEUM RESEARCH.

Fig. 3-5: Third-party R&D revenues, as well as their share of total revenues, by university, 2013



Source: Final account statements of universities 2013. Graphic: JOANNEUM RESEARCH.

the University of Linz, in contrast, R&D revenues from the Austrian Research Promotion Agency (FFG) constituted 31.7% of total R&D receipts, which was the single most important source of third-party R&D funding. Austrian Research Promotion Agency (FFG) funds constituted a share of 19.5% of total R&D revenues at the Graz University of Technology and 18% at the University of Leoben, which meant that Agency funding came in second to business enterprise R&D funding. The share of R&D receipts from EU funds ranged between 10% and 20% for most universities; at the University of Music and Performing Arts Vienna, it amounted to almost 30%.

In terms of regionality, R&D funding from states was significant for both the University of Music and Performing Arts Graz and University of Music and Performing Arts Vienna, at about 25%, although this must be viewed in relation to the comparatively low total R&D funding of €1.5 million and €765,000 respectively. The same applies to the high share of private R&D revenues (78%) at the Mozarteum University Salzburg, with a volume of total R&D revenues of €923,000.

At the University for Continuing Education Krems, third-party R&D funding by state ordering clients represents the most significant source category, with a share of 30% of total R&D receipts. However, consideration of this revenue structure must take into account the University for Continuing Education Krems' special profile as a university for continuing education.

Table 3-5 shows the distribution of revenues from R&D and projects on the development and inclusion of the arts by fields of science. The distribution of third-party funding across fields of science essentially follows overall university specialisations. Among the 'full universities' in Vienna, Graz, Innsbruck and Salzburg, there is a concentration in the natural sciences; at the University of Vienna, for example, in biology, physics, and mathematics.

Since 2005, the share of staff financed by third-party funding according to Sections 26 and 27 of the University Act within the overall staff of universities increased further, from 14.2% in 2005 to 17.3% in 2007 and 20.6% in 2013.[49] The number of people nearly doubled, from 5,773 in 2005 to 11,115 in 2013.[50] The share of overall

Table. 3-3: Third-party funding by ordering client organisation (in %), 2007–2013

	2007	2008	2009	2010	2011	2012	2013
Austrian Science Fund (FWF)	21.4	23.2	23.0	22.9	23.4	23.5	25.0
Austrian Research Promotion Agency (FFG)	5.8	6.2	7.6	9.4	9.1	9.2	8.5
Federal government (ministries)	7.8	6.8	7.5	7.4	6.0	5.0	4.1
EU	10.3	13.2	12.1	12.8	12.5	13.9	13.9
Regional governments (incl. their foundations and institutions)	3.5	2.9	2.0	2.7	4.4	5.0	5.6
Municipalities and municipal organisations (excl. Vienna)	0.6	0.7	0.8	0.3	0.3	0.4	0.5
Firms	25.7	21.8	22.6	20.4	23.1	22.1	26.0
Other*	24.3	24.5	23.7	23.6	20.3	20.7	16.3
unknown/not assignable	0.6	0.6	0.7	0.4	0.8	0.1	0.0
Total	100	100	100	100	100	100	100

* To facilitate a uniform presentation over the period under observation, the rubric of "other" income summarises income by the Austrian Academy of Sciences, the Jubilee Fund of the Austrian National Bank, other public and private institutions, as well as international organisations, that has only been surveyed in this form in 2011. This was previously listed under the rubrics "legal interest groups", "foundations/funds/other funding institutions", and "other".

Source: uni:data (2015). Calculations: JOANNEUM RESEARCH.

49 These are typically employment contracts of limited duration; see Federal Ministry of Science, Research and Economy (BMWFW) (2014, p. 104).

50 See uni:data (2015): Staff at universities – headcount; total of scientific staff on R&D projects financed by third-party funding (2013: 8,646) and general staff on R&D projects financed by third-party funding (2013: 2,469).

Table 3-4: Source of third-party funding by university as share of total R&D/art development/inclusion revenues, 2013

	Revenues from R&D/art development/ inclusion projects	EU	Federal government (ministries)	Regional governments and municipalities	Austrian Science Fund (FWF)	Firms	Other	Other international organisations	Austrian Research Promotion Agency (FFG)	Other public institutions/foundations*	Private (foundations, associations, etc.)	not assignable
	€ millions	in % of total R&D/art development/inclusion revenues										
University of Vienna	76.7	17.1	4.0	7.2	52.9	4.6	4.5	0.3	1.4	5.3	2.6	-
University of Graz	22.5	11.2	4.3	7.6	57.3	4.1	0.5	2.4	3.4	7.2	2.0	-
University of Innsbruck	40.7	21.0	4.5	8.1	33.2	14.1	0.2	0.6	6.5	6.8	5.1	-
Medical University of Vienna	73.5	7.0	2.5	1.9	21.3	23.2	29.8	0.2	1.5	3.8	8.9	-
Medical University of Graz	40.7	6.6	2.5	20.6	10.0	50	4.3	0.2	1.5	2.7	1.7	-
Medical University of Innsbruck	38.3	14.1	9.6	3.3	21.1	41.1	1.1	-	2.0	5.1	2.7	-
University of Salzburg	19.6	17.4	5.9	3.6	28.6	9.7	18.2	-	5.2	10.9	0.5	-
Vienna University of Technology	81.8	17.9	2.7	4.7	21.0	33.6	1.0	0.8	13.6	4.8	-	-
Graz University of Technology	56.7	14.4	2.4	2.5	11.9	38.6	3.4	-	19.5	7.2	0.1	-
University of Leoben	25.2	6.0	-	1.0	3.7	69.9	-	-	18.0	1.4	0.0	-
University of Natural Resources and Life Sciences Vienna	41.7	16.0	7.6	8.7	17.4	27.8	0.3	0.3	6.2	5.7	9.5	0.5
University of Veterinary Medicine Vienna	13.5	10.1	3.7	4.6	28.3	11.6	2.4	-	4.4	6.2	28.6	-
Vienna University of Economics and Business	9.2	15.1	5.9	2.3	20.4	8.3	28.7	-	2.0	10.2	7.0	-
University of Linz	36.3	13.5	1.2	4.1	21.3	15.7	1.0	-	31.7	11.4	0.1	-
University of Klagenfurt	10.4	24.0	13.8	6.2	10.2	26.2	1.6	1.0	7.2	3.8	6.0	-
University of Applied Arts Vienna	1.9	20.5	5.3	2.6	49.9	2.6	4.5	0.1	2.1	10.5	1.9	-
University of Music and Performing Arts Vienna	0.8	29.8	7.2	23.5	16.3	5.7	-	-	-	8.4	9.0	-
Mozarteum University Salzburg	0.9	-	0.3	12.1	-	1.6	-	-	-	8.1	77.9	-
University of Music and Performing Arts Graz	1.5	-	0.3	24.5	46.9	5.4	1.3	0.9	18.7	0.7	1.3	-
University of Art and Design Linz	1.4	0.1	61.4	10.2	1.6	19.4	6.8	-	-	0.5	0.1	-
Academy of Fine Arts Vienna	0.6	-	8.6	1.3	63.6	4.8	12.9	-	-	7.2	1.6	-
University for Continuing Education Krems	3.6	19.2	4.7	30.2	3.3	11.7	0.0	0.0	10.9	4.5	15.5	-

* (Austrian Academy of Sciences, Jubilee Fund of the Austrian National Bank, public foundations/funds)

Source: uni:data (2015). Calculations: JOANNEUM RESEARCH.

staff has been around 20% in the years since 2010. The majority of third-party-financed staff, which had a constant share of 16% of total employees, were found in scholarly and artistic staff (see Fig. 3-6). The share of general staff financed by third-party funding was relatively constant at about 4% between 2010 and 2012, and was 4.6% in 2013.

At about one-third of all universities, the share of scientific/artistic staff financed by third-party funds (head count) according to Sections 26 and 27 of the University Act among overall scientific/artistic staff stood at one quarter or significantly above (Fig. 3-7). The University of Leoben had the highest share of scientific and artistic employees among overall researchers at 52%. The University of Natural Resources and Life Sciences followed with 42%. The technical universities of Vienna and Graz had shares of about 36%, while the medical universities of Vienna and Innsbruck had shares of about 30%.

Table 3-5: Distribution of revenues from R&D projects by fields of science, 2013

	Revenues from R&D/art development/inclusion projects	Visual arts	Performing arts	GeoSci	Human Medicine	AgSci, VetMed	Music	Natural sciences	SocSci	TechSci	not assignable
	€ millions	in % of total R&D/art development/inclusion revenues									
University of Vienna	76.7	-	-	19.2	3.4	0.3	-	59.3	17.1	0.6	-
University of Graz	22.5	-	-	13.2	3.5	-	-	63.8	19.6	-	-
University of Innsbruck	40.7	-	-	11.5	6.2	-	-	59.7	10.3	12.3	-
Medical University of Vienna	73.5	-	-	-	100	-	-	-	-	-	-
Medical University of Graz	40.7	-	-	-	96.2	-	-	2.8	0.5	0.5	-
Medical University of Innsbruck	38.3	-	-	-	91.8	-	-	7.9	0.2	-	-
University of Salzburg	19.6	-	-	17.8	9.0	0.3	-	44.7	23.4	4.9	-
Vienna University of Technology	81.8	0.4	-	0.1	0.4	-	-	41.4	4.8	52.8	-
Graz University of Technology	56.7	-	-	0.2	0.7	0.3	-	33.2	0.7	64.8	-
University of Leoben	25.2	-	-	0.1	-	-	-	23.2	1.4	75.3	-
University of Natural Resources and Life Sciences Vienna	41.7	-	-	0.7	2.5	18.2	-	55.2	9.0	14.5	-
University of Veterinary Medicine Vienna	13.5	-	-	0.7	-	70.8	-	28.5	-	-	-
Vienna University of Economics and Business	9.2	-	-	1.0	-	-	-	2.7	96.3	-	-
University of Linz	36.3	-	-	0.1	-	-	-	53.8	9.0	36.8	0.3
University of Klagenfurt	10.4	-	-	6.2	1.7	-	-	25.7	35.7	27.5	3.2
University of Applied Arts Vienna	1.9	41.4	-	33.1	-	-	-	10.2	8.1	7.2	-
University of Music and Performing Arts Vienna	0.8	-	-	1.8	-	-	-	1.8	-	-	96.4
Mozarteum University Salzburg	0.9	-	-	-	-	-	100	-	-	-	-
University of Music and Performing Arts Graz	1.5	-	13.4	21.4	-	-	23.8	13.8	-	13.8	13.8
University of Art and Design Linz	1.4	65.9	4.0	21.9	-	-	-	-	-	-	8.2
Academy of Fine Arts Vienna	0.6	29.6	-	40.9	-	-	-	29.4	-	-	-
University for Continuing Education Krems	3.6	2.6	0.0	1.7	18.5	0.0	0.0	23.2	28.4	25.6	-

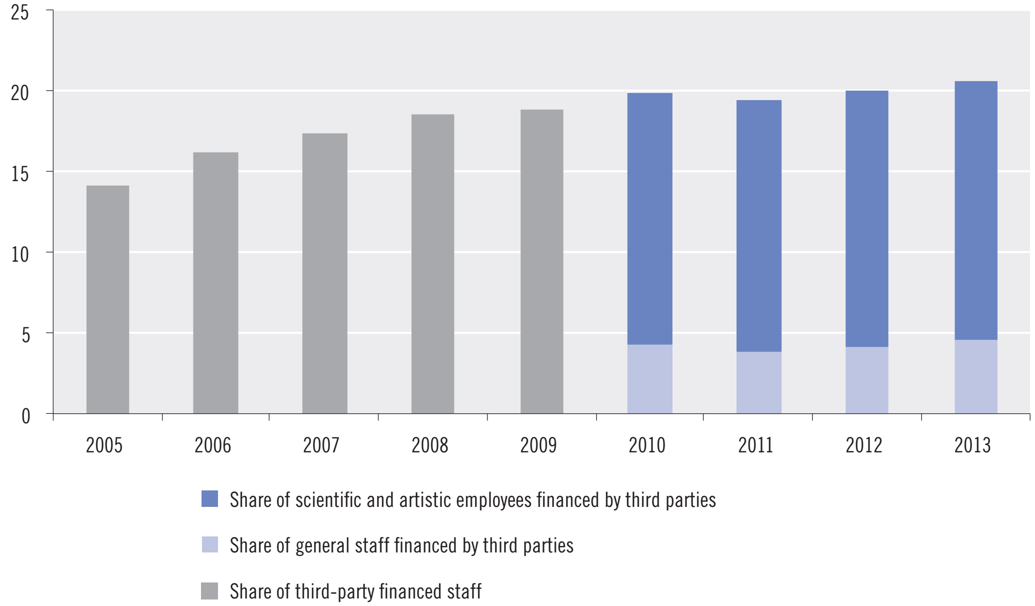
Source: uni:data (2015). Calculations: JOANNEUM RESEARCH.

3.3.3 General questions regarding third-party financing at universities

The increasing share of third-party-financed projects in university funding is associated with indirect costs that have to be covered by global budgets (i.e., acquisition, administration, infrastructures).[51] Although funding mechanisms such as the Austrian Science Fund (FWF) and Austrian Research Promotion Agency (FFG) funding programmes, as well as the current Horizon 2020 EU Research Framework Programme, anticipate third-party funding for university projects, they often do not cover the actual costs incurred by the third-party-financed project.[52] An assessment of project funding introduced into research by Germany's Federal Ministry of Education and Research found that, in the projects reviewed, an average of almost 41% of additional variable costs (measured against funded costs) was incurred. If the run-up and follow-up project phases were also included in the calculations, then the additional costs would increase again significantly.[53]

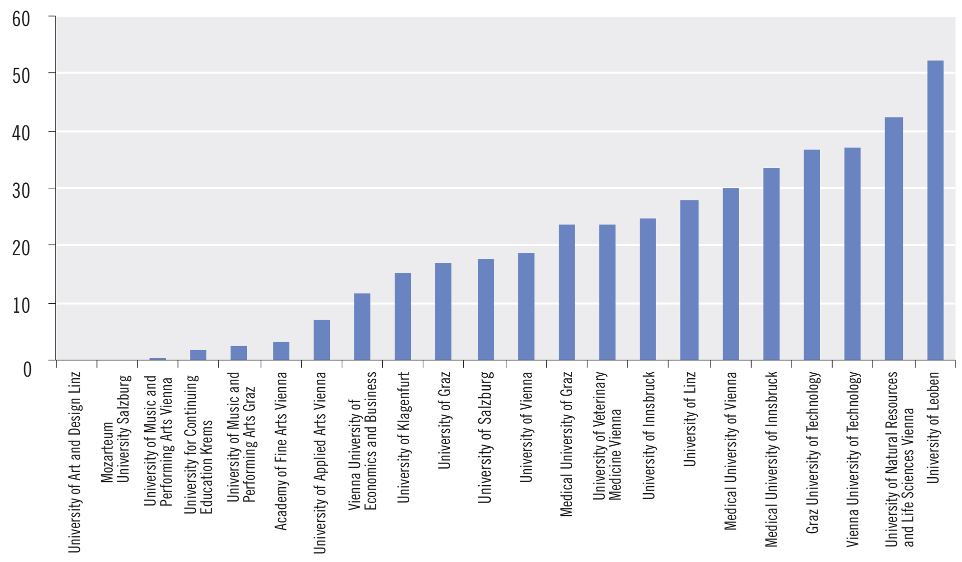
51 See Niederl et al. (2011b).
52 See Elias and Pöchhacker (2012).
53 See Astor et al. (2014).

Fig. 3-6: Share of third-party-financed staff among total staff (in %), 2005–2013



Source: uni:data (2015). Calculations: JOANNEUM RESEARCH.

Fig. 3-7: Proportion of third-party-financed scientific and artistic staff according to Sections 26, 27 of the University Act among total scientific and artistic staff* by university (in %), winter semester 2013



* Total scientific and artistic staff includes professors, lecturers, associate professors, assistant professors, university assistants, senior scientists/artists, senior lecturers, other scientific and artistic staff, and those staff, lecturers and student employees whose positions are financed on R&D projects with third-party funding.)

Source: uni:data (2015). Calculations: JOANNEUM RESEARCH.

This raises questions about the effects of third-party-financed research in terms of patterns of university activity. A series of studies have found a decreasing marginal return on third-party financing in research, meaning a drop in the performance-increasing effect of third-party financing over time. Some have even identified a bell curve pattern in which third-party funding, once past a certain amount, can also have negative effects on the provisioning (of other parts) of the university service portfolio.[54] This is caused on one hand by the high transaction costs in the acquisition and implementation of projects funded by third parties, which can also affect teaching and the supervision of the next generation of scientists due to the allocation of staff capacities. An important factor related to the success in acquiring third-party funding is the structural differences in the individual scientific disciplines in terms of tendencies toward cooperation and publication, which create different potentials for the acquisition of third-party funding.[55] Reference is often made to the danger of competition from third-party-financed research, especially from firms, in basic-oriented research, which typically also has a higher risk in terms of results that can be rendered commercially viable.[56]

3.3.4 Summary

The proportion of third-party R&D financing has increased at Austrian universities in recent years. There are several layers of implications in this development: first, third-party R&D funding in many fields is an indispensable factor for realising research projects and for expanding university research portfolios. At the same time, university administrators are facing new challenges, such as increasing competition for funding in an environment of tighter public budgets at a time when the public share of such financing remains high in international comparison; increasing internationalisation in research; and the rising significance of efficiency and performance indicators. Third-party funding revenues, especially those gleaned from cooperation with businesses, often serve as an important indicator for the strength of research, the success of university priority-setting, and their attractiveness for cooperation partners. At the same time, the acquisition of third-party funding places high administrative requirements on the universities and can also lead to financial burdens, as overhead costs are seldom covered by income from a project financed by third-party funding.

The extent of these costs for universities in Austria, as well as possible instruments for covering them, require a more profound analysis and discussion in Austria, and based on an improvement of available data. At the same time it should be noted, regarding the source of funding, that the amount and development of third-party R&D funding depends a great deal on supply-side factors, such as the economic environment and the development of public budgets for research support. About one quarter of third-party funding acquired in 2013 came from the Austrian Science Fund (FWF), and another quarter came from the business enterprise sector. An increasing share of third-party funding would therefore require corresponding funding for the Austrian Science Fund (FWF), sufficient success in Horizon 2020, and revenues from industry. Furthermore, the financing mix varies for individual types of higher education institutions, as is shown in the distribution of third-party R&D funding across the individual types of universities.

54 See Schubert et al. (2012).
55 See Brandt et al. (2012).
56 See Elias and Pöchhacker (2012).

3.4 Financing and managing research infrastructures

The research infrastructure at universities, universities of applied sciences, and non-university research institutions is an important foundation for excellent research. Research infrastructures, however, also enable the promotion of cooperation between science, industry, and society. The strategic development of research infrastructure is an important objective of the federal RTI strategy and is dealt with by the RTI Task Force's Working Group 4, "Research infrastructure". The following presents and discusses the results of a research infrastructure survey conducted at Austrian universities in 2014.[57] The discussion also takes stock of national and international opportunities for financing research infrastructures. At the European level in particular, Horizon 2020 presents a change in circumstances and funding opportunities for research infrastructures.[58]

3.4.1 Results of the Federal Ministry of Science, Research and Economy's Research Infrastructure Survey

A research infrastructure database was developed with the universities in 2011 to provide a foundation for financing research infrastructures in the context of performance agreements with the universities. The database contains research infrastructures with a procurement cost of at least €100,000. The database also has information about the number and type of research infrastructures in individual fields of science[59], their cooperative use, and the type of financing.

The research infrastructure database does not just deliver information for Austrian RTI policy; rather, participating universities and research institutions also use it as an information platform for the joint procurement and utilisation of research infrastructures.

The data was updated in 2012 and 2014. In 2012, the universities entered data on 1,331 research infrastructures (as at July 2012); 1,492 such infrastructures were reported in the 2014 survey. In addition to the 22 public universities, the Austrian Academy of Sciences also took part in the 2014 survey with 92 research infrastructures, and the Institute of Science and Technology Austria (IST Austria) with 21. A few universities of applied sciences, the Ludwig Boltzmann Gesellschaft, and Campus Science Support Facilities GmbH reported research infrastructures, however these will not be discussed in detail here.

Table 3-6 shows the number and type of research infrastructures in the individual fields of science at universities, the Austrian Academy of Sciences, and IST Austria in 2014; distinctions are drawn between large devices, core facilities, electronic databases, and spatial and other research infrastructures. 1,276 major pieces of large-scale equipment were reported by the institutions listed above, and these comprise the largest share of research infrastructures with 80%. 217 or 14% of all research infrastructures are core facilities. The remaining 7% of research infrastructures are 22 electronic databases, 45 research infrastructure spaces and 45 other research infrastructures. In terms of disciplinary allocation, over 900 research infrastructure spaces at Austrian universities are allocated to the natural sciences, which is more than half of all research infrastructures (55%). One quarter

57 With procurement costs higher than €100,000.

58 This section is based on research infrastructure studies by Heller-Schuh et al. (2015a) and Heller-Schuh et al. (2015b). Earlier evaluations have already been summarised in the University Report 2014 (see Federal Ministry of Science, Research and Economy (BMWFW), 2014). Presentations in the University Report were based on data as at July 2014. Values could therefore differ slightly when compared to the presentations made here, which were based on October 2014 figures.

59 The Austrian system (Statistics Austria 2013) was used as a reference for categorising research infrastructures by fields of science in 2012, which was based on the OECD revision of the system of fields of science (published as "New Fields of Science and Technology Classification").

Table 3-6: Number and type of research infrastructure by fields of science, all universities, Austrian Science Fund, and IST Austria, 2014

Fields of science	Core Facility	Major equipment	Electr. database	RI spaces	other RI	Total
Natural sciences	118.5	717.3	4.2	25.5	20.2	885.7
Engineering	43.0	341.1	0.9	11.9	6.7	403.6
Human medicine, health sciences	29.4	189.1	0.3	1.0	0.5	220.2
Agricultural sciences, veterinary medicine	4.4	19.9	0.7	0.7	2.0	27.7
Social sciences	3.9	4.9	0.7	1.0	4.0	14.5
Humanities	17.9	3.7	15.2	5.0	11.7	53.4
Total	**217.0**	**1,276.0**	**22.0**	**45.0**	**45.0**	**1,605.0**

Source: Federal Ministry of Science, Research and Economy (BMWFW). Calculations: AIT; Abbreviations: RI… Research infrastructure

of research infrastructures (25%) is being used in engineering and 14% in human medicine.

Table 3-7 shows the procurement costs for research infrastructures in the individual fields of science. Overall, Austrian universities, the Austrian Academy of Sciences, and IST Austria reported research infrastructure investments of €548 million: 75% (€381 million) was used for major equipment, 19% (€98 million) for core costs[60] for core facilities, 3% for electronic databases (€13 million), 5% (€25 million) for research infrastructure spaces, and 6% (€31 million) for other research infrastructures. The share of procurement costs in the individual fields of science corresponded in general with the number of research infrastructures: 57% (€311 million) of procurement costs fell to the natural sciences, 22% (€122 million) in engineering, and 12% (€67 million) in human medicine.

The Research Infrastructure Survey by the Federal Ministry of Science, Research and Economy (BMWFW) also collected information on the financing of new purchases. Reported research infrastructures that are valued over €100,000 were purchased with various funds from the public sector, or were financed by firms and sponsors. Information regarding the type of financing for procurement costs is available for 91% of the aforementioned research infrastructures, and were fully available for the Austrian Academy of Sciences and IST Austria. Institutions reported shares (in percentages) by type of funding.[61]

More than half of funds (54% or €281 million) for financing of procurement costs came from global budgets and another 28% or €146 million came from funding programmes of the Federal Ministry of Science, Research and Economy (BMWFW) (e.g., the initiative funding programmes). Table 3-8 illustrates that the shares of financing types differ among the individual fields of science. In most fields of science, research infrastructures are financed about 50% from the global budget (57% or €297 million across all scientific fields); in the natural sciences, about 60% or €179 million come from the global budget, and among the social sciences

60 The core costs are the procurement costs for core facilities that are left after deducting affiliated research infrastructures over €100,000 that are recorded under their own entries.

61 The following distinctions are drawn: Global budget, basic financing (IST), federal funding programmes (FP_BMWF until 28 Feb 2014, FP_BMVIT, FP_BMWFW as of 01 March 2014, FP_FWF, FP_FFG, FP_other), other third-party funding from Section 27 of the University Act of 2002, funds from higher education research institutions (HEI), state or municipal funds, EU funding programmes (EU FP), firms/private sponsors, art institutions.

Table 3-7: Procurement costs of research infrastructure by fields of science, all universities, Austrian Science Fund, and IST Austria, 2014

Fields of science	Core Facility	Major equipment	Electr. database	RI spaces	other RI	Total
Natural sciences	47,788,115	228,659,833	1,984,750	18,298,366	14,323,089	311,054,153
Engineering	22,743,896	88,794,829	640,000	5,219,288	4,738,864	122,136,877
Human medicine, health sciences	10,126,153	55,383,964	118,800	458,000	575,000	66,661,917
Agricultural sciences, veterinary medicine	2,418,212	5,485,610	277,200	572,069	815,502	9,568,593
Social sciences	938,475	1,214,317	116,129	180,000	5,118,181	7,567,102
Humanities	13,565,165	1,693,511	9,757,254	622,212	4,947,166	30,585,308
Total	**97,580,016**	**381,232,064**	**12,894,133**	**25,349,935**	**30,517,802**	**547,573,950**

Source: Federal Ministry of Science, Research and Economy (BMWFW). Calculations: AIT; Abbreviations: RI… Research infrastructure

Table 3-8: Financing of procurement costs for research infrastructure by fields of science, all universities, Austrian Science Fund, and IST Austria, 2014

Fields of science	Global budget	Basic IST financing	FP Federal Ministry of Science, Research and Economy (BMWFW)	other nat'l Third-party funding	EU FP	Business enterprise/ private
Natural sciences	60.2	2	24.7	10.8	0.8	1.6
Engineering	42.4	0	28.1	27.4	1	1.1
Human medicine, health sciences	56.4	0.5	28.6	11.5	1.3	1.7
Agricultural sciences, veterinary medicine	52.8	0.5	40.6	5.7	0.3	0
Social sciences	28.2	0	68.6	1.5	0	1.6
Humanities	45.4	0	51	2.2	0.4	1
Total	**54.4**	**1.2**	**28.4**	**13.7**	**0.8**	**1.4**

Source: Federal Ministry of Science, Research and Economy (BMWFW). Calculations: AIT; Abbreviations: FP… Funding programmes; HEI… Higher education institution

this figure is just 28% (€2 million). Almost 70% of funds (€5 million) in the social sciences are drawn from funding programmes of the Federal Ministry of Science, Research and Economy (BMWFW); for agricultural sciences, veterinary medicine, and the humanities, half of all funding came from funding programmes of the Federal Ministry of Science, Research and Economy (28% on average). Other third-party funding and projects are important as relevant funding sources in the technical sciences. No research infrastructure has yet been (co)financed with use fees. Funding from the Austrian Research Promotion Agency (FFG), Austrian Science Fund (FWF), and the European Research Framework Programmes amounted respectively to about 1% (including all specific competitive public funding programmes).

Figures were available for the type of use for 91% of the research infrastructure spaces reported by the universities, and for all of those reported by the Austrian Academy of Sciences and IST Austria. Fig. 3-8 shows the type of use by field of science. According to this, use within the institutions in almost all fields of science is over 80%. The highest share of usage in cooperation with external partners (18%) is found in engineering. The user profiles have remained unchanged since the first survey. About three quarters of university research infrastructures are available to other institutions of higher education through cooperative agreements ("open for collaboration"); the actual share of use by external partners remains significantly lower though.

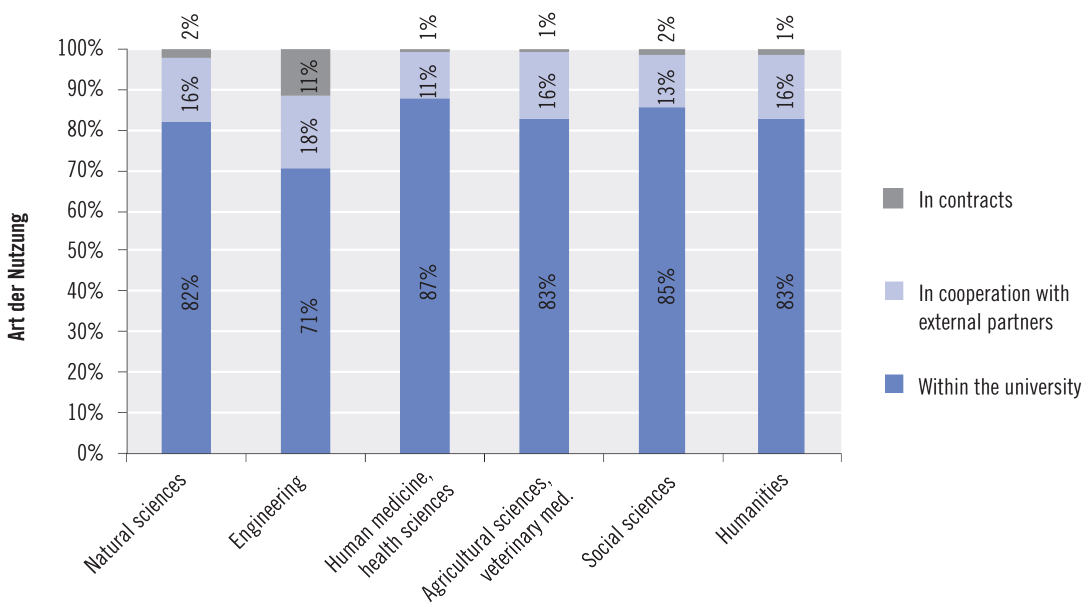
3.4.2 Funding opportunities from the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF)

As described in the previous chapter, base funding remains the most important source of funds for the procurement of research infrastructures by universities and other public institutions included in the database. In addition, a large number of investments were conducted in recent years using the former specific programmes of the Federal Ministry of Science and Research ("specific programme for improving research infrastructure"). An average of 80% of procurement costs is financed from both funding sources.

Furthermore, the extent to which the two large research promotion agencies – the Austrian Research Promotion Agency (FFG) and Austrian Science Fund (FWF) – promote investments in research infrastructures is of interest. These investments play a larger role for non-university research institutions that do not receive any base funding. Third-party funding from the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF) has been repeatedly used for financing at some universities that are oriented towards engineering and the natural sciences.

The Austrian Research Promotion Agency (FFG) represents a possible source of third-party funding for the financing of research infrastructure. For financing of research infrastructure in the context of research projects by the Austrian Research Promotion Agency (FFG), the following generally applies: *"Costs for instruments and equipment [can be financed] insofar and as long as they are used for the project"* (= R&D infrastructure utilisation).[62] According to the

Fig. 3-8: Type of use by fields of science, all universities, Austrian Science Fund, and IST Austria, 2014



Source: Federal Ministry of Science, Research and Economy (BMWFW). Calculations: AIT. Abbreviations: OU: organisational unit; UI: university institutions.

62 See also the pricing guidelines for dealing with project costs in funding searches and reports for projects with funding contracts according to the RTD guidelines and Austrian Research Promotion Agency (FFG) guidelines, V1.4 valid as of 1 April 2014 (see Point "4.2.1 Costs for R&D infrastructure use", page 10); https://www.ffg.at/sites/default/files/downloads/page/kostenleitfaden_v1_4_2014.pdf

cost guidelines, *"proportional depreciation must be applied during the duration of the project."*[63] Furthermore, the following definition is given: *"The calculation of depreciation must be done fundamentally on the basis of useful life according to the schedule of investments (monthly attribution, proportional project use)."*[64] Financing cannot typically be provided however for construction investments, or investments in manufacturing machines or production systems. This rule also applies substantially to all Austrian Research Promotion Agency (FFG) programmes. [65]

Table 3-9 provides an overview of the proportion of funded costs that were fully funded for the procurement of research infrastructure (= category of equipment costs) for 2014 for selected programmes. The list shows that on average about 4.5% of all funding[66] for the procurement of research infrastructures was spent by applicants.

Conditions similar to those of the Austrian Research Promotion Agency (FFG) apply for the application and funding of financing of research infrastructures by the Austrian Science Fund (FWF): Proportional equipment costs are financed for use during the project's duration (= proportional depreciation of procurement costs).[67] Equipment costs can be financed by such vehicles as stand-alone projects, the START Programme, or in the special research areas (SRAs). The Austrian Science Fund (FWF), in its proposal documentation, specifies that only "project-specific costs" required for executing the project and that exceed the resources provided by the research site's "infrastructure" can be financed. The Austrian Science Fund (FWF) therefore does not finance any "basic equipment" for a research site. The rules are stricter than those of the Austrian Research Promotion Agency (FFG), as devices with an initial procurement value of over €24,000 must also meet the condition *"that no comparable device exists within reasonable proximity or can be shared."*[68] Overall, expenditures for equipment costs in total approvals in 2013 by the Austrian Science Fund (FWF) amounted to €1.7 million, which corresponds to 0.9% of total funding (2012: 1.0%).[69]

3.4.3 Funding opportunities from the European Commission

EU financing instruments (which here means the European Regional Development Fund (ERDF) in the European Structural and Investment Funds (ESIF) and Horizon 2020) represent very important complementary funds for the financing of research infrastructure.

Cohesion and structural policy are among the European Union's central policy areas. In the EU funding period of 2014 to 2020, all "European Structural and Investment Funds" (social fund/ESF, regional fund/ERDF, rural development/EAFRD, cohesion fund/CF, fishery fund/EMFF) are being adapted to the Europe 2020 growth strategy and their core objectives, thereby supporting the implementation of the strategy plan in the member states. The development of a "Smart Specialisation" strategy is part of EU cohesion policy in 2014–2020 and is an important ex ante condition for receiving ERDF funds. The "Investments in Growth and Employment Austria 2014–2020" operational programme, co-financed by the ERDF, takes regional factors into account while setting a national

63 See also the pricing guidelines for dealing with project costs in funding searches and reports for projects with funding contracts according to the RTD guidelines and Austrian Research Promotion Agency (FFG) guidelines, V1.4 valid as of 1 April 2014 (see Point "4.2.1 Costs for R&D infrastructure use", page 10); https://www.ffg.at/sites/default/files/downloads/page/kostenleitfaden_v1_4_2014.pdf
64 Ibid.
65 Rules on state aid are applied for the public financing of research infrastructure. Due to an amendment in 2014, there are now also new rules that enable financing that extends beyond the payment of depreciation.
66 Without small formats, innovation vouchers, and internships.
67 See Austrian Science Fund (FWF) notes on applications for "stand-alone projects", November 2013, p. 6.
68 See Ibid., p. 7.
69 Austrian Science Fund (FWF) Annual Report 2013, p. 20.

Table 3-9: Cost allocations of selected programmes and in total (facility costs according to costs funded for R&D infrastructure utilisation), 2014

Selected programmes	Total costs (in €)	Costs of construction (in €)	Share of facility costs in total funded costs (in %)
BASIS	404,120,878	21,116,240	5.2
benefit	5,515,965	51,536	0.9
Bridge	20,906,300	628,300	3.0
COIN	11,825,484	931,080	7.9
COMET K projects	23,692,621	425,259	1.8
COMET K1 and K2 Centres**	138,121,841	4,822,895	3.5
ENERGIE DER ZUKUNFT (Energy of the Future)	7,227,342	42,308	0.6
IKT der Zukunft (ICT of the Future)	49,644,411	787,919	1.6
KIRAS	9,861,244	125,148	1.3
Mobilität der Zukunft (Mobility of the Future)	24,118,091	956,411	4.0
Produktion der Zukunft (Production for the Future)	28,812,713	2,213,797	7.7
Research Studios Austria	21,475,987	2,008,446	9.4
Smart Cities	5,002,116	103,650	2.1
TAKE OFF	12,577,093	576,080	4.6
All programmes total*	**846,606,438**	**38,361,553**	**4.5**

*) Without small formats, innovation vouchers, and internships.
**) Planned values for 2014.
Source: Austrian Research Promotion Agency (FFG)

focus on thematic programme goals and priorities, and it constitutes the basis of intelligent specialisation. In accordance with ESIF regulations, the operational programme of the "Investment in Growth and Employment Austria 2014–2020" focuses on four thematic programme objectives. "Strengthening research, technological development, and innovation" stands at the top of the programme objectives and priorities.[70] The first initiative, "research and technology infrastructure", specifically names the development and expansion of R&D infrastructures with the aim of deepening regional thematic fields or developing centres with an international orientation. It is considered advantageous if projects anticipate cooperation between research institutions or enable firms to have access to research infrastructures, as well as research centres and infrastructures in international context (i.e., in terms of transnational strategies, such as those of the EU Danube Region/EUSDR), and/or if these projects have international relevance (such as ERIC). The Austrian operational programme therefore represents a funding option for research infrastructures and competences so that Austria can attain critical size, and so that existing competences can be introduced to national and international programmes.

Future investments will be oriented towards the development status of innovation systems in accordance with the Austrian operational programme. The programme will specifically do the following: *"In regions with strengths in re-*

70 See ERDF programme investments in growth and employment in Austria, 2014–2020 – Operational programme for the use of ERDF funds, Version 1.2 of 10 December 2014; http://www.oerok.gv.at/fileadmin/Bilder/3.Reiter-Regionalpolitik/2.EU-Kohaesionspolitik_2014_/EFRE/OP_IWB_EFRE_%C3%96sterreich_Fassung_2014-12-16.pdf

search, the development of larger, basic-research-oriented infrastructures and centres with potential European and transnational significance, as well as the support of further development of Austrian ESFRI projects, is realistic. "[71] The ESFRI participation quoted here deals with the *Biobanking and Biomolecular Resources Research Infrastructure* (BBMRI).

Horizon 2020 provides funding of almost €2.5 billion from 2014 to 2020.[72] The main objective is to equip Europe with world-class research infrastructures that are available for all researchers in Europe – and others – and to exploit completely Europe's potential for scientific progress and innovation. These are primarily ESFRI infrastructures listed by the European Strategic Forum for Research Infrastructures (ESFRI) and prioritised on the ESFRI roadmap. The ESFRI Roadmap 2016 is being prepared currently. The procedure for creating the next ESFRI Roadmap was introduced on 25 September 2014 in the "Workshop to Launch the ESFRI Roadmap 2016" in Trieste.[73]

Horizon 2020 promotes the development and operation of research infrastructures, albeit very selectively in the form of ESFRI projects. Activities such as opening, networking, and joint further development are also directed at "world-class research infrastructures". Horizon 2020 only funds research infrastructures if they are accessible to all researchers and if they contribute to world-class research infrastructures of European interest. Funding for Austrian research infrastructure at the European level from Horizon 2020 is currently at relatively modest levels.

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71 See ERDF programme investments in growth and employment in Austria, 2014–2020 – Operational programme for the use of ERDF funds, Version 1.2 of 10 December 2014; http://www.oerok.gv.at/fileadmin/Bilder/3.Reiter-Regionalpolitik/2.EU-Kohaesionspolitik_2014_/EFRE/OP_IWB_EFRE_%C3%96sterreich_Fassung_2014-12-16.pdf

72 See REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014–2020) and repealing Decision No 1982/2006/EC; ANNEX II.

73 See http://www.copori.eu/_media/Report-final_28-10-14.pdf

4 Research and Innovation in the Business Enterprise Sector

4.1 Potential new production and communication technologies: Industry 4.0 and broadband infrastructure in Austria

This chapter examines the trend toward digitisation and integration of industrial value added processes, a development that is commonly referred to in Austria as "Industry 4.0". Industry 4.0 is currently being discussed intensively as part of a potential fourth industrial revolution and as a major opportunity, as well as challenge, for industry and production sites in industrialised countries. The following chapter presents potential opportunities and prospects, along with the challenges that Industry 4.0 poses for RTI policy.

One prerequisite for implementing new production and process technologies – and for the resulting commercial opportunities in business and industry – is the existence of powerful communication networks. This is why a sufficient broadband infrastructure in Austria is so important, a topic we will also address in this chapter.

4.1.1 Industry 4.0 as a new production paradigm

After mechanisation, electrification and automation, the digital integration of industry is being called the fourth industrial revolution and is currently being discussed in science, industry, politics and the media. The concept of Industry 4.0 emerged in Germany and was defined as part of the formulation of the high-tech strategy in 2012 as a project for the future. An important reference study on this topic is the final report of the Industry 4.0 working group,[1] published by the Industry-Science Research Alliance and the German Academy of Science and Engineering (acatech). This report provides recommendations for the implementation of Industry 4.0.[2] In addition to this, concepts such as *advanced manufacturing technologies* (AMT) and the *industrial Internet* are often discussed internationally. Together, these concepts provide road maps for technology to lead to a new form of industrialisation. In addition to Germany, other industrialised nations and the European Commission consider the development and use of new production and process technologies as a strategic challenge for industrial manufacturing.

The integration of people, objects and systems via the Internet is considered a key characteristic of Industry 4.0. The Internet enables machine-to-machine communication of autonomously shared information, as well as the triggering of actions and mutual control of systems. At the heart of this system are autonomous, self-controlling and self-configuring production resources, meaning machines, systems, robots, logistics systems and operating resources. This

1 The report mentioned describes Industry 4.0 as follows: "In production, the increasing intelligence of products and systems, whose vertical integration, combined with universal engineering, and horizontal integration via value added networks are leading to a fourth stage in industrialisation – Industry 4.0" (see Industry-Science Research Alliance and the German National Academy of Science and Engineering (acatech) (2013), p. 23).

2 Germany has a unique strength in mechanical and plant engineering, as well as expertise in automation technology and embedded IT systems, and it considers itself well positioned to develop its position further as a leader in production technology (Industry-Science Research Alliance and the German Academy of Science and Engineering (acatech) (2013)). In combination with competitive production locations in Germany, it made sense therefore to press forward with a strategy to expand the research, development, manufacturing and application of innovative production technologies.

integration of things and services is organised via so-called cyber physical systems (CPS). These virtual systems support interaction and communication and "fuse" physical and digital systems into a coherent, universal and flexible value added network. The overriding aim is the seamless horizontal and vertical integration of process steps and process hierarchies for the purpose of increasing productivity, resource efficiency, quality, and flexibility. The modelling and organisation of such CPS and their system architectures are critical to how Industry 4.0 solutions are actually implemented in practice and what consequences result, particularly, for the workforce and the workplace.

Industry 4.0 is developing into what are known as "smart factories", intelligent manufacturing facilities comprised of closely knit and highly sophisticated production networks.[3] Industry 4.0 also involves "smart products", products which have knowledge of the manufacturing process and actively support future implementation and the manufacturing process. This is intended to improve the flexibility, in order to better meet customer requirements. This is considered a key benefit of Industry 4.0, which creates both opportunities and challenges for the implementation of new business models. The collection and use of a large quantity of production data opens new possibilities, for instance, in the area of services for large, small and new enterprises.

Industry 4.0 also includes the use of information technologies (IT) and the Internet as part of product development. With virtual product development, the vision of digitising the entire value added chain, both inside and outside the enterprise, is becoming reality. IT-supported product development enables the development process to be accelerated, resulting in a shorter time-to-market, as well as allowing for experimentation with product versions and designs, up to and including the use of virtual reality.

The spread of Industry 4.0 is creating a paradigm change in the interaction between man and machine. Factories are going digital, potentially reducing their workforce, are connected electronically, and have an increasingly high level of automation.

Industry 4.0 has had wide-ranging effects on the working world and the role of the individual. New digital and virtual systems of work are undergoing a change due to advances in digitisation and integration so that people, supported and strengthened by information technology, can focus on new, creative activities. Additionally, the possibilities to incorporate collaborative robots and work assistant systems to organise age-appropriate and ergonomic production and work systems is considered an advantage when it comes to these issues, taking into account demographic factors such as staff shortages and an ageing population.[4]

In summary, with Industry 4.0 the following potential added value and value propositions are frequently mentioned, which are intended to considerably increase the competitiveness of Germany and Austria: customerization, flexibility and dynamisation of business processes, optimised decision-making, increased resource productivity and efficiency, value added through offering innovative services, as well as raising market potentials. In order to exploit these potentials, to shape the change and reduce the negative effects, efforts are called for that promote the policy in a diverse and multi-dimensional way.

4.1.2 The spread of innovative production technologies in Austria

The European Manufacturing Survey (EMS) for Austria from 2012 enables us to describe the spread of selected manufacturing technologies,

3 The use of the internet of things and services will not only change production but also many other areas of business, particularly service and supply systems: the concept of the smart factory will be joined by smart mobility, smart grids, smart buildings and smart health.

4 See Riemann et al. (2013).

which are gaining importance and being promoted in the context of Industry 4.0.[5] In the EMS, technologies such as robotics and automation, as well as the digital factory and IT integration, are surveyed.

The results of the EMS for Austria (see Fig. 4-1) demonstrate that the spread of innovative applications is not evenly distributed. Robots and handling systems are most frequently used, followed by supply chain management and automated warehouse management systems. By 2015, these technologies are expected to be in use at more than one-third of the approx. 250 surveyed Austrian industrial enterprises.

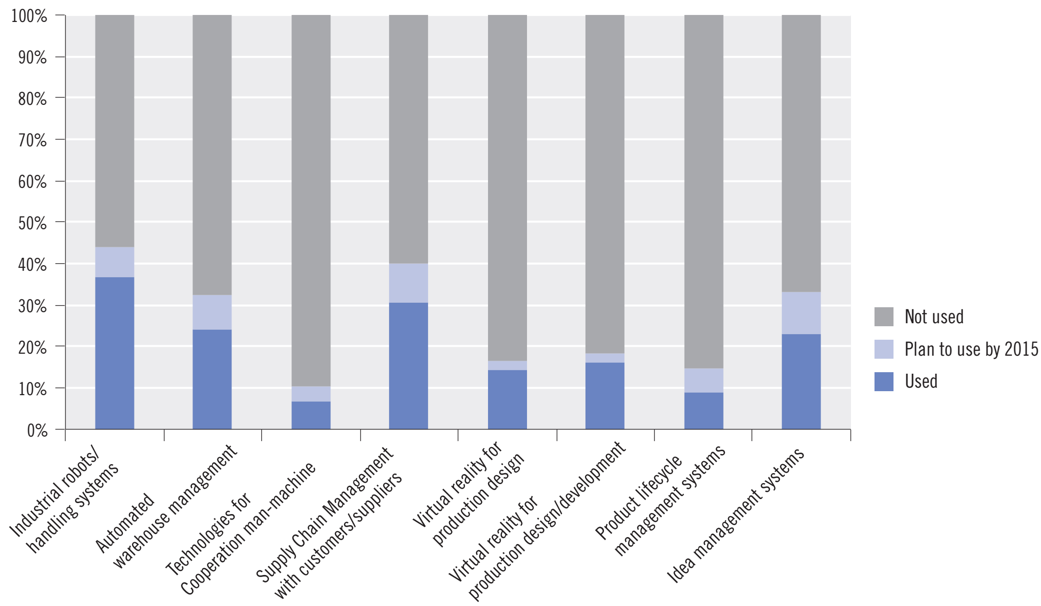
The implementation of the Industry 4.0 approach is a gradual process, which is diffused at different rates across the various sectors. Accordingly, the survey also shows differences in the technology intensity of the enterprises surveyed (see Fig. 4-2). Particularly with advanced applications, such as the use of virtual reality and solutions for human-machine collaboration, the enterprises in the high-tech sector are pioneers.

In order to benefit in the best possible and socially responsible way from the Industry 4.0 potential mentioned here, many different areas of action are required by all stakeholders: enterprises, research partners, employers, interest groups, customers, citizens, and politics.

Industry 4.0 is driven by plant builders and equipment manufacturers, as well as by production plants that deploy innovative production technologies. With its innovative mechanical and plant engineers, competitive industrial plants, and strong connections with Germany, Austria has good conditions for realising potential from Industry 4.0.

Industry 4.0 addresses new issues for technological development and research. In conjunction with German efforts to implement Industry 4.0, concrete topics were listed. The greatest need for research is seen in the area of horizontal and ver-

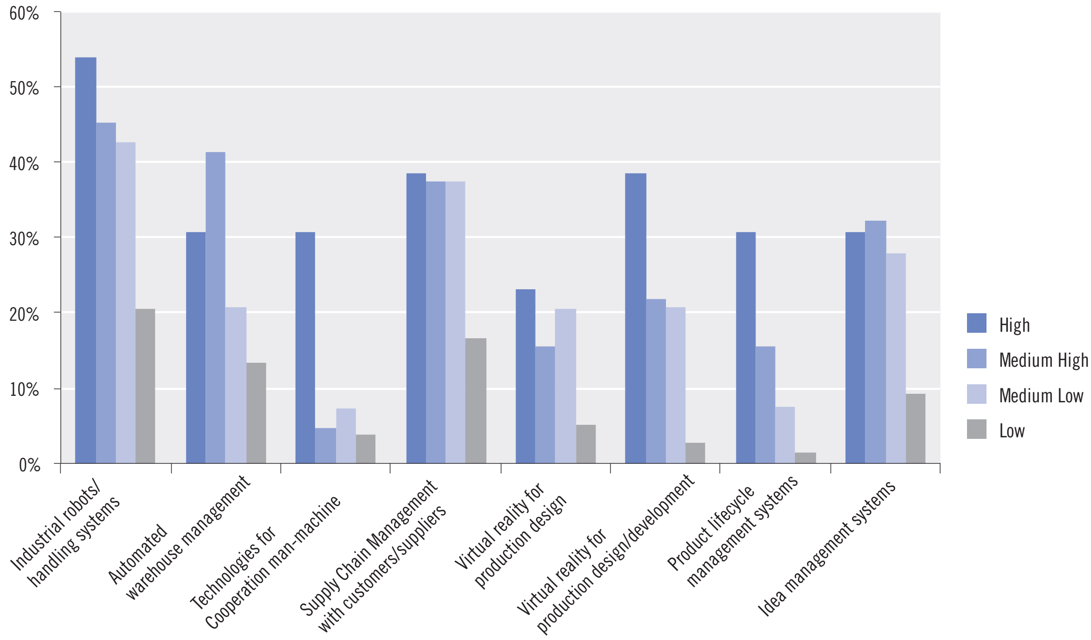
Fig. 4-1: Use of selected production technologies in Austrian Industry (in %)



Source: European Manufacturing Survey (2012). Calculations: AIT.

5 The European Manufacturing Survey (EMS) records the use of technical and organisational innovations in production and the improvements in performance achieved with this in manufacturing. There is now data for Austria available from four survey rounds, with the last survey taking place in 2012 (firms involved in manufacturing with more than 20 employees, for 2012 there were 250 firms in Austria; representative of the base population).

Fig. 4-2: Use of selected production technologies acc. to technology intensity of sector (in %)



Source: European Manufacturing Survey (2012). Calculations: AIT.

tical integration of production processes, as well as the universality of the engineering.[6]

Industry 4.0 is, however, much more than a technical challenge, the realisation of this vision calls for integration of technological and social innovations. As described, Industry 4.0 has manifold impacts on workplaces and work organisations. The goal here is to set relevant framework conditions and develop technologies through collaboration between engineers and users, to launch interdisciplinary R&D projects, and to develop new organisational models for work and its general conditions.

The networking of production steps within and between enterprises seems to allow for a new dimension of process innovations and hence rationalisation. Process innovations are limited not only to manual tasks but also increasingly include intellectual activities. Thus the technological developments of Industry 4.0 imply the question – as already with similar basic innovations in the past – of whether the new technologies and network solutions will or will not have net positive effects on employment.[7]

The strategy of funding Industry 4.0 is also in line with the increased promotion of industrial policy: The European Union has elevated industrial policy to a leading initiative as part of its "Europe 2020" strategy. The assumption here is that a stronger production sector also spurs R&D in other sectors, contributes at an above average level to international trade, and produces above average demand for services from other economic sub-sectors.[8] The USA should also be mentioned in this context, where the concept of the *advanced manufacturing partnership* (AMP) led to the creation of a funding programme in order to counteract de-industrialisation.

In terms of funding for research and development in Austria, RTI policy launched its first tar-

6 See Industry-Science Research Alliance and the German National Academy of Science and Engineering (acatech) (2013), p. 39ff.
7 See also in this regard the comments in Chapter 5.1.
8 See Mayerhofer (2013).

geted initiatives and measures in 2014, aimed at promoting Industry 4.0. They promote activities that were introduced in recent years in connection with funding of production research. In addition, this includes the funding programme Production for the Future, sponsored by the Austrian Research Promotion Agency (FFG), as well as new and complementary measures. In 2014, preparations were completed for the tendering leading projects for 2015 that have a focus on the area of Industry 4.0. The development of new, innovative business models, as well as intelligent products and processes, specifically for SMEs, will be promoted by the Austrian Research Promotion Agency (FFG) in the future as part of its services initiative. In this context we should also mention funding provided to establish a pilot factory at the Technical University of Vienna that was initiated by the Federal Ministry for Transport, Innovation and Technology (BMVIT). An Industry 4.0 information initiative was launched as part of a national cluster initiative of the Federal Ministry of Science, Research and Economy (BMWFW). Alongside the Austrian Research Promotion Agency (FFG) programmes, 2014/15 saw funding for projects for technology transfer and innovation management in connection with Industry 4.0 applications in a pilot project in the ProTrans programme of the Austria Wirtschaftsservice (aws). Finally, at a national level resources will be made available in the ERP fund for investment projects in the area of Industry 4.0 in conjunction with the credit programme for the industry and commerce sector.

Austrian stakeholders are also urged to take advantage of the possibilities for funding in Horizon 2020. The joint undertaking ECSEL (Electronic Components and Systems for European Leadership) is promoting here R&D for cyber physical systems among other topics. Alongside RTI and industrial policy, there are also challenges and areas of activity for other policy sectors, including areas such as technical standardisation, data security, labour law and consumer protection.

In addition, there will clearly be a need for training and professional development. In order to ensure long-term support for Industry 4.0, it is also essential to create the right skills of employees in enterprises through corporate (professional) development opportunities. The topics of training, specialists and qualification are key elements of the implementation of advanced production technologies in enterprises. A systematic development of higher qualifications, in the higher education sector as well as in the area of adult education and vocational training, increases the opportunities for enterprises to compete in a new digital era of work.

The national implementation of Industry 4.0 and the formation of cyber physical systems calls, in particular, for a corresponding broadband infrastructure capable of providing the necessary higher quality data exchange. A dynamic broadband infrastructure is thus not only important to manufacturing industry but also for other sectors such as transport, energy and construction, which also increasingly use the potential of the Internet of things and services. In the following section, we will take a closer look at the development of broadband infrastructure in Austria.

4.2 State-of-the-art broadband networks are the fundament of Industry 4.0

A prerequisite for implementing intelligent production systems is the widespread availability of fail-safe, state-of-the-art broadband networks, also known as next generation access. The economic impact of broadband networks goes further than that of growth-promoting and productivity-enhancing effects.[9] New business models and integrated R&D projects are facilitated, mak-

9 See Airaksinen et al. (2006); Katz, and Suter (2009); Friesenbichler (2012) for literature reviews.

ing data networks more important in terms of innovation and technology policy.[10]

Broadband usage and availability means the potential for using Industry 4.0 across borders varies depending on the country. And a comparison of countries is difficult, partly complicated by multiple data pools and differing statistical methods, as well as by historically-inflected and different definitions of broadband. For instance, the OECD defines broadband as a transmission technology with a download speed of at least 256 kilobits per second (kbit/s). In Eurostat statistics, on the other hand, broadband technology is defined as a telecommunications connection that enables data to be transmitted at an upload and download speed of at least 144 kbit/s. Both transmission speeds represent the lower limit for the definition of broadband, although both figures are significantly below what is technically possible and lower than EU targets.[11]

Building on the minimum transmission speed defined by Eurostat, we can begin to examine the question of the spread of broadband usage. Fig. 4-3 shows the penetration of line-based broadband, i.e. the number of connections to landline-based broadband connections as a percentage of the population. In addition, radio technologies are also available, which are not taken into consideration here. Landline-based transmission technologies allow for higher transfer speeds and provide the basis for intelligent production systems. In addition, they provide the basis for mobile broadband connections. The resulting picture is only marginally affected by the focus on landline-based networks.

The industrialised countries Denmark and the Netherlands have at 41% the highest broadband penetration in the landline network, followed by France (38%), the UK (37%), Germany (36%), Malta (35%), Belgium and Luxembourg (each 34%). Austria is in the middle of the pack in the EU with 27%. The lowest penetration levels are in Romania and Bulgaria (each 20%).

This country comparison refers, however,to transmission speeds that are scarcely acceptable when it comes to Industry 4.0, and the rate does not meet the development goals announced as part of economic policy. The countries' ranking changes when the capacity limits are moved up. Fig. 4-4 shows the make-up of networks based on transmission speeds. The share of broadband connections with a transmission speed of at least 30 Mbit/s – the European Commission has set a goal to reach this level throughout the EU by 2020 – was highest in July 2014 in Belgium with 73%, followed by Romania (59%), Latvia (51%), Lithuania (49%), Portugal and Malta (49% and 48%) and the Netherlands (47%).

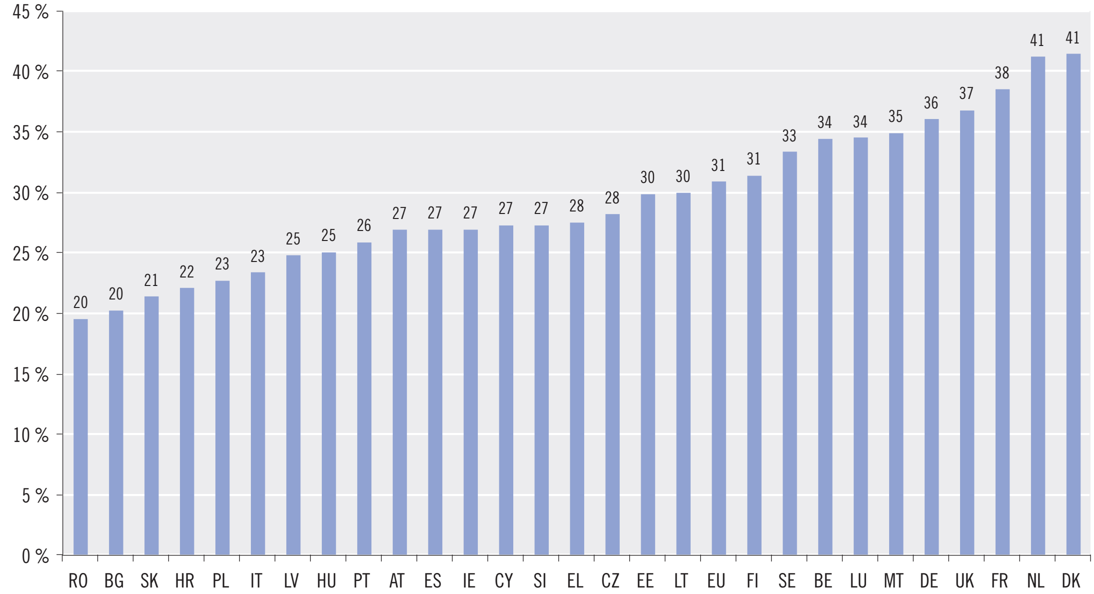
The good scores of some of the newer member states can be explained by the economic catching-up process. The data infrastructure has been newly built and the latest technology could be used. In addition, data networks are considered an important factor in making a location attractive for business, and their development is supported by economic policy, similar to that practised by the global leaders in these categories, South Korea and Japan. Germany and Austria at 18% are in 21st place in the EU ranking, with Spain (2%), Italy (3%) and Cyprus (4%) at the end of the list.

In "Europe 2020", the European Union's growth strategy, and the related digital agenda, the ICT strategy of the EU, growth and employment potential are identified and broadband delivery to all EU citizens at a rate of 30 Mbit/s or more by 2020 has been announced. Half of the households should have access by then to "ultra-fast" broadband at a rate of at least 100 Mbit/s.

The Austrian government has also announced its intent to improve broadband infrastructures. On 25 July 2014, the federal goal to develop nation-wide broadband of 100 Mbit/s by 2020 was announced. The goal is to reach this objective in

10 See Reinstaller (2010).
11 See http://www.oecd.org/document/46/0,3746,en_2649_34225_39575598_1_1_1_1,00.html and http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Broadband/de [Aug. 19, 2014].

Fig. 4-3: Landline-based broadband, penetration rate (in %), July 2014



Source: Broadband indicators, Digital Agenda for Europe (see http://ec.europa.eu/digital-agenda).

steps. By 2018, NGA preparations should be completed in the areas not yet covered. In the last two years of the planning horizon, the upgrade to full transmission speed should take place. Empty conduits and utilisation subsidies will support the programme, which is flanked by additional ICT funding programmes (e.g. AT:net for innovation funding, empty conduit premium or special guidelines intended to enable the connection of stand-alone solutions to landline and mobile networks).[12]

4.3 Strategic cooperation between technology start-ups and large enterprises

We are finding more and more different forms of strategic business cooperation, particularly among actively innovating enterprises. Collaboration can lead to higher revenues for the enterprises involved and stabilise the market. Thanks to the complementary (human) capital resources, there is great potential in cooperation between new technology enterprises and large enterprises.

This chapter examines the increasing importance of strategic partnership between new technology enterprises and large enterprises for RTI activities. The chapter also includes the results of a survey[13] of new Austrian technology enterprises. The results, e.g. with regard to the motivation and obstacles of a strategic cooperation with a large enterprise, align with international studies.

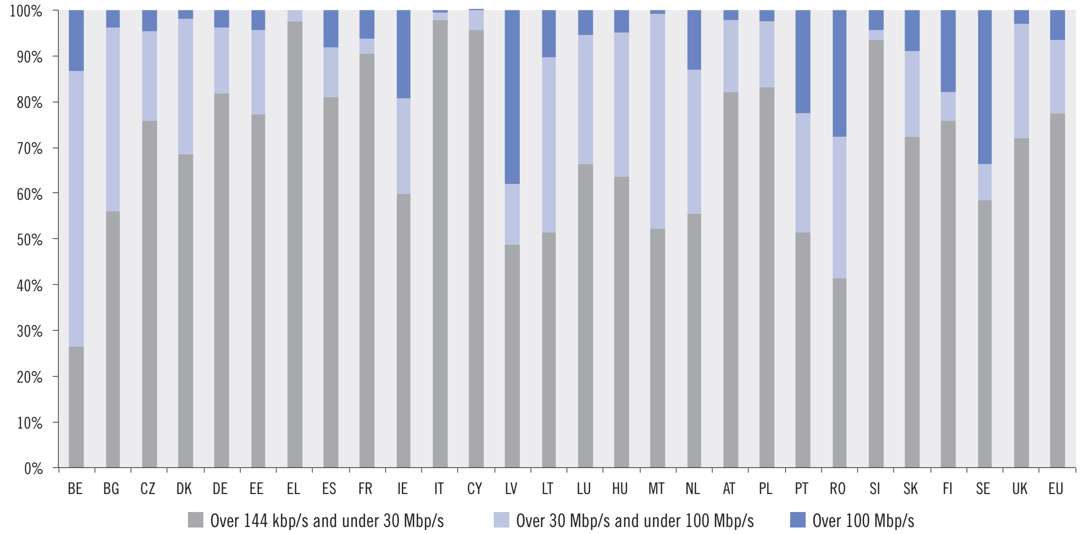
4.3.1 Strategic cooperation and its motivation: Relevance for RTI

One way to look at the behaviour and performance of enterprises is to analyse the aspect of their social and technological relationships with other market participants. Innovative enterprises seldom act alone, as constant interactions and cooperation between the stakeholders in the in-

12 See Federal Ministry for Transport, Innovation and Technology (BMVIT) (2013); for additional information on the "digital agenda", see the European Commission (2010) or http://ec.europa.eu/digital-agenda

13 See Reinstaller et al. (2014).

Fig. 4-4: Line-based broadband acc. to transmission speeds (in %), July 2014



Source: Broadband indicators, Digital agenda for Europe (see http://ec.europa.eu/digital-agenda).

novation process typically benefit knowledge sharing and the exploitation of existing information by encouraging innovations. Particularly in areas with rapid scientific or technological advances, where knowledge is widely dispersed, it is difficult for a single enterprise to remain among innovation leaders in all of the development areas.[14] On top of this, the increasing globalisation is resulting in a complex and highly-structured fragmentation of production processes and the global reallocation of resources without regard for national borders. Globally organised production networks are gaining more and more importance and spatially and organisationally multi-layered value chains for the organisation of production are being developed. These value added chains are controlled primarily by transnational corporations and benefit from the reduction in political and technological transaction costs (customs duties, changes in the field of container transport, upgrade of the Internet, etc.).[15] In light of this, the creation of suitable framework conditions to boost innovation and the competitiveness of Austrian enterprises is essential: strategic cooperations can ensure better access to international value chains and markets.

Additionally, a special interest in the role of these cooperations has developed for small and technology-intensive start-ups.[16] On one hand, small and medium-sized enterprises play a key role in job creation, innovation and also growth.[17] On the other hand, new enterprises face the challenge of obtaining access to resources (human and financial capital) and maintain new markets and sales channels. The incentive for RTI activities is strongly connected to the potential rate of return of these activities. This "liability of newness"[18] due to lack of resources, market access and reputation, not to mention the uncertainty about (the potential of) one's own products, could

14 See Powel und Grodal (2005). See also in this regard Chapter 4.2 on "Open Innovation" in the Austrian Research and Technology Report 2014.
Federal Ministry of Science, Research and Economy (BMWFW), Federal Ministry for Transport, Innovation and Technology (BMVIT) (2014); http://www.bmwfw.gv.at/rtr
15 See Reichwald und Piller (2006).
16 See Colombo et al. (2006).
17 See Headd (2010); Thurik (2009); Malerba (2010).
18 See Freeman et al. (1983).

be relieved by cooperating with large enterprises.[19] Cooperations are attractive mainly thanks to the complementary strategies of the stakeholders involved.[20] Newly founded technology enterprises often have unique technological selling points with regard to an innovative product, process or a service, which can only be used to optimise profits in combination with other (commercial, financial or technological) skills. If these necessary resources are not available within a firm, or if the costs of obtaining the resources are too high, strategic cooperations with other (complementarily equipped) enterprises pose a possible solution.

In the literature, the great flexibility of smaller enterprises in information processing is often mentioned as a comparative benefit.[21] The capacity to develop innovations through external (i.e. generated outside the firm) knowledge suggests that small and medium-sized enterprises have a higher R&D productivity than large enterprises.[22] In particular, in innovation-intensive industrial sectors where highly-qualified human capital is crucial, small enterprises can exploit their comparative advantage.[23] Conversely, large enterprises offer advantages mainly with respect to financial flexibility, existing sales channels, technological resources and the experience of managing intellectual property right. New enterprises, specifically those that come out of the university sphere (academic spin-offs), suffer from a lack of entrepreneurial knowledge and legal knowledge about copyright protection.[24] On the one hand, these enterprises could benefit from the experience of large enterprises with intellectual property. On the other hand, this also requires trust in the partner firm. The increasing number of cooperations between young enterprises with large enterprises is causing the level of flexibility of large enterprises to increase. As a result, an important competitive advantage of small enterprises might be lost.[25] Strategic cooperations serve to make small enterprises competitive and share the experience of large enterprises. However, the opposite effect may occur and rob the new enterprise of its competitive advantage.

In summary, the importance of a cooperation is due above all to shared R&D and market penetration.

4.3.2 Strategic cooperations between new technology enterprises and large enterprises

Based on a comprehensive survey[26] of new Austrian technology enterprises, the following section provides insight into the importance of strategic partnership for the Austrian innovation system. The survey focuses on the reasons for and objectives of strategic cooperations, as well as the obstacles that new technology enterprises must overcome in order to collaborate. The response rate as of the deadline on 25 July 2014 was 33.3%. From a cleaned gross sample of 408 enterprises contacted the questionnaire was completed by 136 enterprises.[27]

On average the enterprises surveyed are four years old and mainly involved in creating and customising software (32% of respondents) and mechanical engineering (22%). A majority (70%) of the young enterprises surveyed are still in the start-up or development stage with their enterprise and sell products and services they have developed themselves (77%). The main product or main service for some one-third of the enterprises is in the development and market introduc-

19 See Baum et al. (2000).
20 See Van Beers und Zand (2014).
21 See Verú-Jover et al. (2006).
22 See Audretsch und Vivarelli (1996).
23 See Acs und Audretsch (1991); Vonortas und Zirulia (2015).
24 See Colombo und Piva (2008); Street und Cameron (2007).
25 See Narula (2004).
26 See Reinstaller et al. (2014).
27 Due to the limited sample, the results should be interpreted cautiously with regard to their statistical relevance.

tion stage. Most of the enterprises surveyed focus their products on very specific applications and thus pursue a niche strategy.[28] They see their competitive advantage foremost in their unique technology (53%) and the high quality (52%) of their products.

The survey indicates that large enterprises are not only important clients (84%) but are also (very) important competitors (55%) for new technology enterprises. This is likely due to the fact that an overwhelming majority of enterprises surveyed (approx. 94%) are active in the business-to-business (B2B) sector. Alongside the negative effects on the flexibility of pricing, approx. 32.9% of respondents state that current competition with the large enterprise has a positive effect on their own R&D activities.[29]

Reasons and objectives

The results of the survey indicate that a trend toward strategic cooperations can be found particularly with research and actively innovating start-up enterprises. Around 38% of enterprises state that they already partner with a large firm. An additional 43% are seeking this cooperation. The main reasons cited are better market penetration (94%), improved integration (as a supplier) in global value chains (62%) and shared R&D activities (61%). Access to new markets, the use of synergy effects and accelerated product development is identified as the main motivation behind open innovation in a study of German-speaking enterprises as well.[30] A hoped-for takeover by a large enterprise plays a subordinate role (32%) as a reason for entering cooperations. As shown in Table 4-1, alongside market penetration, shared R&D plays a particularly strong role during the start-up and development stage of an enterprise (67% and 63%), while its relative importance gradually decreases as the enterprise gets older. In the stabilisation and expansion stage, utilisation and access to technology and know-how, as well as the integration as a supplier in global value chains, become more important.

Table 4-1: Reasons for cooperation

How important are the following reasons for an existing or sought-after strategic partnership between your firm and one or more large enterprises?	Business stage					
	Founding	Development	Stabilisation	Expansion	Downsizing	Other
Important / very important						
Market penetration	21 (95.45 %)	48 (92.31 %)	17 (100.00 %)	7 (100.00 %)	1 (50.00 %)	2 (100.00 %)
Integration of suppliers in global value chains	12 (54.55 %)	32 (61.54 %)	11 (64.71 %)	5 (71.43 %)	1 (50.00 %)	1 (50.00 %)
Better access to advance services & components	10 (47.62 %)	20 (38.46 %)	6 (35.29 %)	2 (28.57 %)	0 (0.00 %)	1 (50.00 %)
Use/access to technologies/ know-how	13 (59.09 %)	27 (51.92 %)	14 (82.35 %)	2 (28.57 %)	1 (50.00 %)	2 (100.00 %)
Shared R&D	14 (66.67 %)	33 (63.46 %)	10 (58.82 %)	4 (57.14 %)	1 (50.00 %)	1 (50.00 %)
Developing technological standards	8 (36.36 %)	26 (50.00 %)	6 (35.29 %)	4 (57.14 %)	0 (0.00 %)	1 (50.00 %)
Acquisition of firm by a large enterprise	7 (31.82 %)	18 (33.96 %)	4 (23.53 %)	1 (14.29 %)	1 (50.00 %)	2 (100.00 %)

Source: Survey by Austrian Institute of Economic Research (WIFO), 2014[31]; number of mentions (percentage of mentions in query category).

28 Approx. 60% indicated that it is very accurate to say that their products and/or services are focused on very specific applications; an additional 31% state that this is rather accurate.
29 Along with cooperative ventures, competition can also have a stimulating effect on research, technology and innovation activities. See too Peneder and Wörter (2014).
30 See Gassmann und Enkel (2011).
31 See Reinstaller et al. (2014).

Venture capital financed technology enterprises often look internationally for strategic cooperations with large enterprises.[32] Venture capitalists act as gatekeepers for networks and provide contacts to potential partner enterprises. They also serve as intermediaries and reduce the negotiation costs that arise in a cooperation agreement between enterprises. As negotiation costs fall, the relative revenues for the collaboration increase.[33] However, this positive context for strategic partnership and venture capital financing was not found among the start-ups surveyed in Austria. Quite the contrary, the chance of cooperation does not seem to depend on any specific form of financing (e.g. financing via public entities, capital increase, venture capital, business angels, strategic investment or bank loan).

Forms of cooperation

The likelihood of a collaboration between small technology enterprises and large enterprises depends, alongside costs of the necessary complementary goods which the partner enterprise provides, on the control the enterprises have over their intellectual property. Different legal instruments are available for the cooperating partners to formally define their collaboration. The legal options range from franchising (where the franchisor provides a total entrepreneurial concept to the franchisee, from planning to execution and monitoring) to joint ventures (in which legally autonomous joint enterprises are founded as part of the inter-enterprise collaboration) and cooperation agreements (that include the key points – duration, completion, obligations and rights, liability issues, etc. – of a future cooperation, which is limited time). These legal forms are characterised by different divisions of rights and obligations and hence also imply a different intensity of cooperation. Joint ventures are found more commonly with long-term cooperation, particularly if product development and marketing will be carried out together.[34] In contrast, cooperation agreements are mostly associated with a specific project and are therefore found with shorter periods of cooperation.[35] In the event of termination of the cooperation, the costs are lower for cancelling a cooperation agreement than dissolving a joint venture.[36] The wish to obtain independence is reflected in the survey, also in the preferred legal form (Table 4-2). Cooperation agreements are considered the most suitable legal instrument by almost all enterprises (91%), while franchising agreements, most of which involve the assignment of rights of use, are rejected by 80% as less suitable or unsuitable.

These results do not change drastically when differentiating between existing cooperations and enterprises that are currently seeking such cooperation (Fig. 4-5). Most new enterprises that work successfully with a large enterprise view cooperation agreements as the most suitable means (81%). This also suggests that such a legal framework is satisfactory in its implementation as well. In addition, a different attitude toward the suitability of the legal form can be found in the analysis of previously undertaken efforts to form a cooperation. Enterprises that previously failed to form a strategic partnership see joint ventures (59%) and capital participation (67%) as a (very) good approach. Although the cooperation agreement continues to be the most popular legal form, new enterprises that have failed at one or more attempts to form a strategic partnership with a large enterprise display a greater flexibility in selecting the legal form. Basically, joint ventures and equity stakes represent a means for (later) access to intellectual property for large enterprises and could therefore be more attractive for them than cooperation agreements.

In the literature, differences between technol-

32 See Gans et al. (2000); Mohr et al. (2013).
33 Ibid.
34 See Alm und McKelvey (2000).
35 Ibid.
36 See Hagedoorn et al. (2000).

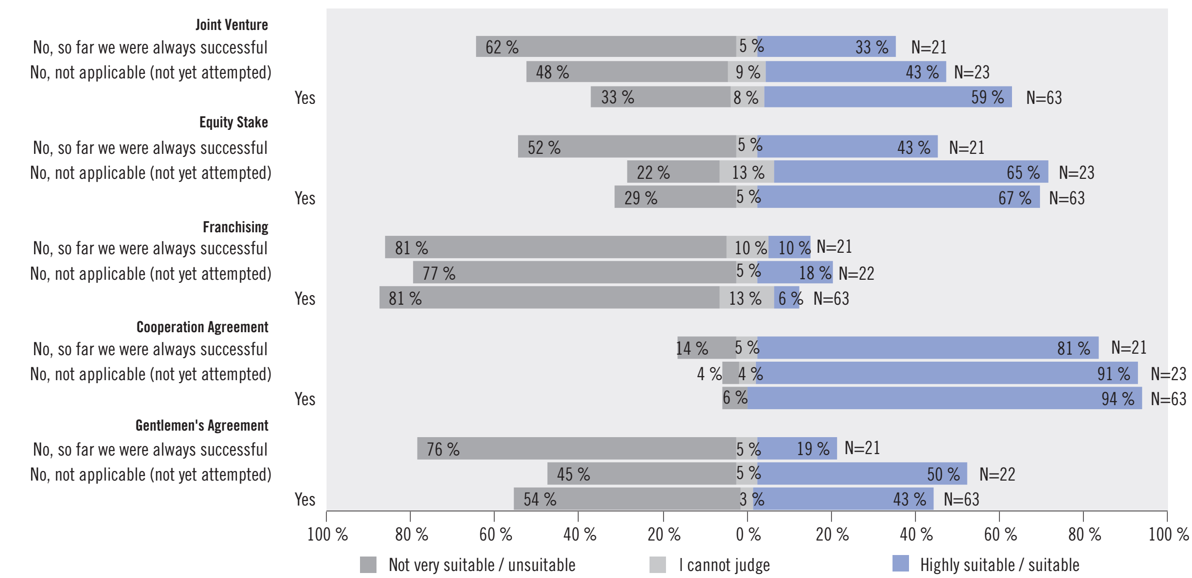
Table 4-2: Preferred legal instruments for collaboration (in %)

	Highly suitable	Suitable	I cannot judge	Less suitable	Unsuitable
Cooperation Agreement	44.04%	46.79%	1.83%	7.34%	0.00%
Equity Stake	23.85%	38.53%	6.42%	20.18%	11.01%
Joint Venture	18.35%	33.03%	7.34%	27.52%	13.76%
Gentlemen's Agreement	12.96%	27.78%	3.70%	30.56%	25.00%
Franchising	0.93%	8.33%	10.19%	27.78%	52.78%

0-10% 10.1%-20% 20.1%-30% 30.1%-40% 40.1%-50% 50.1%-100%

Source: Survey by Austrian Institute of Economic Research (WIFO), 2014; number of mentions (percentage of mentions in query category).

Fig. 4-5: Failed efforts to form a cooperation



Source: Survey by Austrian Institute of Economic Research (WIFO), 2014; percentage of mentions in query category "Failed efforts to form a cooperation", grouped according to legal instrument and number of mentions.

ogy start-ups that come from academic institutions and those that spin off from other enterprises are found. The first type of technology start-ups appear to have major reservations about forming alliances with large enterprises if their intellectual property is difficult to protect.[37] However, with regard to the origin of the new firm,[38] (academic spin-offs, spin-offs of existing firms, etc.) the Austrian respondents see no major differences between the preferred legal forms. The only exception is joint ventures; new enterprises that are spun off from other firms have the least reservations (23%) and the greatest acceptance (69%).[39] Start-ups that grow out of an already existing firm were perhaps able to collect (positive) experience with joint ventures and are

37 See Colombo und Piva (2006).
38 Approx. 26% of the enterprises surveyed came from academic entities (university spin-offs) and 15% from existing enterprises. The largest part (57%) has no relationship with an existing enterprise or an academic institution.
39 In comparison: enterprises without prehistory (48% / 49%); enterprises that spun off from an academic institution (36% / 50%).

therefore often more open to this form than others. When the cooperation partner is the enterprise from which the new enterprise was spun off, the foundation of trust for a long-term collaboration based on a joint venture is much more solid. The preferences of enterprises with regard to the legal form of cooperation change only little during the first year of existence. On one hand, cooperation agreements are generally preferred by very new enterprises (three years or less) (94%). This preference, however, slowly decreases the longer the enterprise is in existence.[40] On the other hand, joint ventures are slowly gaining importance. Less than 50% of very new enterprises but approx. 60% of older enterprises (10 years and older) consider joint ventures to be a (very) good legal instrument. Entrepreneurial research and innovation is significantly influenced by foreign enterprises in Austria,[41] and joint ventures represent a possible means to integrate these enterprises more strongly in the Austrian innovation system. In general, the joint ventures indicator in the global innovation index is a weak point in Austria when compared to other countries.[42] To counteract this, increased information about potential joint ventures and their possible legal forms could make joint ventures more attractive for new enterprises.

Obstacles to strategic cooperation

The biggest obstacles to strategic cooperation are a lack of (informal) contacts/gatekeepers at large enterprises (67%), a different attitude toward the potential of the technology used (61%) and the lack of protection of their own innovations (58%). This overlaps with a similar survey of SMEs in the Hamburg metropolitan area, in which alongside lack of personnel capacity, particularly for international cooperations, the lack of access to (potential) partners and the fear of know-how transfer were cited as the biggest concerns standing in the way of cooperations.[43] Especially for new enterprises that prefer cooperation agreements as their legal form, the lack of a contact person is a major hurdle. The odds of citing a lack of contact person as a (very) important factor is 3.5 times higher for enterprises that prefer cooperation agreements,[44] while no such (statistically significant) relationship can be found between this reason, which was reported to be the most important obstacle, and other legal instruments. It appears that, particularly for the realisation of cooperation agreements, which were labelled the most suitable legal means, a responsible contact person in large enterprises is essential.

Almost half of the new enterprises surveyed had already failed one or more times to form a strategic cooperation, and only 17% had always been successful. Less surprisingly, facilitation and support for strategic cooperations with large enterprises through public funding agencies (e.g. FFG, aws) or other funding measures (e.g. tax benefits) are considered positive by 81% of new enterprises. Possible starting points might be, on one hand, help finding contacts that might be potential cooperation partners and, on the other hand, providing more information about and/or legal assistance in (contractually) forming the cooperation concept.

Summary

Increasing globalisation and the resulting growing importance of globally organised production networks, are making strategic cooperations more relevant, because they facilitate access to international markets. Particularly for innovation-intensive new enterprises with limited internal (financial) resources, collaboration with

40 Only 60% of the enterprises that are ten years old or older, found cooperation agreements to be a (highly) suitable legal instrument.
41 See Janger und Reinstaller (2009).
42 See Austrian Research and Technology Report 2014 Federal Ministry of Science, Research and Economy (BMWFW), Federal Ministry for Transport, Innovation and Technology (BMVIT) (2014); http://www.bmwfw.gv.at/rtr
43 See Herstatt et al. (2007).
44 The calculated odds ratio of 3.464 is statistically significant with an α-level of 1%.

large enterprises plays an important role in improving market penetration and market access opportunities, as does shared R&D. Besides these incentives, the desire to be independent is shaping the legal organisation of the cooperations. Cooperation agreements are rated the most suitable legal instrument. Their realisation depends, however, on the availability of contact persons in large enterprises. Besides the lack of these (informal) contacts, different attitudes about the potential of the technology used and the lack of protection for own innovations are the greatest factors hindering cooperation with large enterprises. These constraints gain particular relevance when we consider that approximately half of the surveyed start-ups had already failed to develop a strategic cooperation one or more times. A comprehensive support of cooperations between new enterprises and large enterprises through public funding agencies would therefore make sense.

4.4 Innovations in the Austrian environmental technology industry

Environmental technology is considered a key factor for solving impending problems, such as limiting climate change and replacing fossil fuels. It is playing an important role in the structural shift toward an energy and resource-efficient economic system.

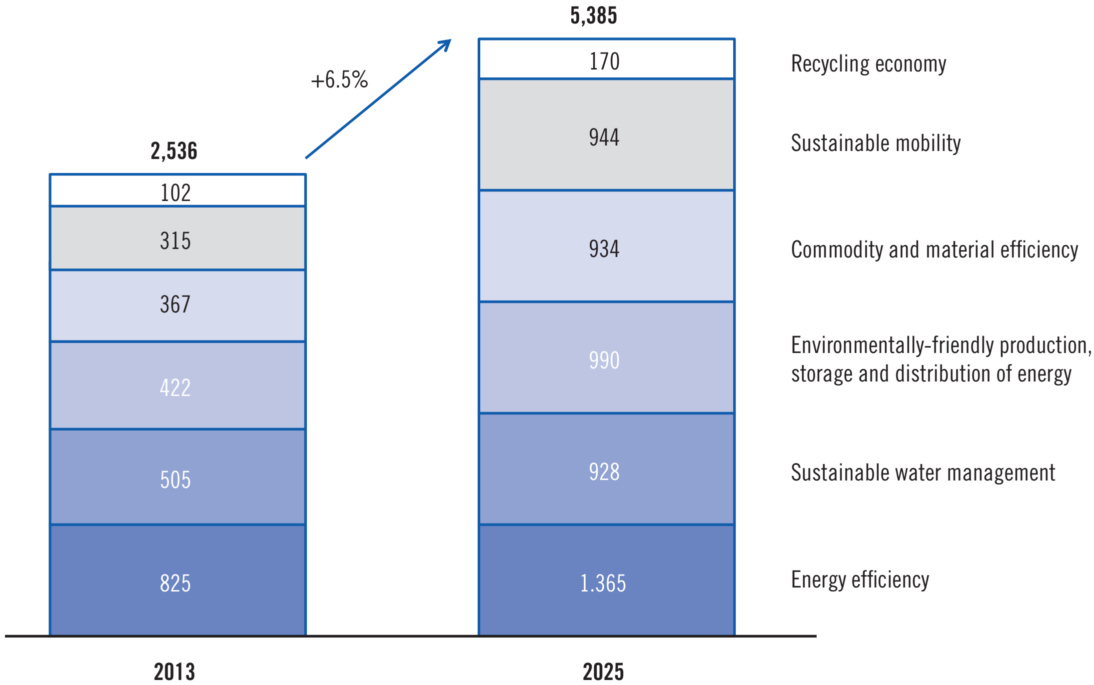
The empirical analysis of the economic performance of the environmental technology industry as well as its innovation activities presents a challenge. This is because environmental technology is a cross-sectional industry, which can neither be assigned to a specific core technology area nor a sector of manufacturing. Enterprises with different economic activities and technological expertise are active in the market for environmental protection goods and services. An analysis of this sector therefore requires extensive data collection from the providers of energy and environmental technologies.[45] Only a few countries, such as Germany and Austria, have solid empirical evidence gathered from regular studies, about the structure and performance of the environmental technology industry. Based on the data collected from Austrian providers of environmental technologies,[46] this sector has also proven to be relatively resilient in times of global economic and financial crisis.

In addition to the country-specific industry studies there are estimates for global market volumes in the area of environmental technologies and services done by consulting firms. According to the findings, an expansive market growth at the global level in the area of environmental technology is expected in the future. Global ecological challenges, strengthened efforts in developing countries to solve local environmental problems, but also increasing awareness that a transformation of the energy system is necessary, are factors contributing steadily to the international growth of the environmental technology industry. A recent study[47] forecasts that the global market volume for environmental technology and resource efficiency will increase from €2,536 billion in 2013 to €5,385 billion in 2025. This corresponds to an average annual growth rate of 6.5% across all technology categories.[48] The highest growth rate for the period 2013–2025 with 9.6% p.a. is ascribed to the area of sustainable mobility, followed by resource and material efficiency (8.1%) and the area of green energy (7.4%).

Alongside the strong growth dynamic, another trend has come to light in recent years. In addition to countries that have already been successful for decades in the environmental technology segment such as Germany, Denmark and Austria,

45 This includes the core segment of the energy and environmental technology industry, i.e. the enterprises that develop and manufacture downstream or integrated technologies for environmental elements of air, water, waste, energy, soil, noise and traffic.
46 See Köppl et al. (2013).
47 See Berger (2014).
48 Berger (2014) analyses the market segments of energy efficiency, sustainable water management, environmentally-friendly generation, storage and distribution of energy; commodity and material efficiency, sustainable mobility and the recycling economy.

Fig. 4-6: Development of the global market volume (in € billions) and average annual change (in %), 2013–2025



Source: Berger (2014).

new competitors such as China are playing an increasingly important role. Data from UN Comtrade were used to analyse the global trade in environmental goods and the competitiveness of domestic providers, .

Austria's share in global trade in environmental technologies is 1.5% and thus higher than the share in total goods export during the period 2009–2011. The countries with the highest shares in global trade in environmental goods during this period are Germany (16.8%) and China (16.6%). China is characterised by particularly dynamic growth. In the period 2003–2005, the average global trade volume was 7.7%, i.e. China has since been able to double its global market share.

Conclusions about the economic significance and structure of the Austrian energy and the environmental technology industry can be made based on corporate surveys and analyses conducted by the Austrian Institute of Economic Research (WIFO). As early as the mid-1990s, the first corporate survey was conducted for Austria and it was repeated at intervals of several years. In the meantime, the development of this economic sector can be tracked over a span of nearly 20 years, based on five data collections. In the following, results of the latest survey for the years 2009 and 2011 are summarised with a focus on innovation activities of the Austrian energy and the environmental technology industry.[49]

As shown in the past, the providers of energy and environmental technologies in Austria have an above-average innovation propensity and thus act as innovation drivers. For a highly-developed country like Austria, one key success factor for ensuring international competitiveness as well as entering new markets is its innovation activity. This is of particular relevance for a sector that is faced with permanently changing require-

49 See Köppl et al. (2013).

ments – from solving local climate problems using end-of-pipe technologies to integrated technologies and especially new energy technologies in the context of global climate problems.

4.4.1 Research and innovation are growth drivers

Compared to manufacturing overall, the Austrian the environmental technology industry is considerably more research-intensive. This finding is supported by all previous research.[50] While manufacturing enterprises experienced an average research intensity of 2.4% in 2009, the figure was at 9.8% on average for the enterprises in the sample. In 2011, this was 7.6% in total as it declined during the financial crisis.

Research, development and innovation play an important role in securing and improving the market position, particularly for enterprises such as the providers of energy and environmental technologies faced with quality competition. In the corporate survey, respondents were asked about the effects of innovations on the enterprises' competitiveness. Almost half said there was an improvement as a consequence, and almost one-third of the innovating enterprises said they saw a significant improvement.

Another important aspect with regard to the economic impact of innovation is the resulting changes in employment. Enterprises were asked whether and to what extent they expected a change in the employment level during the years 2009–2011 and whether they expected a change in the three following years. 48% of the innovating enterprises indicated that as a result of the innovation activities, employment in their enterprise had changed positively. For the three subsequent years, 57% expected a further increase in the personnel level based on environmental innovations.

Research and development are prerequisites for innovative products and production processes, and are important drivers for growth and job creation. Looking at the enterprise surveys, there is a positive correlation between an enterprise's research intensity and its job growth: Around 57% of enterprises expect an increase in jobs in the following three years, based on environmental innovations. In general, employment in innovative enterprises is considerably higher (see Fig. 4-7).

4.4.2 Innovation activities

Overall, in the most recent survey, 71% of the environmental technology producers reported that they had introduced innovations in their product area in the years 2009–2011. The percentage of environmental technology enterprises reporting innovations was significantly higher than the data collected for manufacturing firms in the context of the 2010 Community Innovation Survey (CIS).[51]

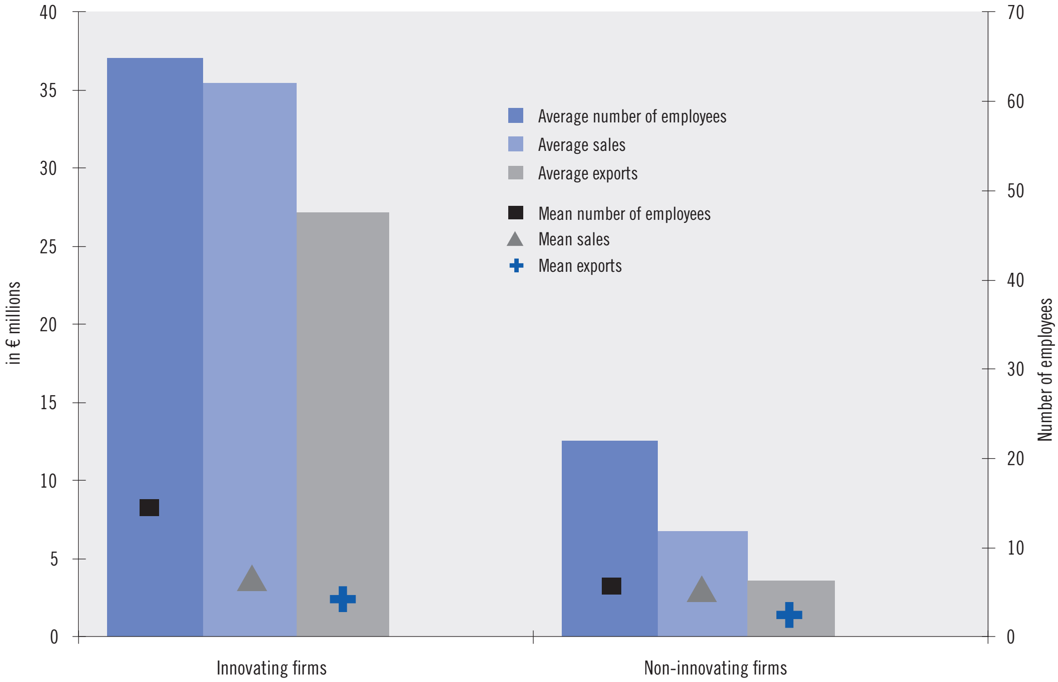
With regard to the development of innovation activities compared to the past, 43% of enterprises reported an expansion and 32% a constant level. In 5% of the cases, the innovation activities were reduced. The expectations for the future development correspond largely to this sample: 47% of enterprises expect innovation activities to increase or hold steady, while 3% expect a decline.

To solve environmental problems such as climate change, emphasis is on the need for far-reaching and radical innovations. How far-reaching an innovation is can be determined from whether it is a novelty in the domestic market only, or also internationally. 79% of enterprises indicated that their innovation is novel for the Austrian market, and 66% for the international market, too.

The strength of the incentive for innovation depends on the opportunities to appropriate the increased revenues from it. This can be ensured

50 See Köppl und Pichl (1995); Köppl (2000, 2005), Kletzan-Slamanig und Köppl (2009); Köppl et al. (2013).
51 During 2008–2010, some 56.5% of the enterprises conducted innovation activities. If you only take into account product innovations – that are relevant for the field of environmental engineering – this amount drops to 38%.

Fig. 4-7: Economic indicators for innovating and non-innovating enterprises



Source: Environmental Engineering Database of the Austrian Institute of Economic Research (WIFO).

by patenting. Patents are widely used as indicators of innovation output. In 42% of the current enterprise sample, innovation led to filing a patent.

Cooperations play a major role for actively innovating energy and environmental technology producers. In the most recent survey, the percentage of enterprises that collaborate on innovation activities has climbed to 89% from just under two-thirds (2008). The most important cooperation partners continue to be universities (61% of those named), followed by clients (40%) and suppliers (37%). For the first time, the survey also asked about cooperations with networks and clusters, and 32% of innovating environmental technology producers reported that they cooperate with such initiatives. This puts them ahead of the associated enterprises (27%) in terms of their importance as cooperation partners. Less importance is given to consulting firms (17%) and competitors (16%) as partners for innovation activities.

4.4.3 Stimuli and obstacles for innovation activities

The impetus for innovation activities in a firm has to be seen in connection with the environment that it operates in. The survey distinguishes between legal framework conditions that basically determine the environment and demand for enterprises, internal factors, and factors external to the enterprise (Fig. 4-8).

The most important impulses for innovation cited come from internal research and development, followed by customers. The enterprise's management comes third as an initiator for innovations. The legislation in the EU and in Austria is also seen as an important factor in spurring innovation, as it defines the framework conditions for demand and the technological requirements. Public R&D funding programmes are – as in the past – considered less important as a stimulus or reason for conducting innovation activities, as is scientific literature, suppliers or technical literature.

High costs are considered the most pressing problem in conducting innovation activities. They are followed by high financial risk and lack of skilled personnel. This survey also cited the costs and the financial risk as a problem significantly more frequently than in the past. Legal problems domestically and abroad are in fourth place. Market dominance, low customer acceptance and missing market information continue to be rated as minor obstacles to innovation.

Fig. 4-8: Stimuli for innovation activities

	Ranking
Domestic legislation	6
EU legislation	4
Internal	
Research and development	1
Production and materials handling	15
Marketing, product support	5
Corporate management	3
External	
Enterprise affiliated with own enterprise	
Domestic	10
Abroad	8
Competition	7
Suppliers	11
Customers	2
Technical literature	14
Science field	13
Trade shows, conventions, etc.	9
Government R&D funding programmes	12

Ranking calculated according to the number of times mentioned, then weighted by the importance the firms give to each reason (very important – important – less important – unimportant).

Source: Environmental Engineering Database of the Austrian Institute of Economic Research (WIFO).

Enterprises that reported having conducted no innovation activities during 2009–2011 stated past innovation activities and the current market situation as reasons. In addition, lack of financial resources is gaining significance. Public funding can have a positive impact on several levels. On one hand, it improves the financing situation for environment-related research and innovation projects. On the other hand, it internalises the benefit of reduced environmental pollution thanks to environmental innovations.

In this sample, 51% of innovating enterprises received financial support from public funds. With regard to the funding purpose, applied research is cited most frequently (55%). Basic research and market introduction are significantly less important as reasons for funding. Some 35.2% of the funding provided came from the Austrian Research Promotion Agency's basic programme, 13.3% from the Climate and Energy Funds (KLIEN) and 7.6% from specific funding schemes such as, for example, the mission-oriented RTI programmes of the Federal Ministry for Transport, Innovation and Technology (BMVIT).

4.4.4 Summary

The data available since the mid-1990s on the economic performance and structure of the Austrian energy and environmental technology industry confirms that this sector is heavily research and innovation-intensive. Above all, an important role is played by the far-reaching innovations that help, for example, to mitigate climate change. In this context, an environmental and energy-policy framework is important to provide a stable but also ambitious environment for developing energy and environmental technologies, and subsequently to enable a successful market introduction and penetration.

Despite the sector's high propensity for research, the enterprises emphasise the high financial risks of environmental innovations as being a major barrier. Specifically in currently uncertain conditions, it will take heightened efforts and ongoing investments in the research and development of new technologies in order to maintain or improve the market position. To safeguard the research and innovation dynamics seen in the past, not only is a framework for ambitious energy and environmental policy called for, further development of suitable instruments for research and technology policy will also be required.

5 Key themes in Austria’s RTI policy

5.1 Innovation and employment

Are new technologies “job killers” or are they the most important driver behind the creation of new jobs? The connection between innovation and employment is multi-layered, making it impossible to give simple answers to such questions. The following chapter, drawing on the latest research, will first provide an overview of the possible positive and negative effects of innovation on employment growth. Secondly, the importance of innovation for employment will be demonstrated using data from the European Innovation Survey (CIS) for the period from 1998 to 2010. Then we will take a specific look at the effects of information and communication technologies (ICT) on job growth in Austria. Finally, this chapter will examine the connection between innovation and the demand for skilled workers in natural sciences and engineering.

5.1.1 Positive and negative effects of innovation on employment growth

The effect of innovation on employment at an enterprise level can be extremely varied. Different types of innovation have different employment effects. Moreover, innovation-based employment effects have an impact not only on the innovating firms themselves, but also on their competitors, customers, and suppliers. The diversity of possible effects is the most important reason for the varying assessments of how innovation affects employment.

Based on the most current literature[1], Fig. 5-1 it is clear that the most important connections between employment and innovation exist at the enterprise level. A distinction is drawn between effects due to the introduction of new products (product innovation) and effects due to the introduction of new production technologies (process innovation).

The direct effect of process innovation in most cases is lower demand for labour because the aim of introducing new production technologies is to reduce the inputs necessary for manufacturing a specific ware. In this sense, process innovation has a direct negative influence on employment growth (see Fig. 5-1).

This negative effect is mitigated, however, by various indirect effects. Process innovations lower the manufacturing costs for products and enable price reductions (see Fig. 5-1). This can lead to more demand for products and thereby partially compensate for employment losses. The magnitude of this compensation is determined by the extent to which the manufacturing firm passes on cost savings to its customers as well as the degree to which price changes motivate customers to demand more from the product.

Another indirect effect of process innovations that may possibly compensate for employment losses, is the effect on employment in those firms that manufacture these new production technologies, meaning above all the vehicle and mechanical engineering industries. These two industries belong to the most significant manufacturing sectors in Austria, which means that

1 See Pianta (2005), Harrison et al. (2014), Vivarelli (2014).

this effect is probably substantial in the Austrian context.

Finally, process innovations often lead to improvements in production quality, such as increased precision or the reduction of waste. On one hand, these improvements can lead to improved product quality, which can increase demand for the products. On the other hand, higher production quality enables product innovations that were not possible with earlier production technologies.

In contrast to process innovations, new products, meaning product innovations, have a positive effect on employment (see Fig. 5-1). This effect is explained above all by the fact that new products also create new demand because they satisfy needs that were previously insufficiently covered by existing products.

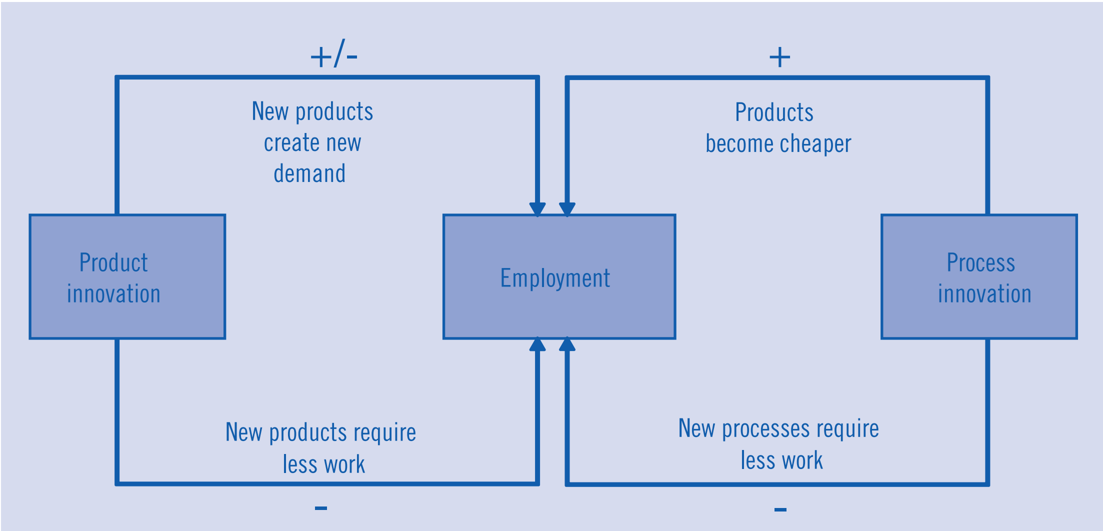
However, as with process innovations, this positive effect is attenuated by several negative displacement effects. New products displace a firm's existing ("old") products; when introducing a new mobile telephone, for instance, demand for previous models typically goes down drastically. By the same token, the introduction of a new product to market often has negative effects on the sales of competing products from other firms ("business stealing"). The strength of these displacement effects, and the net employment effect of product innovations, is determined by price differences between new and existing products; at the same time, the net employment effect related to product innovations results from the degree to which new and existing products complement or replace one another.

Another effect that can weaken the potentially positive effect of product innovations on employment is the productivity effect of product innovations (see Fig. 5-1). New products often require less labour input for their production than do earlier products, which may dampen the originally positive effect of product innovations.

5.1.2 Empirical connections between innovation and employment in the European Community Innovation Survey (CIS)

Which factors create these different effects on overall employment growth at the business enterprise level? A study by the Centre for European Economic Research (ZEW) and the Austrian

Fig. 5-1: Important relationships between employment and innovation



Source: Austrian Institute of Technology (AIT).

Institute of Technology (AIT)[2] examined this question for the European Commission. Data from the European Community Innovation Survey (CIS) provided the foundation for the analysis. The available dataset covers the period from 1998 to 2010 and contains over 400,000 studies at the business enterprise level from 20 countries. Austrian firms are not included in the data, however.[3]

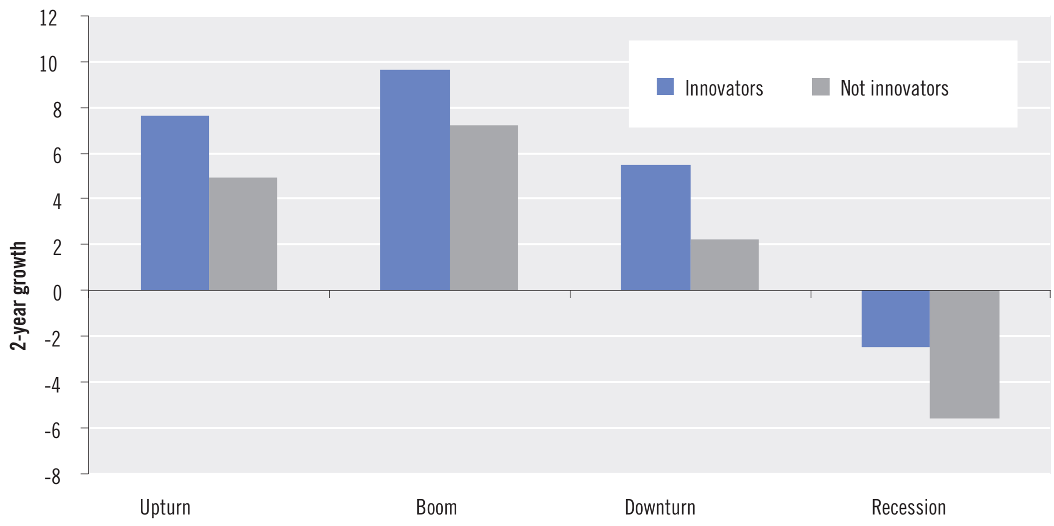
A comparison of employment growth at innovative and non-innovative firms in this period provides an initial answer regarding the connection between innovation and employment: innovative firms create more new jobs – during upturns, booms and downturns – than non-innovative firms (see Fig. 5-2).[4] In the recession during 2008 to 2010, innovative firms lost fewer employees than did firms that did not introduce any innovations.

According to the study, all employment growth can be attributed to the following specific effects:

- the effect of process and organisation innovations, as well as general productivity developments;
- the effect of changes in demand for a firm's old products;
- employment growth created by product innovations; and
- employment losses caused by the displacement of old products due to product innovations.

Fig. 5-3 shows the result of this breakdown into specific effects for the four phases of an economic cycle. Overall productivity development, and process and organisation innovations have a negative effect on employment growth in all economic phases, with the exception of a recession. In a recession, productivity falls because of reduced working hours and the "labour hoarding", which creates a positive effect on employment growth that balances out the negative effects of a decrease in demand. It is particularly

Fig. 5-2: Growth in employment for innovative and non-innovative enterprises in different European countries, 1998–2010



Source: Peters et al. (2014), based on the Community Innovation Survey (CIS).

2 See Peters et al. (2014).
3 There is no legal obligation for the national statistics offices to supply individual data to Eurostat.
4 The employment changes shown in Fig. 5-2 do not agree with overall economic employment trends because, for instance, the effects of business closures cannot be taken into account.

the collapse in demand for old products that is behind this general slump in demand during a recession. In the other phases, however, old products support positive trends in employment growth. They make an essential contribution to the expansion of employment, especially in boom times.

The second major stimulus for employment growth comes from the introduction of new products. Innovations have their greatest effect during a boom, when innovations make their highest contribution to employment levels. However, innovations are also important during a recession because firms can use them to at least partially compensate for job losses caused by a slump in sales of old products with sales of new products.

Innovations and old products therefore exercise a positive effect on employment growth in all economic phases aside from recessions. The negative employment effects of increasing productivity brought about by process and organisation innovations are compensated for under normal circumstances. Everything is different in a recession, though: employment losses in the production of old products are significant, while new products can only partially compensate for these losses. Innovations therefore stabilise employment, and this effect is most pronounced during a recession.

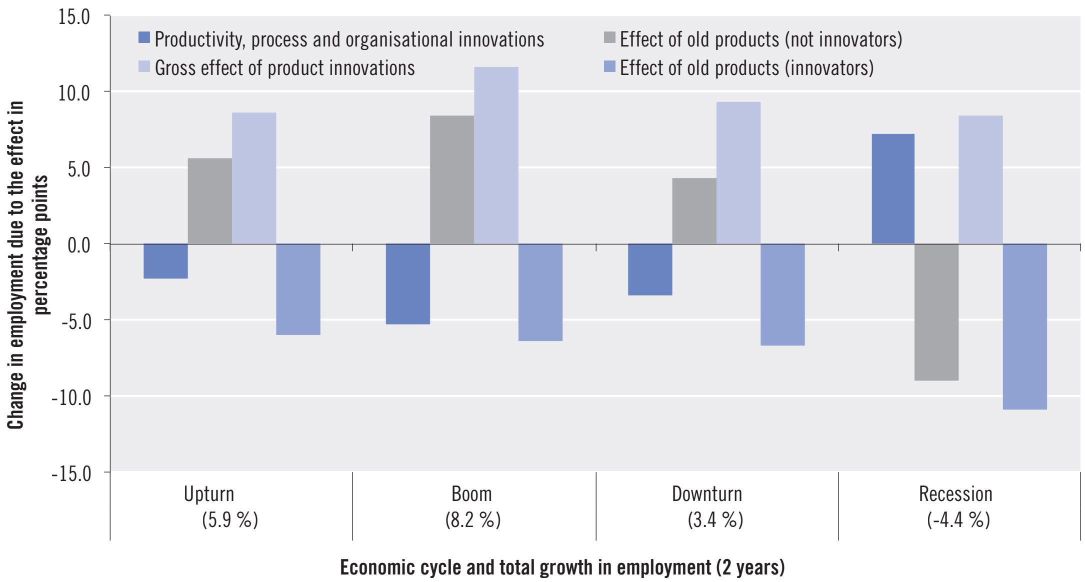
Further analyses show that the effect of product innovations on employment growth is greater in the manufacturing sector than in the services sector, greater in the high-tech sector than in the low-tech sector, and lower at SMEs than at large firms. Large firms, however, have much weaker increase in employment growth than SMEs.

5.1.3 Connections between technological innovations, ICT technologies, and employment growth in Austria

This section evaluates the connections between technological innovations and employment growth in Austria. The effects of information technology and e-commerce activities are assessed along with employment effects from new products and processes.

The employment effects of ICT applications

Fig. 5-3: Results of breaking down employment growth in manufacturing, 1998–2010



Source: Peters et al. (2014), based on the Community Innovation Survey (CIS).

are controversial in the relevant research. On the one hand, IT-supported applications are often associated with rationalisation measures, which can lead to downsizing. On the other hand, ICT applications lead to a reduction in transaction costs in information acquisition, thereby increasing production efficiency and employment in the medium term. The question of what effects predominate is an empirical one.

In Austrian firms, the diffusion of ICT and the use of various ICT applications are well advanced. In 2015 almost all firms had a website and used broadband Internet, with minimal differences between SMEs and large firms. Meanwhile, the proportion of employees with a computer workstation and Internet access is over 40% (Statistics Austria, see Table 5-2). ERP applications and e-commerce activities are less prevalent and exhibit comparatively low dynamism.

More recent studies point increasingly to the job-destroying effect of ICT applications in production. The use of software-controlled management systems in particular renders many business processes superfluous and leads to downsizing. In contrast, the growing pervasiveness and increasing sales of digital products and services is leading to more employment.[5] Studies based on aggregated data for 27 EU countries[6] find a positive correlation between ICT use and labour productivity. There are also weak positive effects on employment. Weak employment effects from ICT applications could also be attributed to the fact that innovation effects could lessen with increasing use.[7] Only limited growth can be expected from the increasing breadth of diffusion of ICT applications. This means that only slight employment effects can be expected from further dissemination of ICT applications.

In summary, current research regarding the employment effects of ICT does not present a clear consensus.

The following discussion examines the connection between different ICT and e-commerce activities and employment for Austrian firms. The classic indicators of innovation are also incorporated in the assessment.

These relationships are examined at the industry level (NACE two-digit level) during 2002 to 2010. The data basis is comprised of the Structural Business Statistics Survey, the Community Innovation Survey, and the ICT/e-commerce Survey. We use industry-level data that can be linked over time. The analysis is based on 75 observations for manufacturing and a maximum of 18 observations for services during 2002 to 2010, though the rates of change in employment and the change in the indicators for innovation and ICT are calculated for two-year periods. The advantage of an empirical analysis at the industry, as opposed to business enterprise, level is that the "business stealing" effect can be considered. When product innovations are successful, the innovator creates demand while the maker of old products loses customers.

In manufacturing, we find a significant positive correlation between the change in the share of sales and new products for the market and employment growth, although the correlation is not particularly strong (r=0.24).[8] This connection is not significant for the share of firms with process innovations, meaning that process innovations at the industry level had a neutral effect on employment. These findings are largely similar with those at the business enterprise level, as discussed in the previous chapter.

For the ICT indicators, measured as change in a two-year period, there are also discernible pos-

5 See Brynjolfsson and McAfee (2011).
6 See Evangelista et al. (2014).
7 See Acemoglu et al. (2014).
8 The Pearson correlation coefficient r is a measure for the strength of a relationship between two continuous quantities. It lies between -1 and +1-.

itive associations with employment growth. This applies in particular to the share of firms with broadband Internet access (r=0.54), the share of firms with a website or homepage (r=0.33), the share of employees with a computer and mobile broadband Internet (r=0.35), the share of firms with Internet (r=0.33), and the share of firms with an ERP software package. The significant correlation between the increasing use of ERP software packages and changes in employment (r=0.51) is remarkable. The use of ERP software is often thought to have negative effects on employment. At the industry level, however, findings indicate that industries with an increasing use of ERP software packages have above-average employment growth.

These correlations, however, should not be interpreted as evidence of direct causality. These connections could go both ways, and there may also be interactions. It is likely that growing industries with above-average employment rates exhibit stronger diffusion of ICT technologies than do stagnant industries.

Another important result is that an expansion of e-commerce activities does not go hand-in-hand with a decrease in employment. The opposite turns out to be true: there are positive correlations, some of them even significant, for some e-commerce activities. In manufacturing, for example, there is a significant positive correlation between the proportion of firms with e-commerce sales and employment growth (r=0.28). In services, there is a significant positive correlation between the sales share of e-commerce purchases and employment growth (r=0.81). The results for services should, however, be interpreted with caution due to the low number of cases.

We are therefore able to draw the following conclusions. There was no demonstrable negative relationship between employment growth and increasing use of ICT applications at the aggregated industry level.[9] There was even a positive relationship in most cases for the ICT and Internet diffusion indicators, which, however, does not exclude the possibility that negative effects could have an impact on some firms.

For new products on the market, there was a somewhat positive relationship between employment growth and the change in revenue share with new products for the market. This connection could only be demonstrated for manufacturing, though. Firms with a high share of outdated products are therefore required to constantly review and update their product portfolio. What is important here is that possible gaps between research, product development, and market introduction be closed quickly. The widespread fear that the increasing use of ERP software is connected with a decline in jobs, however, seems, on the basis of existing studies, to be unfounded.

Finally, we should point out several limitations of this empirical analysis. First, employment and innovation depend on a variety of additional factors, including demand, salary and wages, and investments. Second, the empirical analysis looks at the period during 2002 to 2010. Since then, almost all firms have installed broadband Internet connections. It is possible that the relationship between specific ICT applications and employment growth will become weaker over time, as the effects of the ICT in question are slowly diffused.

5.1.4 Relationship between innovation and demand for personnel in natural sciences and engineering

Finally, this chapter takes a look at the relationship between innovation, ICT applications, and the demand for skilled workers in natural sciences and engineering. Demand for skilled personnel has risen in all EU countries in recent

9 For the results of other EU countries, see Hagsten et al. (2013).

decades, while employment for less skilled personnel has declined significantly. The number of personnel in jobs assessed to be medium-skilled is stagnating, in Austria as elsewhere. The employment of university graduates and, more specifically, of natural scientists, mathematicians, and engineers (including engineering science technicians) has experienced dynamic development in recent years. According to the micro census, the number of employees in this professional group in Austria has grown at an average rate of 3% per year between 2008 and 2013. The development in demand for engineers and natural scientists in the manufacturing sector is particularly dynamic, with average growth rates in employment from 6% each year during 2008 to 2010 and 5% each year during 2011 to 2013 (see Table 5-1). In the private sector, manufacturing is the most important employer of natural scientists, mathematicians, and engineers (including engineering science technicians), with an employment share of 50% in 2013 and 115,000 employees.

The primary explanation for this development is that a complementary relationship exists between new technologies and activities that require a high (technical) level of qualification, while there is a substitution relationship between new technologies and activities that require a low level of qualification. Well-educated engineers and personnel can be used in many ways. Unlike other personnel, they have advantages when it comes to the application of new technologies because they have learned how to appropriate new knowledge in an ongoing way. Previous studies for industrialised countries show a significant positive relationship between ICT applications or ICT investments and the proportion of highly qualified personnel.[10] Various recent studies have shown that ICT applications can, under some circumstances, have a polarising effect on the labour market. As such, ICT increases demand for highly qualified personnel and, to a lesser extent, for less qualified personnel while simultaneously reducing demand for medium-qualified workers. This rela-

Table 5-1: Development of employment levels of engineers, natural scientists, and specialists

	Number of employed persons				Average annual growth in the number of employees in %	
	ÖISOC08		ÖISOC11			
	2008	2010	2011	2013	2008–2010	2011–2013
Manufacture of goods	81,153	91,337	104,782	115,070	6.1	4.8
Energy, water, wastewater, and rubbish disposal	9,399	8,186	10,433	13,452	-	-
Construction	34,087	31,235	45,853	48,796	-4.3	3.2
Wholesale and retail trade; repair of motor vehicles	30,559	30,620	21,560	20,036	0.1	-3.6
Transport and warehousing	9,725	9,879	10,943	12,717	0.8	7.8
Hotels and restaurants	510	666	570	878	14.3	24.1
Information and communications	36,800	43,509	21,351	21,921	8.7	1.3
Finance and insurance services	4,574	5,044	2,911	2,947	5.0	0.6
Properties and housing; freelance, scientific and technical services	1,616	1,764	1,315	1,262	4.5	-2.0
Provisioning of other economic services	5,414	3,608	5,021	2,830	-18.4	-24.9
Total	**213,837**	**225,850**	**224,739**	**239,908**	**2.8**	**3.3**

Notes: STEM 2008–2010: Natural scientists, mathematicians, and engineers (21) and technical specialist and comparable specialists (31). STEM 2010–2013: 21+31+35 ("Information and Communication Technicians"). Values weighted with inflation factor.

Source: Microcensus, Statistics Austria. Calculations: Austrian Institute of Economic Research (WIFO).

10 See Vivarelli (2014).

tionship has been confirmed on the basis of industry data for the USA, Japan, and nine European countries.[11] The studies demonstrate that industries with faster growth in ICT capital stocks have above-average increases in relative demand for well-educated personnel and a reduction in relative demand for medium-qualified personnel. ICT use, however, had little influence on demand for uneducated labour. The few studies[12] that have assessed the effects of broadband Internet access on employment conclude that increasing broadband access led to an increase in the employment rate. In particular, they found that the positive employment effects from broadband Internet are stronger in regions and industries with a higher proportion of people with a university degree.

In Austria, the increasing use of ICT applications and trends in employment of engineers and natural scientists seem to exist in a positive relationship to each other. At the industry level, both the share of computer workstations with Internet access and the proportion of firms with ERP software is rising. In manufacturing, these indicators increased by three percentage points between 2009 and 2012. At the same time, there was a strong increase in employment of engineers and natural scientists in manufacturing. Due to the limited number of cases, however, it is not possible to carry out a correlation analysis.

This technological progress, which promotes qualification increases, should be met, on the one hand, by the acquisition of higher qualifications by personnel with low or medium skills in non-technical professions and, on the other hand, by promoting further education activities for highly qualified personnel in technical professional groups.

5.1.5 Summary

The results of a survey of European firms show that product innovations make a major contribution to employment. This applies in both downturn and upturn phases. Firms are therefore required to constantly assess their product portfolio and adjust it as necessary. Possible

Table 5-2: Selected ICT indicators by industry level

	Employees with computer workstations with Internet access in %			Firms with ERP systems in %		
	2009	2012	2009–2012	2009	2012	2009–2012
Manufacture of goods	38.2	41.3	3.1	35.4	38.6	3.2
Energy, water, wastewater, and rubbish disposal	56.8	61.7	4.9	40.9	33.8	-7.1
Construction	28.7	28.5	-0.2	8.9	12.9	4.0
Wholesale and retail trade; repair of motor vehicles	43.8	49.0	5.2	30.0	33.8	3.8
Transport and warehousing	34.4	42.0	7.6	16.9	15.3	-1.6
Hotels and restaurants	19.3	19.8	0.5	4.0	9.3	5.3
Information and communications	90.4	94.7	4.3	34.4	52.2	17.8
Finance and insurance services	89.9	n.a.	n.a.	16.8	26.2	9.4
Properties and housing; freelance, scientific and technical services	84.0	81.6	-2.4	15.6	19.7	4.1
Provisioning of other economic services	27.0	23.1	-3.9	17.6	25.7	8.1
Total	**43.7**	**43.5**	**-0.2**	**21.4**	**25.7**	**4.3**

Source: ICT/e-commerce survey, Statistics Austria. Calculations: Austrian Institute of Economic Research (WIFO).

11 See Michaels et al. (2010).
12 See Atasoy (2013), study on the USA for the period 1999–2007.

gaps between research, product development, and market introduction must be closed quickly. One important finding is that product innovation not only causes a rise in employment in innovating firms, but also generally in the overall sector to which they belong. This relationship was demonstrated for Austrian industry data for the period during 2002 to 2010. The "business stealing" effect only plays a subordinate role; the expansion effect predominates.

Furthermore, the results show that the increasing use of ICT applications in the Austrian economy do not entail a loss of jobs. There was even a positive relationship in most cases for the ICT and Internet diffusion indicators. This is particularly evident in the use of broadband Internet and the use of ERP software packages. Fears that increasing utilisation of ICT and ongoing digitalisation would lead to downsizing appear to have been unfounded. Moreover, we can assume that the increasing use of ICT applications is leading to increased demand for engineers and natural scientists. In fact, employment in this professional group rose by 3% per year during 2008 to 2013. The development in demand for this professional group in the manufacturing sector is particularly dynamic, with growth rates between 5% and 6% each year. The increased demand for engineers and natural scientists is leading to a transformation in occupational distribution. The training and further education of the workforce must take this into account.

5.2 Gender and equal opportunities in RTI

Equal opportunities and gender in research, technology and innovation have been central topics in RTI policy at the national and international levels for decades. The following section offers a multi-dimensional perspective on this topic in Austria according to Horizon 2020, addressing gender at three levels: the level of representation of women and men in research teams, the level of participation by women and men in decision-making, and the level of integration of gender into research content. This chapter explores two of these levels with regard to the situation in Austria. Firstly, we will present and discuss developments in the representation of female researchers in non-university research in natural sciences and engineering in Austria; and secondly, we will investigate the degree to which gender is currently taken into account in research projects funded by the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF). The analysis of these two levels supplies information about how well Austria is able to meet the objectives articulated by the European Commission in Horizon 2020 regarding equal opportunities and gender. To that end, this section begins with a closer look at the importance of gender in Horizon 2020.

5.2.1 Gender and Horizon 2020

The promotion of equal opportunities in research, technology and innovation (RTI) is a major objective of the European Commission in the course of establishing the European Research Area (ERA). Women continue to be underrepresented in RTI, although they comprise nearly half of all PhD graduates. In order to address this gender imbalance and associated inefficiencies in ERA, the European Commission has established the promotion of equal opportunities as a cross-cutting theme in Horizon 2020. In keeping with ERA priorities, specific activities are planned to promote equal opportunities of men and women in pursuit of the following objectives:

- Fostering gender balance in research teams in Horizon 2020, in order to close the gaps in the participation of women.
- Ensuring gender balance in decision-making: The target is 40% participation of the underrepresented sex in panels and group and of 50% in advisory groups. In addition, all panels and committees should have at least one expert (of any gender) with explicit expertise in gender.

- Integrating the gender dimension in research and innovation (R&I) content helps improve the scientific quality and societal relevance of the produced knowledge, technology and/or innovation.[13]

Equal opportunities are therefore anchored in every phase of research funding and in the research process: from programme design to implementation, monitoring, and programme evaluation. This comprehensive approach to supporting equal opportunities is expressed in the various programme components of Horizon 2020.

In the working programme for 2014–2015, applicants are encouraged to consider equal opportunities when implementing their research and innovation activities and to ensure balanced participation by men and women. In addition, gender is incorporated in various thematic areas of the working programme and must feature in research applications as well. The working programme therefore firmly states: *"A topic is considered gender relevant when it and/or its findings affect individuals or groups of persons. In these cases, gender issues should be integrated at various stages of the action and when relevant, specific studies can be included."*[14] In its "Gendered Innovations"[15] publication, the European Commission summarises how the integration of gender content in research processes can be done in methodological terms, and what benefits and challenges this will bring. Furthermore, relevant expertise already exists in the Austrian research landscape. This has been gained especially through experience with FEMtech research projects[16] and will be especially useful in preparing to meet the new demands of Horizon 2020.

The Horizon 2020 application forms also reflect these requirements in terms of gender balance in research teams and the integration of sex and gender analyses. In addition, at least a part of the experts serving as evaluators must have appropriate gender expertise to be able to evaluate the implementation of sex and gender analyses in the applications in an adequate and fair way. This is because the implementation of the gender aspect is a full component of the evaluation process. Furthermore, in cases where there are two applications with otherwise equal merit, it is the project that better implements gender balance in the research team that will receive support.[17] This emphasis on equal opportunities in research teams can become an essential factor in determining success, and it may serve furthermore as a model for other national funding providers in future. Finally, the implementation of the planned measures and activities is fully taken into account in the preparation of grant agreements as well as in Horizon 2020 monitoring. To strengthen awareness and knowledge regarding gender issues among scientists involved in Horizon 2020[18], project designers are welcome to include costs for training and further education in the project budget and account for these as project-relevant costs.[19]

Along with embedding equal opportunities as a cross-cutting topic, the working programme on the theme of "science for and with society"

13 See European Commission (2014a).
14 See European Commission (2014b, p. 17).
15 See European Commission (2013).
16 See https://www.ffg.at/femtech-forschungsprojekte
17 See European Commission (2014f, p. 33). Note: However, this criterion is the last of four decision criteria. First the points for the criterion of excellence and then impact are used. If the applications still have an equal number of points, the amount of the budget reserved for SMEs is used to make a decision, and only if the requests are still evenly placed is the criterion of gender-balanced research teams used. We can assume that this criterion is only very rarely applied.
18 The European Commission does not give any details in the available documents about what exactly is meant by gender expertise. However, we can assume it refers to a sensitisation on the part of researchers as regards the meaning of gender when implementing research projects and the consideration in research content.
19 See European Commission (2014a).

foresees specific proposals for promoting equal opportunities as well as the participation of women in research, technology, and innovation. For example, research institutions and research funding organisations receive support to implement measures that remove barriers and obstacles in women's scientific careers and that support the integration of gender into research content. In addition, support is given to measures that encourage girls and young women to pursue careers in research, technology, and innovation.[20]

The European Commission also supports the development of capacities and networks in areas of equal opportunities and structural change in research institutions as well as the integration of gender in research content within the COST framework (European Cooperation in Science and Technology). The genderSTE[21] (Science, Technology, Environment) network, which is funded by COST, comprises policy stakeholders and experts who seek to work together to promote equal opportunities in RTI and to promote a more comprehensive consideration of gender in research and innovation processes. genderSTE focuses above all on the integration of gender into the fields of urban research, transportation and mobility, energy and climate change, and (product) innovations in firms. COST's genderSTE network therefore supports the dual strategy of promoting equal opportunities in the context of the European Commission's Horizon 2020 programme.

5.2.2 Gender dimension in research projects at the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF)

Austrian funding agencies such as the Austrian Research Promotion Agency (FFG) and Austrian Science Fund (FWF) have integrated the consideration of gender and equal opportunities into their application and reporting mechanisms in a way that is comparable to Horizon 2020. This is notable when compared to the situation across Europe.[22] The Austrian Research Promotion Agency's "FEMtech research projects" funding scheme also supports innovative pioneer projects that take into account gender aspects in technological research and development processes.

What has been missing in Austria with regard to funded research projects with an explicit focus on gender, however, is an analysis of the specific areas of science research and technology to which these projects belonged and the amount of funding they received. This is presented below for the first time, drawing on data related to research projects funded by the Austrian Research Promotion Agency (FFG) through the FEMtech RTI programme and projects with a focus on gender funded by the Austrian Science Fund (FWF) since 2008.

FEMtech research projects

FEMtech research projects were created as a funding scheme within the FEMtech programme entitled "FEMtech RTI", which began in 2008 with its first call for proposals. FEMtech – "Women in Research and Technology" was a programme of the Federal Ministry for Transport, Innovation and Technology (BMVIT) for promoting equal opportunities for women and men in research and technology within the fFORTE initiative[23] and ran during 2003 to 2010. After 2010, FEMtech RTI continued under the Talents programme as FEMtech research projects.

The FEMtech research projects funding scheme supports projects in research, technology, and innovation in which the research focus

20 See European Commission (2014c).
21 See http://www.genderste.eu/index.php
22 See European Commission (2014d).
23 fFORTE is an Austrian initiative that is meant to help promote the potential of women in professions previously dominated by men.

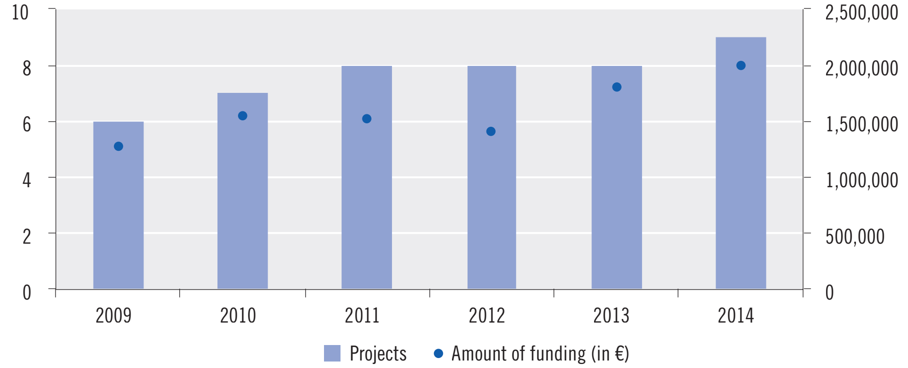
takes into account women's and men's different lived experiences and needs. The funding scheme's objective is to support innovation by incorporating gender relevance into project content, to create new market potentials, and to increase the utility of technological products for consumers.[24] The Austrian Research Promotion Agency (FFG) is sending a signal with the establishment of FEMtech RTI, emphasising the importance of considering gender in research, technology, and innovation and, at the same time, encouraging researchers working in the field to submit project applications and to engage with this topic.

The FEMtech research projects funding scheme funded a total of 46 projects with €9,747,700 between 2009 and 2014. The last call for proposals was issued in 2014 (and closed on 15 January 2015), and funding decisions will be taken over the first half of 2015. Fig. 5-4 shows the distribution of projects that have been funded thus far.

There was an annual call for proposals for FEMtech research projects between 2008 and 2013. Funding contracts with projects that were successful in the application round were published in the following year and are shown in Fig. 5-4. Six to nine projects were successful in each proposal round, and €1.3 to 2 million in funds were disbursed. Programme management at the Austrian Research Promotion Agency (FFG) allocated different SIC Codes[25] to the projects, which makes it possible to perform an evaluation of content priorities (see Fig. 5-5).

Fig. 5-5 shows that most funded research projects are situated in the field of information and communication technology (ICT). This is probably because the usability/user experience approach is most broadly distributed in the ICT field, which means that there is a comparatively great deal of know-how on user incorporation into research projects. FEMtech research projects are distinguished by their high degree of interdisciplinarity because gender experts and social scientists work together with researchers from engineering and natural sciences to incorporate user perspectives into the project. Interdisciplinary research approaches that include

Fig. 5-4: Number of FEMtech RTI projects and funding totals in the years in which the funding contract was signed



Source: Data from the Austrian Research Promotion Agency (FFG). Calculations: JOANNEUM RESEARCH.

24 See https://www.ffg.at/femtech-forschungsprojekte

25 The Austrian Research Promotion Agency (FFG) establishes new standards for reporting theme-oriented information under the keyword "thematic monitoring". Since 2012, all projects have been indexed systematically in a uniform catalogue. This is creating a data basis that will enable the presentation and analysis of funding instruments from various thematic perspectives. This project indexing uses an adapted version of the "Subject Index Code" (which the European Commission uses to categorise content on the CORDIS information platform) (see the FFG Working Programme 2013; https://www.ffg.at/sites/default/files/allgemeine_downloads/ffg%20allgemein/publikationen/ffg_arbeitsprogramm_2013.pdf).

natural sciences, engineering, and social sciences are found less frequently in other research fields, but this is exactly what is needed to incorporate gender and diversity in research projects. Experience has been gathered and competences developed in the fields of mobility, manufacturing, and energy and environment through the FEMtech research projects funding scheme.

This graph also shows that life sciences projects – including projects in the fields of medicine and health – received higher funding than other projects.

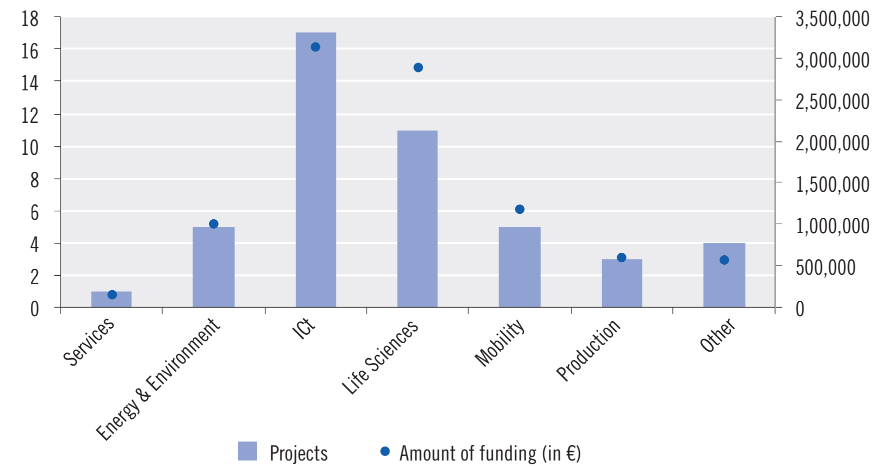
Research projects with a focus on gender that received Austrian Science Fund (FWF) funding

Unlike the Austrian Research Promotion Agency (FFG), the Austrian Science Fund (FWF) does not have its own funding scheme for supporting research projects that include the dimension of gender. Between 2008 and 2014, the Austrian Science Fund (FWF) funded a total of 84 research projects in different funding programmes that explicitly took gender into account.[26] Most of the projects (31) were funded as stand-alone projects; 23 projects were independent publications, and ten projects were funded in the Richter Programme (incl. the Richter Programme for the Development and Inclusion of the Arts (PEEK)). The other 20 projects were distributed broadly across the Austrian Science Fund's funding schemes.[27] Total funding of €15,229,565 was approved for these 84 research projects. Fig. 5-6 shows that between nine and 16 projects were approved per year. Viewed in terms of approved funds, 2012 saw the most funds approved for gender-specific projects (over €3 million), while 2013 brought comparatively less funding at about €1.5 million.

Between 2010 and 2014, approved funding totals were relatively low in relation to the number of projects. This is based on the fact that in both years a great many publications were funded, which have lower funding volume in comparison to other projects.

Applicants at the Austrian Science Fund (FWF) allocate their project to a maximum of four scientific disciplines (allocation using the

Fig. 5-5: Number of FEMtech RTI projects and funding totals by content foci (SIC codes)

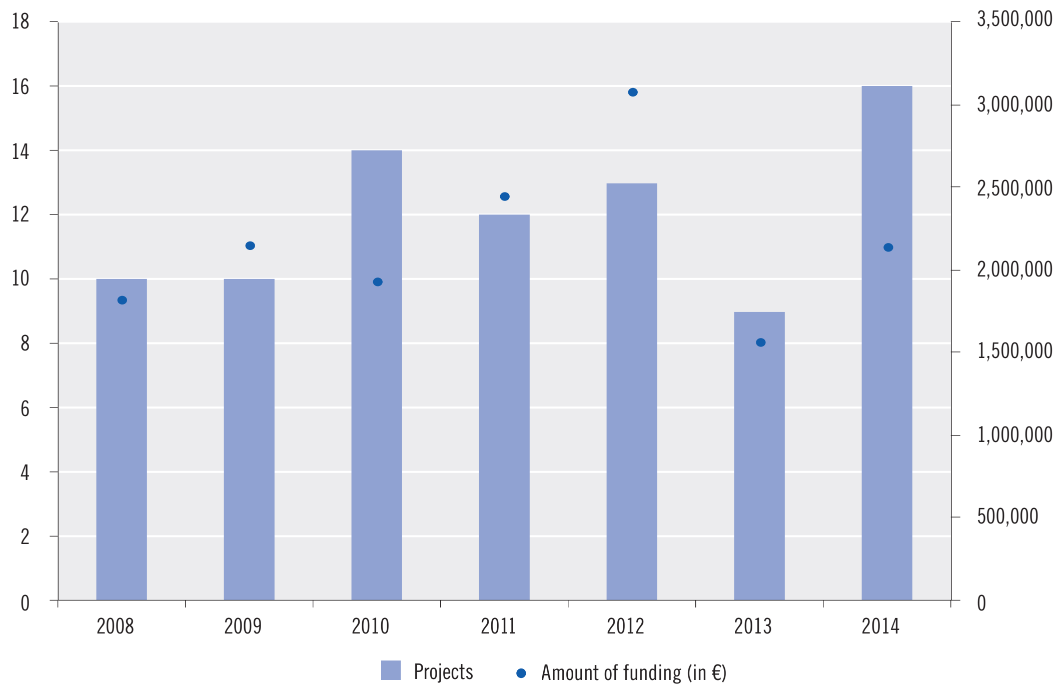


Source: Data from the Austrian Research Promotion Agency (FFG). Calculations: JOANNEUM RESEARCH

26 Considers those projects that reported the involvement of gender studies, gender research, women's studies, or feminism as scientific disciplines in a project, or where an abstract clearly indicated the inclusion of gender in a research project.

27 Meitner Programme (4), international projects (4), Firnberg Programme (3), Schrödinger Programme (3), Programme for the Development and Inclusion of the Arts (2), Initiation of a joint seminar (2), Translational Research Programme (1), Scientific Communication Programme (1).

Fig. 5-6: Number of projects funded by the Austrian Science Fund (FWF) and approved funding totals* by the year in which the projects were approved



* For projects during 2008 to 2010, there are only aggregated funding totals coded by funding programmes. These were weighted by project times and distributed to individual projects for the purposes of illustration.

Source: Data from the Austrian Science Fund (FWF). Calculations: JOANNEUM RESEARCH

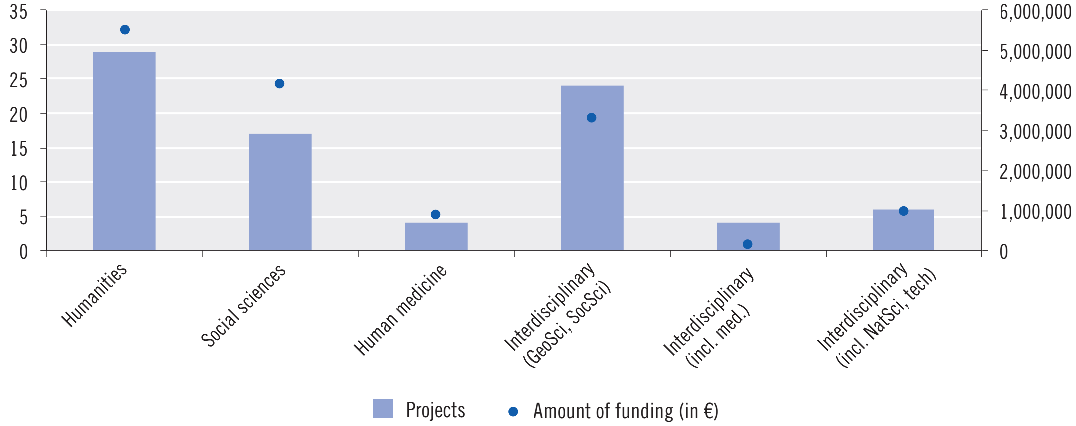
Austrian system of scientific fields 2012 from Statistics Austria). To gain an idea in which scientific disciplines gender-specific projects had been funded by the Austrian Science Fund (FWF), these are shown in Fig. 5-7 at the highest level of aggregation (single-digit).

As Fig. 5-7 shows, research projects with a gender focus are better funded if they are situated within one scientific discipline. Interdisciplinary projects receive lower funding volumes on average. This can be partially attributed to funding for independent publications, which are often situated in the interdisciplinary field between the humanities and social sciences (ten projects!). Not a single funded publication, however, was situated solely in social sciences. There was also publication funding for interdisciplinary projects that had a human medicine or natural science/engineering focus.

Overall, the evaluations of the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF) data show that experience with gender-specific research has been collected in a broad range of thematic fields and scientific disciplines in recent years. This was only possible because both funding agencies implemented measures for integrating gender as a dimension in research projects. This research funding policy is not yet widespread among ERA member states, as the European Commission study, *"Analysis of the state of play of the European Research Area in Member States and Associated Countries: focus on priority areas"* shows.[28] Over 50% of the countries have not yet

28 See European Commission (2014e).

Fig. 5-7: Number of projects financed by the Austrian Science Fund (FWF) with gender focus, and funding totals by fields of science



Source: Data from the Austrian Science Fund (FWF). Calculations: JOANNEUM RESEARCH.

introduced measures that support or implement the consideration of gender in research, or there is no information available about such measures. Another 20% of the studied countries have only initiated activities on a small scale. The FFG's FEMtech research projects funding scheme has been highlighted in this context as good practice. Only one-third of 33 ERA countries explicitly set aside budgeted funds for research projects that consider the dimension of gender (for example, in the form of programmes, calls for proposals, premiums, etc.), including Germany, Iceland, Norway, France, Switzerland, and the United Kingdom. And only five countries have national guidelines for integrating gender aspects into research content in the framework of research programmes, research projects, and studies. These countries are Austria, Spain, Iceland, Portugal, and Norway. To successfully meet the requirements of Horizon 2020, researchers in Europe must have acquired competences related to the integration of gender into research projects. They can receive support to this end from national funding agencies such as the Austrian Research Promotion Agency (FFG) and the Austrian Science Fund (FWF).

Why gender and other dimensions of diversity, such as age, physical impairment, or level of education, should be included in research becomes clear in the field of technology development: the development of technologies with an eye to gender and diversity leads to a stronger target-group orientation and therefore to an expansion of a product's market segment.[29] Product quality is improved through incorporating the perspective of gender, and products can be customised to meet the demands of different users.[30] Examples such as the Concept Car from Volvo, which was developed for women by a team of female engineers, also show that innovations can arise to meet the needs of a specific, formerly neglected group of users – in this case, women – while also satisfying other groups as well – in this case, men. In the case of the Concept Car, the innovations included emergency running properties and Easy Clean colour.

Stanford University established a focus on "gendered innovations" in 2008 to delve into the specific dimensions of this user-group orien-

29 See Danilda and Thorslund (2011); Schröder (2010); Ratzer et al. (2014).
30 See Schraudner and Lukoschat (2006); Schiebinger (2008); Schiebinger and Schraudner (2011); Pollitzer (2011); genSET (2010).

tation[31] with the goal of finding out how considering the dimension of gender can lead to specific product innovations. The examples of "gendered innovations" developed there demonstrate that considering different groups of users in the process of technology development can be profitable while also preventing losses. For example, they found that women are injured more severely and more often than men in car accidents. This was because crash-test dummies were designed to be the size of an average man's body. The auto industry has reacted since then and developed airbags that protect small and large passengers alike.

The experience of implementing the FEMtech research projects make clear the kinds of challenges that come along with including considerations of gender and diversity in research teams. These projects show that interdisciplinary cooperation across the boundaries of natural sciences, engineering, and social sciences is especially challenging and rarely takes place at the present time.

A central theme of scientific and practice-based literature is the fact that research projects at the interface between gender research and applied research in engineering or natural sciences often reproduce and perpetuate gender stereotypes in an unreflective manner. Gender and diversity competence is therefore viewed as a necessary prerequisite for carrying out gender-sensitive research and development. A broader understanding of innovation and technology among the stakeholders provides a basis for an implementation strategy which, aside from economic aspects, also includes political and social factors. In addition, the innovation process is meant to include external knowledge from different social groups ("open innovation"). The search for shared concepts between researchers from heterogeneous disciplines in such a process (gender researchers, technicians, target groups, and user groups) and the creation of mutual understanding are presented as central challenges. This is also shown by the results from the FEMtech RTI interviews.[32] The added value that researchers from other disciplines bring to the research project must be recognised first. If this is successful, it strengthens cooperation. Gender experts involved in such an interdisciplinary research project are also required to create a shared understanding of gender in the project and to share their expertise on gender. In order to avoid reproducing gender stereotypes, research projects also face the challenge of taking into account other dimensions of diversity, such as age or technological competence. The requirement of intersectionality increases the project's complexity.[33]

FEMtech research projects have given researchers the opportunity to gain their first experiences in conducting challenging interdisciplinary research projects. Additional opportunities to perform research with a focus on gender or diversity will be required to further develop this promising field.

5.2.3 Gender in non-university research in natural sciences and engineering

The participation of female scientists in research and development continues to be very low in Austria. In 2011, a total of 37,114 full-time equivalent scientists were employed in R&D in Austria. Of these, 8,463 were female scientists. This means that women made up about 23% of researchers. The participation of women in the R&D sectors, however, varies quite widely: While women make up 34% of scientists in the higher education sector, they constitute only about 15% in the business enterprise sector. The business enterprise sector is the largest R&D sector in Austria, with 62% of

31 See http://genderedinnovations.stanford.edu/
32 See Holzinger and Schaffer (2011, p. 2).
33 See Reidl (2014).

all scientists in Austria working in this sector. In comparison, 33% of all scientists work in the higher education sector. However, there is little information about the status quo on equal opportunities in the business enterprise sector because it is not subject to detailed, continuous monitoring.

Results of the Gender Equality Survey

The monitoring of non-university research in natural sciences and engineering in Austria, which was released in published form under the title "Gender Booklet – Non-university research" up to 2008, could provide a model. The research institutions covered in the former Gender Booklet represent an essential connection between university research and the business enterprise sector. The monitoring of non-university research in natural sciences and engineering covers the Austrian Institute of Technology (AIT), JOANNEUM RESEARCH (JR), Salzburg Research (SR), the COMET Centres (COMET), the Laura Bassi Centres of Expertise (LBC), the Christian Doppler Laboratories (CDLs), the Nano TechCenter Weiz, and the members of Austrian Cooperative Research (ACR). Other non-university research institutions, such as the Ludwig Boltzmann Institute, the Austrian Academy of Sciences, the Josef Ressel Centres, the Research Studios Austria, and IST Austria, have not yet been included in this monitoring.

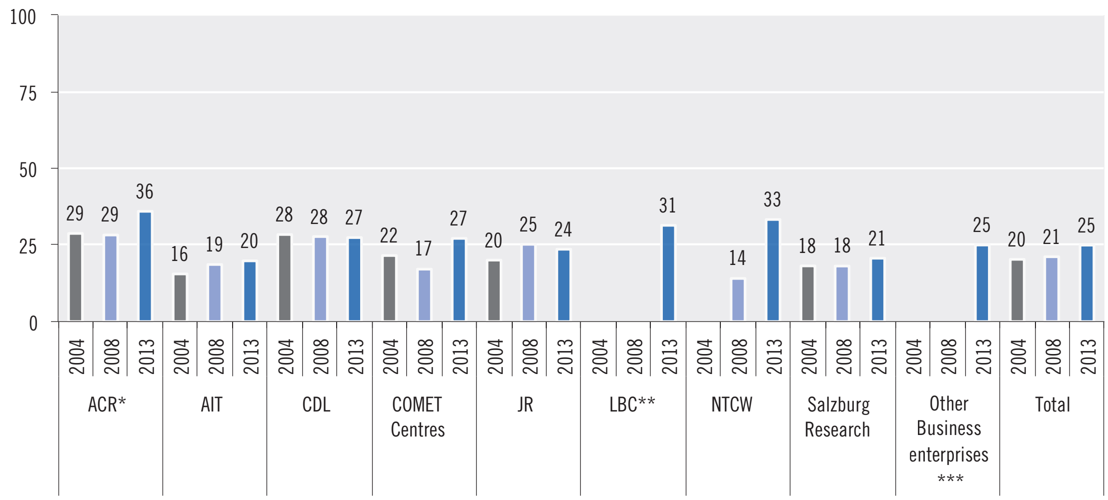
The Gender Booklet performed annual monitoring of the employment of scientists between 2004 and 2008. This monitoring was performed once again in 2014. This section therefore focuses on gender equality developments in non-university research in natural sciences and engineering between 2004 and 2013.[34] This enables us to illustrate changes over the medium term and detail their effects on equal opportunities among men and women.[35] The existing monitoring data may only cover a comparatively small R&D sector, but it shows very clearly that action is required to promote equal opportunities between women and men and it can point to some targeted successes. In addition, we were able to identify research institutions that have made progress in the promotion of equal opportunities with measures that can be described as good practice. A more precise examination of these successful research institutions, their activities, and related measures for promoting equal opportunities could provide important insights and lessons learned for other institutions.

The proportion of female scientists in non-university research in natural sciences and engineering rose from 20% to 25% between 2004 and 2013. The non-university research sector, which focuses on research in natural sciences and engineering, therefore lies somewhat in between the two large R&D sectors in Austria, namely the business enterprise and higher education sectors. The share of women among newly hired scientists in non-university research also rose to 39% in 2013. Fig. 5-8 shows, however, that the proportion of women was stagnant between 2004 and 2008; the overwhelming share of growth occurred between 2008 and 2013. This pattern of development, though, is not reflected at the level of individual institutions. AIT and JR, for example, posted stronger growth between 2004 and 2008, while the proportion of female scientists remained flat between 2008 and 2013. In contrast, SR and COMET had flat to falling numbers during 2004 to 2008, followed by strong to very strong growth during 2008 to 2013. This points, on the one hand, to the different courses of development in individual research institutions and, on the other, to the discontinuity of success – and perhaps also activities – in the promotion of equal opportunities in those respective institutions.

34 The Gender Equality Survey 2014 surveyed employment conditions in non-university research in natural sciences and engineering in 2013.

35 The results presented in the following are based on Holzinger and Hafellner (2014).

Fig. 5-8: Trend in the proportion of women by research institution[36] (in %), 2004/08/13



* The proportion of women determined by the Gender Equality Survey for the ACR was above average. However, this data overestimates current status quo because the data on researchers that the ACR collected itself and that include all ACR institutes showed only limited growth.

** The Laura Bassi Centres of Expertise participated in the Gender Equality Survey for the first time.

*** The group of other enterprises includes research enterprises in which non-university institutions have holdings and that have voluntarily participated in the survey (n=2).

Source: JOANNEUM RESEARCH: Gender Equality Survey 2014.

The Nano TechCenter Weiz (NTCW), the COMET Centres, and Salzburg Research also posted major growth in the share of female researchers between 2008 and 2013. The positive developments in overall non-university research in natural sciences and engineering can be attributed in particular to the COMET Centres, which reported growth from 17% to 27%.

The positive development in the proportion of female scientists between 2008 and 2013 is also reflected in the results for other indicators (age, income, and function). It remains striking, however, that the strongest growth and greatest proportions of women are in the younger age groups, the lower-income groups, and the lower functional levels. The proportion of female scientists in the age group up to 25 years is 39% (2008: 34%) and 28% (2008: 21%) for the 26-to-35 age group. In the income groups, most women fall into the monthly income groups of up to €2,000 (43%; 2008: 36%) and between €2,001 and €3,000 (31%). Income was recorded as full-time equivalent income, which excludes distorting effects caused by part-time employment. Other determinants of income were not included. However, a multi-variate regression analysis of gender-specific income disparity in the Gender Booklet 2008 found that women earn about €150 less per month than their male counterparts due to their gender.[37] In terms of functional levels, female scientists are significantly overrepresented in lower functional groups, such as technicians/specialists (36%) or junior scientists (27%), whereas they are represented at 10% in business enterprise management and 14% in the higher levels of management. This shows that growth is occurring primarily among young female scientists with low income. We

36 For a list of research institutions participating in the Gender Equality Survey, see Holzinger and Hafellner (2014).
37 Federal Ministry for Transport, Innovation and Technology (BMVIT) (2009).

will therefore have to watch in the coming years to see whether this positive trend in the proportion of female scientists continues, and whether this growth will also find purchase in higher incomes, higher functions, and other age groups.

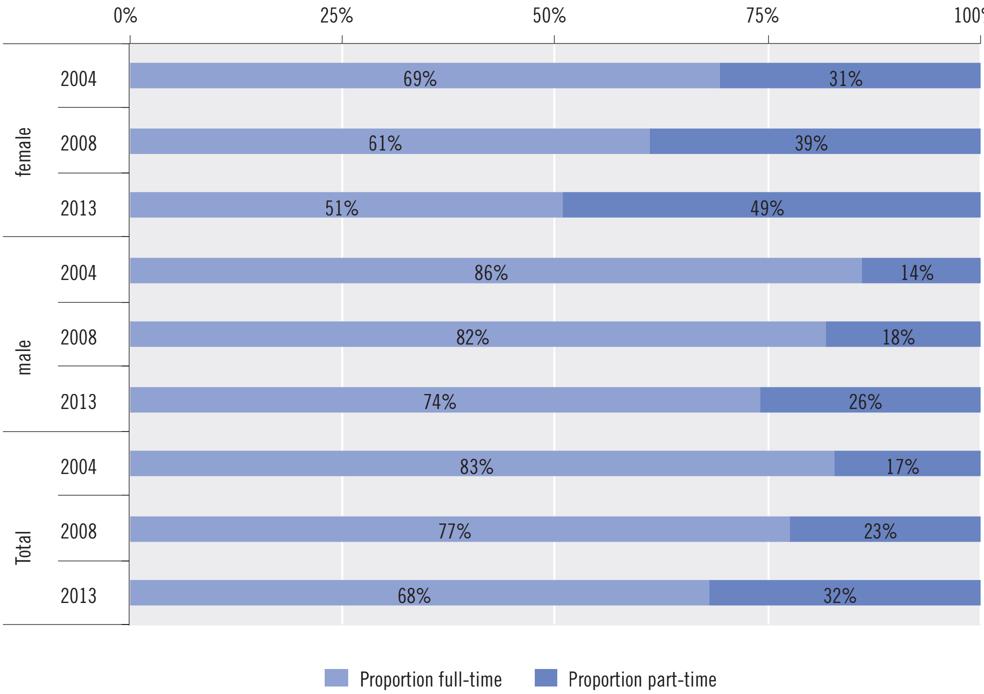
An important finding of the comparative perspective is the change in terms of full-time and part-time employment of female scientists during 2004 to 2013. The authors of the first Gender Booklet 2004 wrote: *"The share of scientific employees with part-time positions is not very high overall. (...) Research apparently requires full concentration on research work, expressed in the form of full-time employment."*[38] This changed completely by 2013. Since 2004, the proportion of both men and women in part-time employment positions has increased significantly; in 2013, 49% of all female scientists, and 26% of all male scientists, were employed part-time. Overall, about one-third of scientists in non-university research in natural sciences and engineering are working part-time (as opposed to 17% in 2004). We should emphasise that the growth in part-time employment affects both women and men. In addition, significantly more male scientists took parental leave in 2013 (39%) than in 2008[39] (19%) (see Fig. 5-9).

Science professions are characterised by high full-time engagement, long working hours, and limited work-family balance, which also applies in principle to non-university research.[40] Based on the monitoring results, however, we can formulate the hypothesis that higher flexibility and increased use of part-time work or part-time parental leave by women and men may be preliminary signs of a transformation in working conditions and working culture in non-university research in natural sciences and engineering. The Gender Booklet and the Gender Equality Survey cannot, however, provide information about the reasons and motives for part-time work. It may be assumed, though, that part-time work is chosen to enable work-life balance and caring for children. This would confirm the hypothesis of a shift in working culture. On the other hand, increased part-time employment could also reflect the situation of young researchers taking up their first scientific employment.[41] The data from the Gender Equality Survey do not clarify whether part-time employment meets the desires of young scientists, or whether research institutions simply offer a majority of their young hires part-time positions. A more precise assessment is therefore required as to what effects the distribution of part-time forms of employment have on gender equality among men and women.

The Gender Equality Survey 2014 also showed that non-university research institutions are placing increased priority on the topic of equal opportunities among women and men. About half of these institutions consider equal opportunities to be an integral component of their business enterprise culture and corporate governance, and gender equality measures are believed to have organisational utility: they lead not only to more equal opportunities, but also reduce conflicts at the workplace, strengthen innovation potential, and expand the talent pool in recruiting processes. Furthermore, 60% of the institutions surveyed reported that they take gender into account when it comes to research content (Gender in Research). The high relevance that research institutions assign to the topic of equal opportunities is not, however, directly reflected in institutional budgets. Only a few institutions have a budget for gender equality measures. This situation is also reflected in the gender equality measures that are im-

38 Federal Ministry for Transport, Innovation and Technology (BMVIT) (2005).
39 The legal right to part-time employment for parents ("parental part-time employment") came into force on 1 July 2004 and was therefore not yet included in the 2004 survey.
40 See Lind (2013); Holzinger and Reidl (2012); Acker (1990).
41 See Federal Ministry for Transport, Innovation and Technology (BMVIT) (2009); BMVIT (2010).

Fig. 5-9: Distribution of full-time and part-time employment among researchers[42] by gender, 2004/08/13



Source: JOANNEUM RESEARCH, equal opportunitiesSurvey 2014.

plemented. Across the board, the emphasis is on instituting those measures that support modern, flexible organisation of work while simultaneously supporting work-life balance (for example, flexible working times and locations, facilitating part-time work, supporting scientists with children) but which do not carry with them any (high) financial burden. In contrast, specific gender equality measures are seldom implemented, such as gender competence training, sensitisation activities, or grants for young female scientists. Interviews with selected research institutions also show that commitments to equal opportunities often tend to be of a formal nature or stated as a principle that is not fully integrated into the organisation's activities. The underrepresentation of women is viewed as an external problem belonging to schools and universities, not as a challenge for one's own organisation. By contrast, there are also institutions that are making active efforts to recruit female scientists and to support girls who are interested in technical education. These institutions perceive their role in the promotion of equal opportunities in a very different way. Instead of shifting responsibility to external agents, they make an active contribution towards greater equality in research, technology, and innovation.

In summary, there have been positive developments in gender equality in non-university research in natural sciences and engineering between 2004 and 2013. Nevertheless, there is clearly a need for more action: developments were intermittent at the individual research institutions, and some research institutions showed signs of stagnation or slight setbacks. One positive highlight is the development of

42 Incl. scientists with marginal employment and on parental leave.

the COMET Centres, which have made a major contribution to elevating the proportion of female scientists, especially since 2008. The results of the Gender Equality Survey show that the COMET Centres are above all motivated and urged by funding providers to implement measures to ensure equal opportunities. Gender equality is also a consistent topic in the interim reports. This means that the subject has a different priority and is given more attention in the COMET Centers, which ostensibly has a positive effect on participation by women.

5.2.4 Gender equality in non-university basic research

The Austrian Academy of Sciences (ÖAW) and the Institute of Science and Technology Austria (IST Austria), which are classified as belonging to the non-university sector of institutions with a focus on basic research, have not yet been included in gender equality monitoring. The following provides an overview of existing measures and activities promoting equal opportunities in these two institutions.

The ÖAW is committed to equal treatment of men and women, has embedded this in its rules of procedure in 2011, and is trying to increase participation by women at all levels. In 2014 there were 1,152 people (calculated as full-time equivalents) employed at the ÖAW. The share of women amounted to about 43%. If we take a look at scientific personnel, we find that 39% of all scientists are women. There is a larger gender gap between mathematics, natural science and technology (MNT) as a group and the humanities, social sciences, and cultural studies (HSC). While there is a nearly equal gender balance in HSC (48%), only 33% of scientists in the MNT fields are women. Of 29 institute management positions, only one is currently occupied by a woman (3.5%). It is therefore an extremely important sociopolitical matter for the ÖAW to promote internationally proven female researchers into top ÖAW positions. Suitable female applicants are identified during the hiring process and invited to submit applications. Women made up about 13% of the ÖAW membership in 2014, while 50% of new members admitted in 2014 were women.[43]

A plan for the promotion of women and a ÖAW career model were developed in the 2012–2014 performance agreement. Both measures are closely interwoven with one another and will be further fleshed out and implemented in subsequent performance agreement periods. Central challenges were identified in the transition from the doctorate to the postdoc phase, a point at which the share of women drops significantly, as well as the presence of women in leadership functions. This is why the following activities are being implemented in the plan for promoting women: The participation of and opportunities for women in the recruiting process should be increased by means of targeted approaches to women and hiring committees with equal gender representation. A mentoring programme is also being implemented to provide targeted support to women for their scientific careers.

The function of the ÖAW's working group for equal opportunities has been significantly strengthened since 2011, when it was included in the rules of procedure. It is responsible for the development and monitoring of the implementation of the plan for the promotion of women in the course of the 2015–2017 performance agreement. The working group must also be included in decision-making processes regarding personnel. Furthermore, the working group serves in an advisory capacity in fundamental matters associated with equal opportunities and support for women. The group submits an annual report on equal treatment, which also focuses on equal opportunities for men and women, to the executive committee of the Austrian Acade-

43 Data was provisioned upon request by the Austrian Academy of Sciences for the preparation of this report.

my of Sciences. "Academic age" is the only criterion considered in the awarding of grants. This means that age limitations can be extended for people who, for example, have interrupted their career to take care of children.

IST Austria is dedicated to basic research in the natural and formal sciences. The institute views the diversity of its employees as an important foundation for creating new knowledge, new ideas, and excellent scientific results. Its commitment to diversity and equal opportunities is also enshrined in its mission statement: *"We are committed to the highest international academic standards, integrity, equality and diversity on campus, as well as respect and recognition for all."* Women occupied about 32% of research posts in 2014. There are, however, significant differences amongst career levels: 16% of professors are women, while 38% of PhD students and 34% of postdocs are women.[44]

The institute has launched several measures since its founding that are related to equal opportunities, especially with a focus on recruiting researchers. Hiring searches for scientific employees explicitly encourage women to apply. All of the relevant meetings, search committees, and advisory boards prioritise searching for highly qualified female scientists. Parenthood and the compatibility of work and family are additional focal points of efforts regarding equal opportunities. Career interruptions for family reasons are taken into account, which is meant to minimise their effects on the selection of scientists at all levels. Tenure[45] evaluations can be postponed for one year due to parenthood. Supportive career rules for researchers at all levels (PhD students, postdocs, professors) who have child care obligations are being defined and implemented. A workplace kindergarten was also built on campus as another measure to reconcile work and family. Furthermore, IST Austria received a basic certificate from the "berufundfamilie"[46] (work and family) audit, which gave it the right to call itself a family-friendly institution. The audited measures are undergoing further development in the coming years. IST Austria has also established an internal Dual Career[47] Advice Service and is also a member of the Dual Career Service Support network of the Vienna Science and Technology Fund.[48] Moreover, there has been a central point of contact for gender and diversity issues since 2011 that provides advice to management, identifies possibilities for further action, and develops appropriate measures.

5.2.5 Summary

Austria has made progress in terms of equal opportunities and gender in RTI, both at the level of the representation of women in research teams as well as the consideration of gender in research content and technology development. Both provide support to the Austrian research landscape in meeting the objectives articulated by the European Commission in Horizon 2020 regarding equal opportunities and gender.

The analyses that form the heart of this chapter clearly show how essential a consistent funding policy has been for furthering this progress. The proportion of women among all scientists has risen slowly in Austria overall and has increased from 20% to 25% in non-university research during 2004 to 2013. The COMET Centres have made a major contribution to this rise in the proportion of female researchers because they make sure that funded institutions implement measures to promote equal opportunities.

44 Data was provisioned upon request by IST Austria for the preparation of this report.
45 Tenure-track positions are performance-based career positions for the next generation of scientists. Their scientific achievements are assessed after a limited trial period and, if the assessment is positive, then the position is turned into a permanent position.
46 See http://www.familieundberuf.at/leistungen/massgeschneiderte-audits/audit-berufundfamilie/
47 Dual-career offers support the mobility of researchers by providing assistance for researchers and their partners who come to IST Austria from abroad. The focus here is on job search assistance for partners.
48 See http://www.wwtf.at/other_activities/dual_career_service_support/

Nevertheless, there is still a need for action because women are represented at below-average levels in leadership positions, for example. Furthermore, there is very little data on the status quo for equal opportunities in the business enterprise sector. This is the largest R&D sector in Austria, and it has only had a very low proportion of women up to this point. If the proportion of women in R&D in Austria is to be raised overall, effective gender equality measures also need to be implemented in this sector and progress should be reviewed on a regular basis. Progress monitoring for the Austrian Academy of Sciences and IST Austria is done in the performance agreement meetings. Gender equality is an important theme for and is structurally embedded in both institutions. The Austrian Academy of Sciences and IST Austria strive to increase the share of women in research and in leadership positions through active recruiting and efforts to improve the compatibility of work and family.

The Austrian Research Promotion Agency (FFG) and Austrian Science Fund (FWF) have integrated the consideration of gender and equal opportunities into their application and reporting mechanisms in order to more deeply anchor gender in research. The FEMtech research projects funding scheme also enables researchers at the Austrian Research Promotion Agency (FFG) to gain their first experience with incorporating the dimensions of gender and diversity into technological research. This funding policy has facilitated experience with gender-specific research in a broad range of thematic fields and scientific disciplines in recent years. Austria occupies an internationally pioneering role with its funding policy, which supports researchers in integrating the requirements of Horizon 2020.

The analyses for this chapter show something else in addition to the central role of funding providers: long-term effort and consistent funding policy are required to increase the proportion of women in science and to integrate gender into research and development projects.

5.3 Public procurement as an instrument of innovation policy

Demand-side innovation policy is becoming increasingly important; including such instruments as public procurement promoting innovation (PPPI), innovation-promoting regulations and standards, and innovation-friendly consumer policy. However, these are not meant to replace supply-side instruments, such as direct and indirect promotion of research, technology, and innovation (RTI), but rather to supplement them in a sensible policy mix.[49] Because public procurement is an important economic factor, PPPI is currently the most prominent demand-side instrument in play and has secured a fixed position on the innovation policy agenda.

The European Commission – an essential driver for this theme – has announced in its *Innovation Union* document[50] that its aim is to see member states create PPPI budgets that will facilitate innovation procurement markets in the EU totalling up to at least €10 billion for precisely those innovations that increase the efficiency and quality of public services and thereby address prominent social challenges (environment, health, inclusion, security, etc.).

Demand-side instruments, and especially PPPI, were embedded in 2011 as an objective in the Austrian federal government's strategy for research, technology, and innovation.[51] This was followed in 2012 by the approval of an action plan for public procurement promoting innova-

49 See OECD (2014), (2011); EC (2010/C/546).
50 See EC (2010/C/546).
51 See The RTI strategy of the Austrian federal government (2011).

tion (PPPI) in Austria in a ministerial council application[52] filed by the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Science, Research and Economy (BMWFW).[53] The global aim is to increase the share of public procurement that is used for innovations. Unlike other European countries, a quantitative PPPI target was not set.

The fact that quantity plays a fundamental role in procurement in Austria is clear in that the demand from public administration for goods and services manufactured domestically amounted to about €40 billion in 2010.[54] This is almost 14% of GDP and constitutes a significant demand factor for firms in Austria. However, the proportion of Austrian firms that have conducted innovation activities in the context of public procurement orders is not (yet) particularly high. The initiative in innovation policy to engage more intensely for the promotion of innovation in the business enterprise sector by means of public demand is therefore justified to a high degree.

This chapter will present, first, the current status of PPPI at the federal level, especially in terms of legal and organisational framework conditions. Second, we will assess the importance of public procurement for innovation activities in the Austrian economy, Using the new results of the European Community Innovation Survey (CIS) for the year 2012, which, for the first time, contained a block of questions regarding the distribution of procurement orders by public institutions and the role this plays in innovation activities in the private sector.

5.3.1 Uses and types of PPPI

We speak of public procurement promoting innovation whenever public purchasers create an "innovation market" by issuing calls for tenders for new or improved goods or services. This can have a significant effect if the call involves large financial volumes of procurement of innovative solutions. It can also generate a significant indirect effect if the public institution steps forward as a *lead user*, meaning that the innovation in demand serves as a reference project.

Multiple benefits of PPPI: the public purse, the economy, and citizens

First, public purchasers can profit from PPPI in four ways:

(1) Effectiveness and impact orientation: participating in the general societal modernisation process, citizens expect the modernisation of services and infrastructure as well. PPPI is necessary whenever the solutions needed do not exist at all, or only at insufficient levels.

(2) Efficiency: New solutions can contribute significantly to increasing productivity and lowering costs.

(3) Optimality: Whenever similar problems exist among two or more public institutions, they can use PPPI to share costs, minimise risks, and thereby attain optimal solutions.

(4) Image: There are often expectations that the public sector assume a pioneering role; with PPPI, among other things, it can show that it co-facilitates modernisation.

Firms also profit in many ways from PPPI. Calls for tenders give firms a clear market signal, and successful bidders (contractors) make revenue. Whenever prototypes are part of PPPI, contractors have the opportunity to test their goods/systems/services (which is normally time-consuming and expensive, which therefore saves them money). Completed projects also serve as references and support further acquisitions.

52 Formerly the Federal Ministry of Economy, Family and Youth (BMWFJ).
53 See Federal Ministry of Economy, Family and Youth (BMWFJ) and Federal Ministry for Transport, Innovation and Technology (BMVIT) (2012a), (2012b).
54 See Federal Ministry of Economy, Family and Youth (BMWFJ) and Federal Ministry for Transport, Innovation and Technology (BMVIT) (2012a); Clement and Walter (2010).

Eventually, the guiding concern for PPPI may be the advantages for citizens. This is because provisioning high-quality services and their affiliated infrastructures is the ultimate task of public institutions. PPPI must therefore be understood as a hub between the economy on the one hand and citizens on the other (Fig. 5-10).

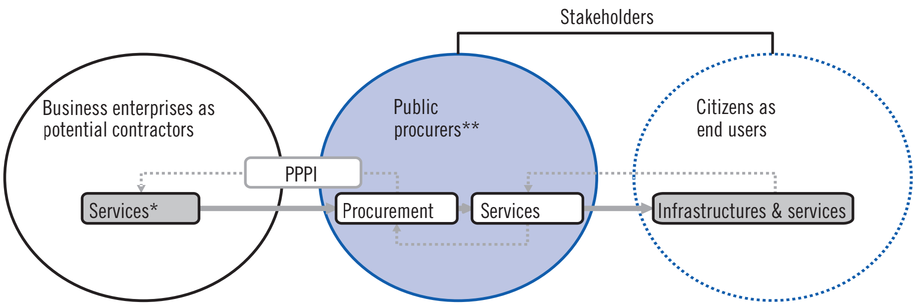
Types of PPPI: pre-commercial and commercial procurement of innovation

On the basis of current law – in this case the Federal Procurement Act (Bundesvergabegesetz)[55] – we must draw a distinction between two kinds of PPPI. Commercial procurement of innovation as the normal case in the context of BVergG and pre-commercial procurement as an exception in the BVergG.

The commercial procurement of innovation (*public procurement of innovation*, PPI) signifies the call for tenders for new/improved goods and services. This includes (i) new development (developed for the public sector as client[56]), (ii) first purchase (public client as the first point at which this product is purchased, thereby enabling its use as a reference project), and (iii) diffusion (procurement of innovative goods or services that have only recently become available on the market). The BVergG says the following: Section 19/7 "*Innovative aspects can be considered in the procurement process. This can be done in particular by taking into account innovative aspects in the description of the service, the establishment of technical specifications, or by the determination of specific award criteria.*"

Pre-commercial procurement (PCP) means the call for tenders for R&D services that are done under the following conditions set forth in the BVergG: Section 10/13 *"This federal law does not apply (...) to research and development services unless their results are the exclusive property of the client for its use in the exercise of its duties and the services are completely remunerated by the client"*. This means, among other things, that the rights to the R&D results are shared. PCP can occur in the form of classical R&D services, or in the form of a multi-stage procedure (PCP scheme), as this is also applied in EU research frameworks (Horizon 2020). This stepwise, intensely competitive process facilitates optimal solutions for public purchasers (Fig. 5-11).

Fig. 5-10: PPPI as the hub between the economy and the citizens

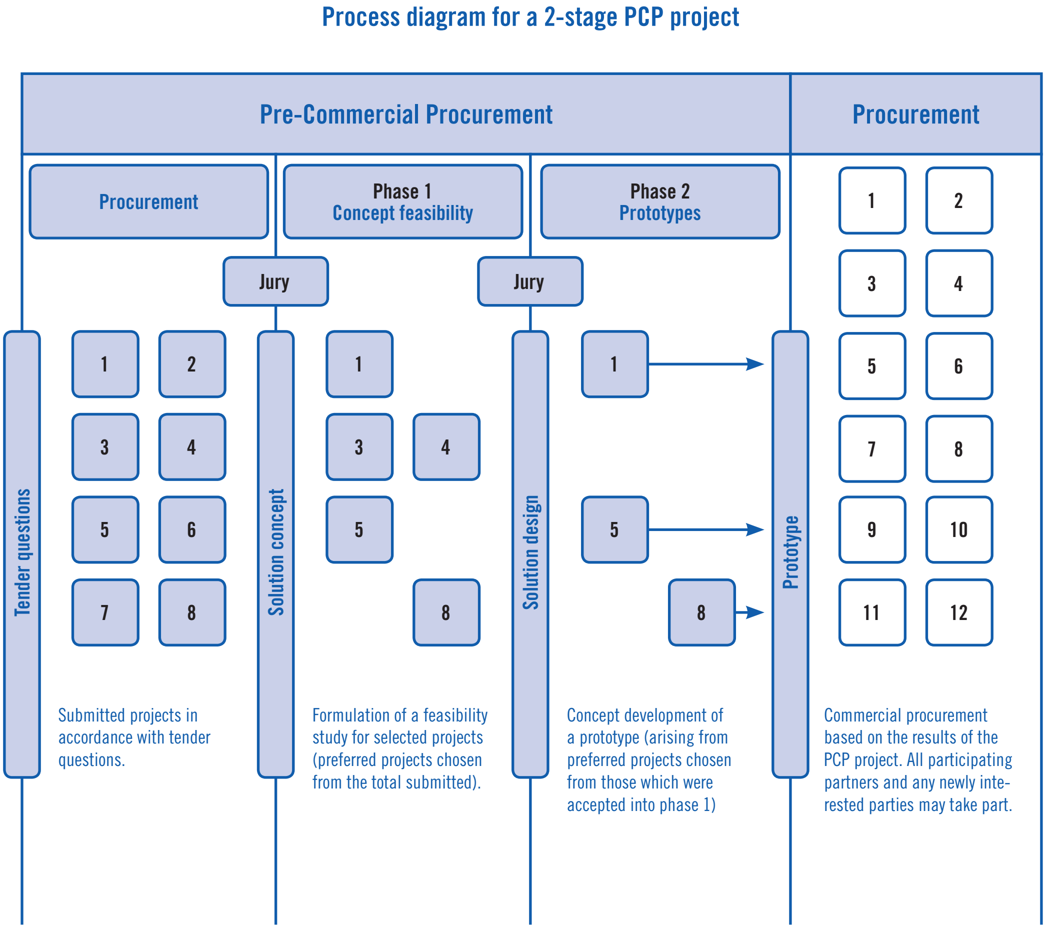


* Services acc. to the Federal Procurement Act (Bundesvergabegesetz): Provisions of construction services & supply of goods & provision of services
** Public procurers acc. to the Federal Procurement Act (Bundesvergabegesetz): Federal government, regional governments, local governments & public entities & sectoral contractors

Source: Buchinger (2012).

55 See Federal Law Gazette (2006/17).
56 Including R&D services that are performed according to the BVergG rules and therefore do not need to adhere to the BVergG conditions for exceptions, such as the sharing of rights (see pre-commercial procurement). Exclusive expert reports, standard studies, etc.

Fig. 5-11: Schematic representation of a PCP project (Austrian scheme*)



* Deviates from the EU and US scheme because of its two-stage (not three-stage) design.
Source: Federal Ministry for Transport, Innovation and Technology (BMVIT) et al. (2014).

5.3.2 Developments in Austria

The "action plan on public procurement promoting innovation (PPPI) in Austria" defines the framework for PPPI activities in innovation policy. It went into force in 2012 and has a well-secured political and institutional basis. The action plan relates to the requirement of the strategy for research, technology and innovation of the Austrian Federal Government[57] to promote demand-side instruments. It was established on the basis of a participative process that involved relevant stakeholders in the Austrian procurement community. Both the creation of the action plan itself and its implementation were decided by the Council of Ministers.[58] The ministries responsible for the creation and execution of the PPPI action plan are the Federal Ministry for

57 See the principles and objectives of the RTI strategy of the Austrian federal government 2011: p. 11, p. 26.
58 See also Federal Ministry of Economy, Family and Youth (BMWFJ) and Federal Ministry for Transport, Innovation and Technology (BMVIT) (2012a), (2012b), (2011).

Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Science, Research and Economy (BMWFW).[59]

As already mentioned in the introduction, the PPPI action plan aims to increase the share of public procurement volume that is used for innovations. This is meant to generate two types of impact. On one hand, manufacturing should be stimulated to offer better goods and services, which is meant to enable public institutions to offer better public services and infrastructures on the other.

Although there have already been public procurement activities with innovation stimulation[60], their number is low. To overcome this marginalisation, a clear message was formulated during the aforementioned stakeholder process that the increase of share of PPPI in procurement budgets requires political support. The action plan therefore proposes a mix of measures that cover four dimensions:

- Strategic dimension ("soft law"): Political support for the introduction of innovation-related procurement plans in public institutions and the setting aside of appropriate budgets. Integration of the innovation needs of public institutions in existing programmes.
- Operative dimension (funding & procurement): Establish a PPPI service centre and PPPI competence and contact points to be able to offer custom-tailored support for public institutions. Provisioning of financial incentives for PPPI and the initialisation of PPPI pilot projects.
- Legal dimension ("hard law"): Amendment of the BVergG with the objective of naming innovation as an explicit goal.
- Impact dimension: Establishment of a PPPI monitoring and benchmarking system.

The action plan does not identify a quantitative target (i.e. a percentage of the procurement budget dedicated to PPPI). This is a difference with respect to other European countries such as France, Spain, the United Kingdom, and the Netherlands, where quantitative goals exist.

Progress in the implementation of the PPPI action plan

The implementation of the PPPI action plan is coming along well. Progress was made in all four dimensions.

In the strategic dimension, preparations were made for the introduction of innovation-related procurement plans with information campaigns. Furthermore, there is already an example of integrating the innovation needs of public institutions via PCP into an existing programme focused on transportation (transport infrastructure funding). There is also a pilot programme for innovative heating and cooling of historical buildings, which uses the PCP instrument. Table 5-3 presents an overview of completed and ongoing PCPs in Austria.

In the operational dimension, the PPPI Service Centre was set up in the Federal Procurement Agency (BBG) in 2013. Its website[61] provides information about the Service Centre's offerings, which range from online platforms to events and training sessions, to pilot projects and strategic support. Efforts then began in 2014 to gradually establish the PPPI competence and contact centres envisioned in the action plan. They should be viewed as subject-specific institutions that are complementary to the Service Centre and work closely with it. Currently, these institutions include Austria Wirtschaftsservice (aws) (focus: commercial PPPI), the Austrian Research Promotion Agency (FFG) (focus:

59 Previously Federal Ministry of Economy, Family and Youth (BMWFJ).
60 The action plan includes a list of good practices; for further examples, see also PPPI Service Centre (2014), Brünner et al. (2012), Buchinger and Steindl (2009).
61 See http://www.ioeb.at/

Table 5-3: Completed and ongoing PCPs in Austria

Purchaser	Problem	Solutions via PCP	Duration
ASFINAG	Mobile transportation management system for construction sites & major events	MOVEBAG (mobile sensor components that can be mounted on-site with a few hand movements) MOVE BEST (mobile, energy self-sufficient, dynamically controlla-ble components and displays)	05/2012 – 09/2014
ÖBB INFRA	Detection of natural dangers	SART (early warning for initial slide movements with Impact Sentinel sensors) NATURAL DANGER RADAR (energy self-sufficient detection of mass movements by means of high-frequency radar technology) RISKCAST (mobile, decentralised data capture using meteorological information)	05/2012 – 09/2014
ÖBB PRODUKTION	eHybrid train engine with and without overhead lines		05/2014 – 12/2016
Burghauptmannschaft	Heating & cooling of historical buildings		09/2014 -

Sources: Federal Ministry for Transport, Innovation and Technology (BMVIT) et al. (2014), https://www.ffg.at/mobilitaetderzukunft_call2014as4; https://www.ffg.at/PilotHeizenKuehlen

pre-commercial PPPI), AustriaTech (sectoral focus: intelligent mobility), the Austrian Energy Agency AEA (sectoral focus: energy), the Austrian Economic Chambers WKO, and the "procurement platform of the regional governments" as contact centres. Discussions are being held with additional potential competence centres, such as the Federal Real Estate Association BIG, for example. The result is a series of events in which best practice examples are introduced and offered in interactive learning forums.[62]

Both the PPPI Service Centre and, to some extent, the competence/contact centres are financed by both of the ministries in charge (the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Science, Research and Economy (BMWFW)). This not only allows for the aforementioned events to be held, but also enables the provisioning of financial incentives for PPPI and the initialisation of PPPI pilot projects. Examples of this are the PCP projects outlined above and a recent project competition in which public institutions could win consultancy services.

Progress has been especially rapid in the attainment of the goals in the action plan. The 2013 amendment of the BVergG named innovation as an explicit goal.[63] The BVergG now includes a total of three mission-oriented goals: the inclusion of environmental aspects as a "should" criterion and the consideration of socio-political concerns and innovation aspects as "can" criteria.

In terms of the impact dimension, the action plan anticipated an overall evaluation that will be conducted in 2016. The first steps are being taken right now to establish a PPPI monitoring and benchmarking system. The first events have undergone an assessment, and Statistics Austria was commissioned to conduct a PPPI pilot survey, the results of which will be completed in the autumn of 2015. The PPPI pilot survey will include the major public institutions of the federal government (ministries and the related state-owned firms) as well as exemplary regional governments and larger cities.

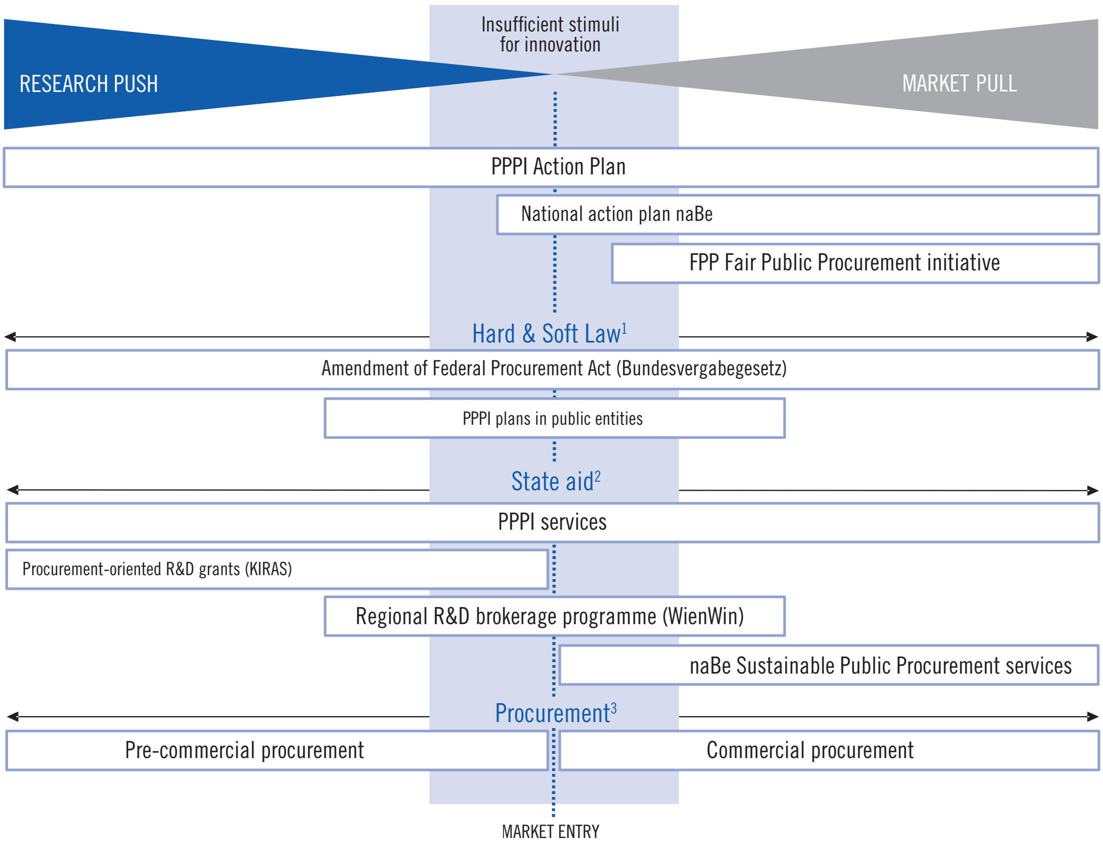
62 See http://www.ioeb.at/downloads-links/nachlesen-zu-veranstaltungen/
63 See Federal Law Gazette (2006/17).

The Austrian procurement policy mix smart

A bundle of instruments exist around the theme of procurement in Austria. These can be understood and referred to as a policy mix (Fig. 5-12). They include, along with the PPPI action plan (from 2012), the Austrian action plan for sustainable public procurement (from 2010[64]) and the new initiative, "Fair procedures secure jobs" (from 2014).[65] Even if environmentally friendly and fair procurement procedures do not aim primarily for innovation, there are nevertheless areas of overlap.

In this policy mix, we often encounter envi-

Fig. 5-12: Austrian Procurement Policy Mix smart



PPPI innovation-friendly public procurement: National action plan
naBe Sustainable procurement: National action plan
Fair contract allocation secures jobs: Social partner initiative
WienWin: Regional R&D brokerage programme of the city of Vienna
KIRAS: National research programme for security research

1) "Hard Law" = laws, "Soft Law" = strategies, plans, treaties, etc.
2) Government financial assistance acc. to EU "Framework of state aid for research & development & innovation" (OJEU 2014/C/198)
3) Pre-commercial procurement of R&D (PCP), commercial public procurement of innovative solutions (PPI), acc. to the EU "Procurement Directives" (EU 2014/25, 2014/24) and their incorporation in the Austrian Federal Procurement Act (Bundesvergabegesetz) (Federal Law Gazette 2006/17)

Source: Buchinger (2014).

64 See Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and Federal Ministry of Finance (BMF) (2010).
65 See http://www.faire-vergaben.at/

ronmental agencies at the regional and national level as counterparts and increasingly as partners to the PPPI Service Centre and the Competence & Contact Centres. Furthermore, the KIRAS R&D programme (funding programme for security research directed at the needs of public institutions)[66] and the WienWin Initiative (brokerage of pre-existing R&D results with an orientation towards public institutions in Vienna) belong to Austria's smart procurement policy mix.

The establishment of PPPI in Austria encountered again and again the difficulty of conceiving of legal foundations, because while R&D was almost always involved, substantially different laws were affected. Commercial and pre-commercial procurement must be separated in a clear way from R&D funding: whereas both forms of procurement are governed by the BVergG, the rules for R&D funding (*state aid*) are based on the RTD guidelines.[67]

5.3.3 Importance of public procurement for innovation activities in the Austrian economy

Public procurement includes a multitude of stakeholders in the public sector that range from regional administrative bodies (local administrations, regional governments, federal government) and downstream agencies to public institutions such as social security funds, public enterprises and overwhelmingly publicly controlled sectors (such as energy and water supply, health, education, and broadcasting). Each year a large number of procurement transactions take place in all of these public fields; the larger organisations conduct hundreds to thousands of such transactions. A uniform recording and documentation of these procurement transactions in one database does not exist, and it does not make sense to do so in the face of the heterogeneity of individual procurement transactions. However, the current Community Innovation Survey (CIS) 2012 by the European Commission provides an information source that allows us to assess the significance of public procurement for enterprises in Austria, while simultaneously providing indications of how much public procurement contributes to innovation activities at enterprises. One advantage of this data base is that it facilitates international comparison and thereby a classification of the importance of innovation-oriented public procurement in Austria in comparison to other EU countries. One disadvantage of the data base is that it does not cover the entire business enterprise sector; it only covers enterprises with ten or more employees in manufacturing (including mining, energy and water supply and disposal) and selected services segments (retail, transportation and warehousing, information and communication, financial and insurance services, architectural and engineering activities, research development, advertising and market research).

The CIS 2012 first recorded whether enterprises received public procurement contracts in the period during 2010 to 2012, and whether innovation activities were performed in connection with these contracts (either because the order requested it or innovation was done independently of any contractual stipulations). Second, the survey then asked whether enterprises had worked actively together with public clients on innovation projects. Third, the CIS asked about the importance of public clients as a source of information on the innovation activities of business enterprises.

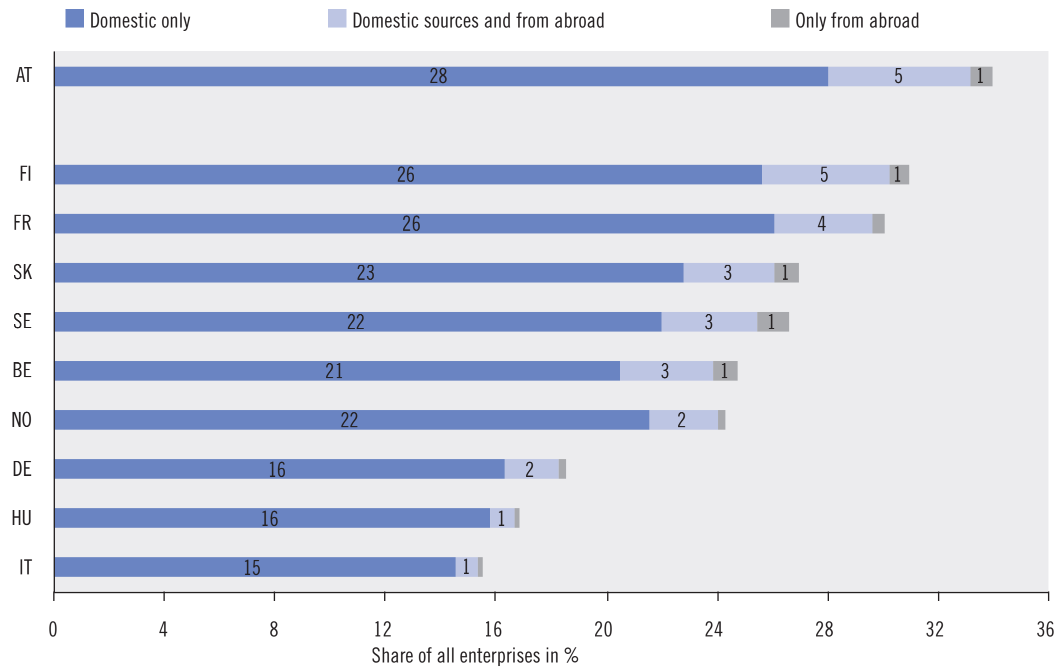
Austria has very good preconditions for the use of public procurement as an innovation pol-

66 See Chapter 6.5 and https://www.ffg.at/kiras-das-programm
67 See Federal Ministry for Transport, Innovation and Technology (BMVIT) and Federal Ministry of Science, Research and Economy (BMWFW) (2015a) (2015b) (2015c); Federal Ministry for Transport, Innovation and Technology (BMVIT) and Federal Ministry of Economics and Labour (BMWA) (2007).

icy instrument. This is because no other EU country[68] has a higher share of business enterprises that have received public procurement contracts.[69] During 2010 to 2012, 34% of enterprises in Austria received at least one procurement contract (Fig. 5-13). 28% received such contracts exclusively from domestic sources, 5% from both domestic and foreign sources, and 1% only from sources abroad. Other European countries with a high share of enterprises with public procurement contracts are Finland (32%) and France (30%). This share came in at only 18% in Germany. The high figure for Austria underscores first the great overall economic significance of public demand, yet also shows that this demand is distributed across a very large number of enterprises, including many small to medium-size enterprises (SMEs).

The proportion of enterprises in Austria with public procurement contracts from domestic sources[70] is almost the same among small enterprises (10 to 49 employees) at 34% as among large enterprises with more than 250 employees (35%). Within manufacturing (excluding construction), the proportion of small enterprises with domestic procurement contracts is even higher than that of large firms. Among medium-sized enterprises (50 to 249 employees),

Fig. 5-13: Share of enterprises that received public procurement contracts, 2010–2012



All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39, 46, 49-53, 58-66, 71-73.

Sources: Eurostat: CIS 2012. Calculations: ZEW.

68 Because the question regarding the reception of public procurement contracts was not included among the obligatory questions in the CIS 2012, not all countries integrated these questions into their national surveys, which means that data only exists for some EU member states and EU accession candidates. The reference countries include those countries bordering on Austria, the six largest EU member states, the Benelux countries, and the Scandinavian countries, insofar as information was available for these countries.

69 Public procurement contracts are defined as procurement orders by public institutions related to public administration and security, as well as publicly operated institutions including schools, hospitals, utility enterprises, etc.

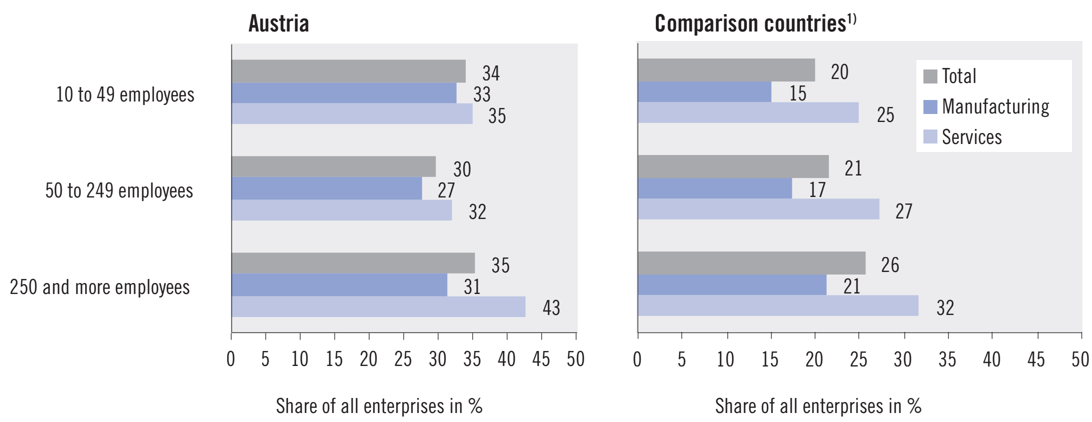
70 Because this chapter focused above all on public procurement activities in Austria, the following only considers those enterprises that received public procurement contracts from domestic agencies. All information for the reference countries only refers to procurement contracts from domestic public agencies.

30% receive public procurement contracts. In most other EU countries, public agencies tend to award contracts more often to larger enterprises. In these countries, 20% of small enterprises and 21% of medium-sized enterprises receive public contracts, while the figure was 26% for large firms (Fig. 5-14). The differences in the distribution of public procurement contracts in the reference countries between manufacturing (15% of enterprises) and services (25% of enterprises) is larger than in Austria, where there were only minimal differences.

The CIS 2012 recorded the extent to which these enterprises with public procurement contracts completed innovation activities in the context of such contracts.[71] The survey distinguished between innovation activities that were explicitly required in the contract and innovation activities that were not explicitly requested. The proportion of enterprises in Austria with public procurement contracts for which at least one of these contracts included a contractual provision for the implementation of innovation activities stood at 7% in the period during 2010 to 2012. This rate was somewhat lower than the figures for the reference countries. Slovakia and Italy both posted a share of 11%, France 10%, Norway and Germany 9%, and Belgium and Finland were at 8% (Fig. 5-15, left part).

The share of enterprises in Austria with public procurement contracts that engaged in innovation in the context of at least one of their contracts without such activity being requested explicitly in the contract stood at 16% for the 2010–2012 period, which was significantly higher than the share of enterprises that pursued contractually required innovation activities.[72] Higher shares of "voluntary" versus "required" innovation activities only occurred in Finland and France. The high proportion of "voluntarily" innovative enterprises in the context of procurement contracts shows that there is potential for innovation in a larger number of pro-

Fig. 5-14: Share of enterprises in Austria and in reference countries that received public procurement contracts during 2010 to 2012 from domestic agencies, by size class



1) BE, DE, FI, FR, IT, NO, SK.
All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39 (= manufacturing) and 46, 49-53, 58-66, 71-73 (= services).

Sources: Eurostat: CIS 2012. Calculations: ZEW.

71 Innovation activities include activities related to the development or introduction of product, process, marketing or organisation innovations.

72 It should be noted that a portion of firms completed both contractually required and "voluntary" innovation activities in the context of public procurement contracts. The scope of these overlaps, however, is not presented in the statistics published by Eurostat.

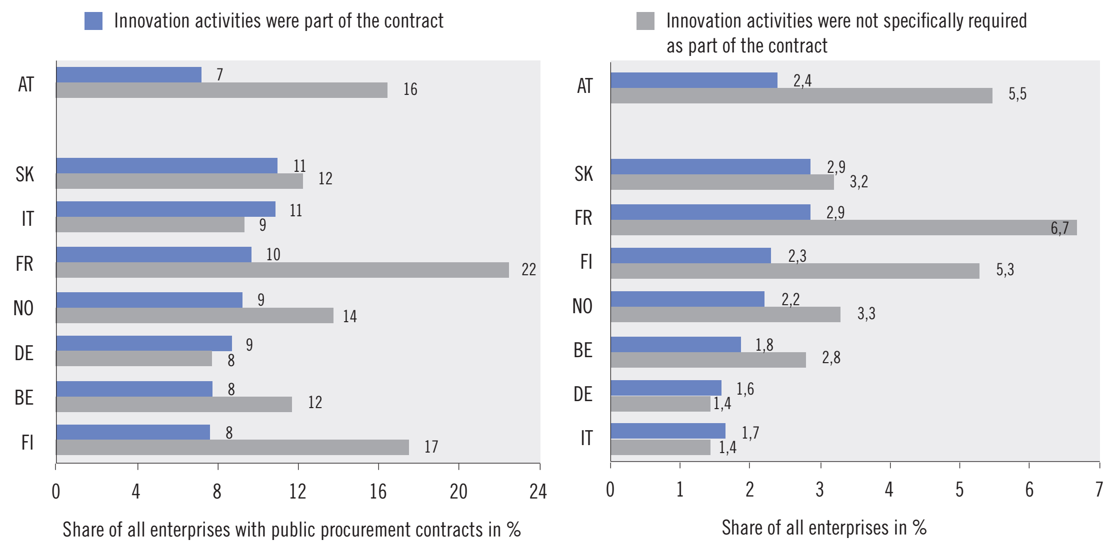
curement processes, without this potential necessarily leading to direct demand for innovations by procurement offices. This underscores the importance of supporting public agencies in the identification and formulation of innovation opportunities.

If we express the number of enterprises that conducted contractually obligated innovation activities in the context of public procurement contracts as a percentage of all enterprises, then Austria has attained the third highest value among the European reference countries (2.4%, following France and Slovakia with 2.9% each) (Fig. 5-15, right part). In absolute numbers, there were somewhat more than 400 enterprises that fit this description and were surveyed in the CIS (i.e. more than ten employees in manufacturing and selected enterprise-oriented services segments). Austria's higher proportion related to the overall number of enterprises is due to the significantly higher distribution of public procurement contracts in the Austrian business enterprise sector overall. This enabled innovation-oriented public procurement to reach a comparatively large proportion of enterprises, although the share of public procurement projects that explicitly require innovations is not very high.

The share of enterprises that have implemented innovations in public procurement contracts without such innovation being required in the contract was 5.5% of all enterprises in Austria, which was the second-highest result among all of the reference countries for which information was available. Only France had a higher value of 6.7%.

An interesting result emerges if these proportions are differentiated by size. Whenever large enterprises in Austria conduct innovation activities in the context of procurement contracts, this is done significantly more frequently because of a contractual requirement than is the case for SMEs. Of large enterprises with public procurement contracts, 20% performed contrac-

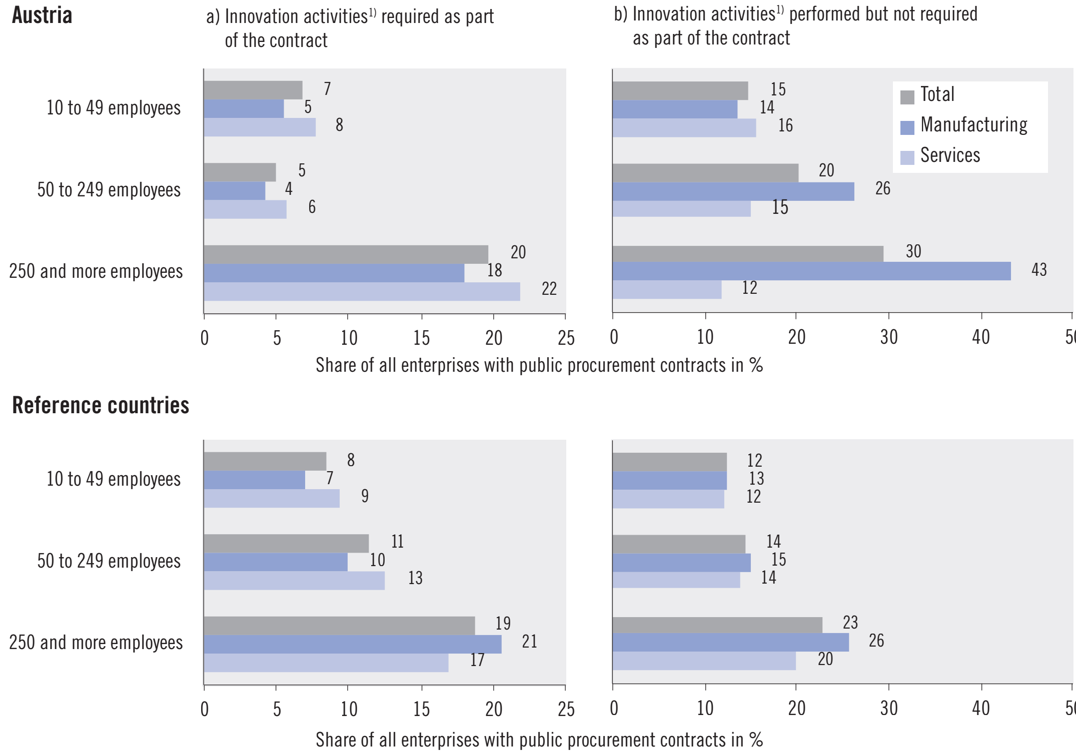
Fig. 5-15: Share of enterprises that during 2010 to 2012 conducted innovation activities in the context of public procurement contracts from domestic agencies



* There is no distinction for Sweden as to whether or not innovation activities were explicitly required in a contract.
All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39, 46, 49-53, 58-66, 71-73.

Sources: Eurostat: CIS 2012. Calculations: ZEW.

Fig. 5-16: Share of enterprises that during 2010 to 2012 conducted innovation activities in the context of public procurement contracts from domestic agencies, by size



1) Activities in the development or introduction of product, process, marketing or organisation innovations.
All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39 (= manufacturing) and 46, 49-53, 58-66, 71-73 (= services).

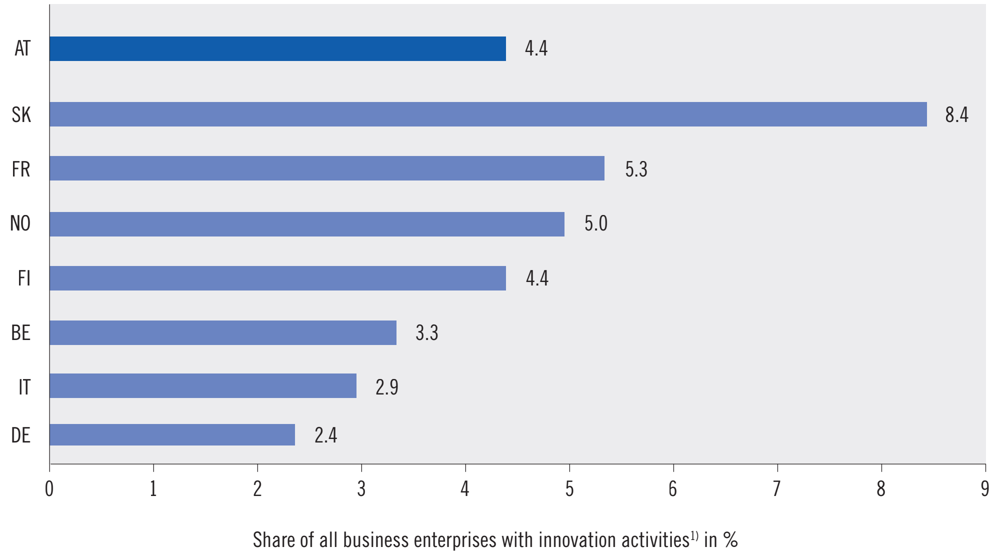
Sources: Eurostat: CIS 2012. Calculations: ZEW.

tually required innovation for at least one order, while 30% report that they conducted innovation activities in connection with public procurement contracts without this being contractually required (Fig. 5-16). At medium-sized enterprises (50 to 249 employees), the share of "voluntary" innovative activities was 20%, which was four times as high as the share of innovative activities completed due to contractual requirements (5%). About twice as many small enterprises (10 to 49 employees) are "voluntarily" innovative (15% versus the 7% that completed innovation projects as part of a contract). There were significantly closer gaps between "voluntary" and contractually required innovation activities in the reference countries in terms of public procurement contracts. The share of SMEs in the reference countries that conducted contractually required innovation activities was somewhat higher than in Austria. This allows us to conclude that in Austria, innovation demand at public procurement agencies tends to be oriented more towards large enterprises than is the case in other countries. At the same time, there may be an even greater potential for more strongly innovation-oriented procurement in Austria for procurement contracts to SMEs.

The importance of public procurement contracts for innovation activities in the business enterprise sector can be assessed roughly by looking at the share of innovating business enterprises that implemented at least part of their innovation activities in connection with public procurement contracts that they received from domestic agencies. For Austria, this proportion was 14% for the 2010–2012 period (Fig. 5-17). This is the third highest value among the reference countries. Slovakia and France (both 18%) exhibited a greater significance of public procurement as an innovation driver. This rate was only 7% for Sweden and a mere 4% in Germany.

Differentiation by industry suggests that public procurement contracts have different importance in different sectors when it comes to innovation activities in the business enterprise sector (Table 5-4). It should be noted that procurement contracts play a role in nearly all manufacturing and services segments. The share of enterprises with public procurement contracts from domestic agencies is especially high, at over 50% in telecommunications, waste disposal, sewage, manufacture of other transport equipment (including railway locomotives and rolling stock), architectural and engineering activities, and textile manufacturing. Only a few industries have high proportions of enterprises with procurement contracts that have implemented innovation activities as part of their contracts. This includes manufacture of other transport equipment, information services, telecommunications, and the manufacture of computer, electronic and optical products. The research and development sector has the highest value at 81%. R&D contracts for government authorities and public research institutions (including universities) may play an essential role here. Enterprises that have completed innovation projects in the course of public procurement contracts without being explicitly required to do so are more often found in a larger number of industries, including industrial sectors such as textile manufacturing, pharmaceuticals, the construction materials industry, metal production, mechanical engineering and machinery, and manufacture of automobiles, as well as water supply and the software industry. This shows that public clients are completely

Fig. 5-17: Share of enterprises that during 2010 to 2012 conducted innovation activities in the context of public procurement contracts from domestic agencies that required innovation activities, among all enterprises with innovation activities



1) Activities in the development or introduction of product, process, marketing or organisation innovations.
All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39 (= manufacturing) and 46, 49-53, 58-66, 71-73 (= services).

Sources: Eurostat: CIS 2012. Calculations: ZEW.

Table 5-4: Share of enterprises in Austria that received public procurement contracts during 2010 to 2012 for which they conducted innovation activities, by industry

Economic sector (ÖNACE 2008)	Received PPC[1)]	PPC innovations[2)]		Share of PPC innovations[3)]
		Required	Not required	
5 to 9 Mining and quarrying	48	0	0	0
10 Manufacture of feed products	18	0	10	0
11, 12 Manufacture of beverages, Tobacco processing	35	0	0	0
13 Manufacture of textiles	52	0	48	0
14 Manufacture of wearing apparel	19	0	0	0
15 Manufacture of leather and related products	40	0	0	0
16 Manufacture of wood and products of wood and cork (except furniture)	25	1	11	0
17 Manufacture of paper and paper products	38	0	0	0
18 Printing and reproduction of recorded media	47	11	5	11
20 Manufacture of chemicals and chemical products	33	0	13	0
21, 19 Manufacture of basic pharmaceutical products and pharmaceutical preparations, Manufacture of coke and refined petroleum products	22	0	57	0
22 Manufacture of rubber and plastic products	27	0	18	0
23 Manufacture of other non-metallic mineral products	49	11	28	12
24 Manufacture of basic metals	20	0	35	0
25 Manufacture of fabricated metal products, except machinery and equipment	37	5	11	4
26 Manufacture of computer, electronic and optical products	40	24	32	10
27 Manufacture of electrical equipment	21	11	23	3
28 Manufacture of machinery and equipment n.e.c.	21	16	45	4
29 Manufacture of motor vehicles, trailers and semi-trailers	28	12	58	7
30 Manufacture of other transport equipment	56	73	100	44
31 Manufacture of furniture	35	1	20	0
32 Other manufacturing	7	0	0	0
33 Repair and installation of machinery and equipment	48	0	3	0
35 Electricity, gas, steam and air conditioning supply	41	16	18	8
36 Water collection, treatment and supply	21	0	71	0
37, 39 Sewage, remediation activities and other waste management services	58	0	0	0
38 Waste collection, treatment and disposal activities; materials recovery	62	13	13	15
46 Wholesale trade, except of motor vehicles and motorcycles	36	6	14	4
49 Land transport and transport via pipelines	30	4	7	4
50, 51 Water transport, air transport	0	0	0	0
52 Warehousing and support activities for transportation	11	11	11	2
53 Postal and courier activities	41	8	8	25
58 Publishing activities	41	8	0	6
59 Motion picture, video and television programme production, sound recording and music publishing activities	28	0	0	0
60 Programming and broadcasting services	25	0	0	0
61 Telecommunications	65	48	0	48
62 Computer programming, consultancy and related activities	41	17	37	8
63 Information service activities	19	55	50	14
64 Financial service activities, except insurance and pension funding	25	2	4	1
65 Insurance, reinsurance and pension funding, except compulsory social security	32	0	7	0
66 Activities auxiliary to financial services and insurance activities	0	0	0	0
71 Architectural and engineering activities; technical testing and analysis	54	4	19	4
72 Scientific research and development	39	81	59	32
73 Advertising and market research	35	15	7	9
Total	**33**	**7**	**16**	**4**

1) Enterprises with public procurement contracts from domestic agencies (public procurement contracts, PPC) as a % of all enterprises. – 2) Enterprises that conducted innovation activities in the context of PPC as a % of all enterprises with PPC. -3) Enterprises that conducted innovation activities in the context of PPC as a % of all enterprises with innovation activities.
All information refers to enterprises with ten or more employees.

Sources: Eurostat: CIS 2012. Calculations: ZEW.

open to innovation, even if they do not require it directly in their call for tender documents.

The significance of innovation-supporting public procurement for overall innovation activities in enterprises also varies strongly between industries. A high proportion of innovative enterprises that are also party to public contracts requiring innovation activities is found in telecommunications, manufacture of other transport equipment, the R&D sector, post and courier services, waste management, information services, the construction materials industry, and the print trade.

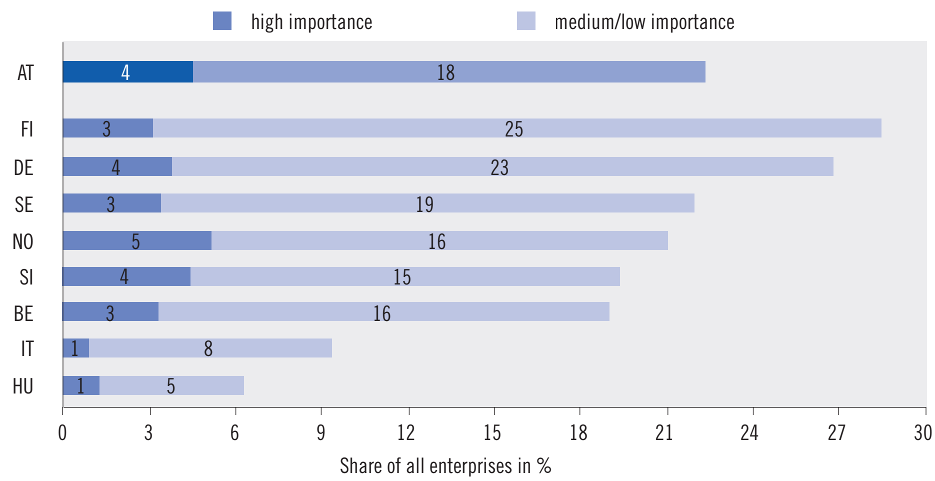
Another aspect of the importance of the public sector for innovation activities at business enterprises is the use of information provided by public sector customers or contracting authorities in determining the direction that an enterprise's product or process innovation will take. During 2010 to 2012, 22% of enterprises in Austria referred to customers from the public sector as sources of information. For 4% of enterprises, public sector customers or contracting authorities were very important as suppliers of ideas. In European comparison, the use of the public sector as a source of information for product and process innovation stands at a significantly above-average level. Only in Finland and Germany is the proportion higher.

Another indicator is the direct, active cooperation with customers or clients from the public sector in innovation projects. In the period 2012–2014, 4% of all enterprises from Austria sought this kind of cooperation. In terms of all enterprises with innovation cooperation agreements, about every fifth enterprise was engaged in cooperation with public institutions. This is an average distribution in European comparison. These proportions are significantly higher in some Scandinavian countries, the United Kingdom, and a few neighbouring Eastern European countries.

5.3.4 Summary

Public procurement is well established in Austria as an instrument of innovation policy at the institutional level. The amendment of the Federal Procurement Act (Bundesvergabegesetz), the establishment of the PPPI Service Centre and the PPPI Competence/Contact Centres, the completion of pilot projects in pre-com-

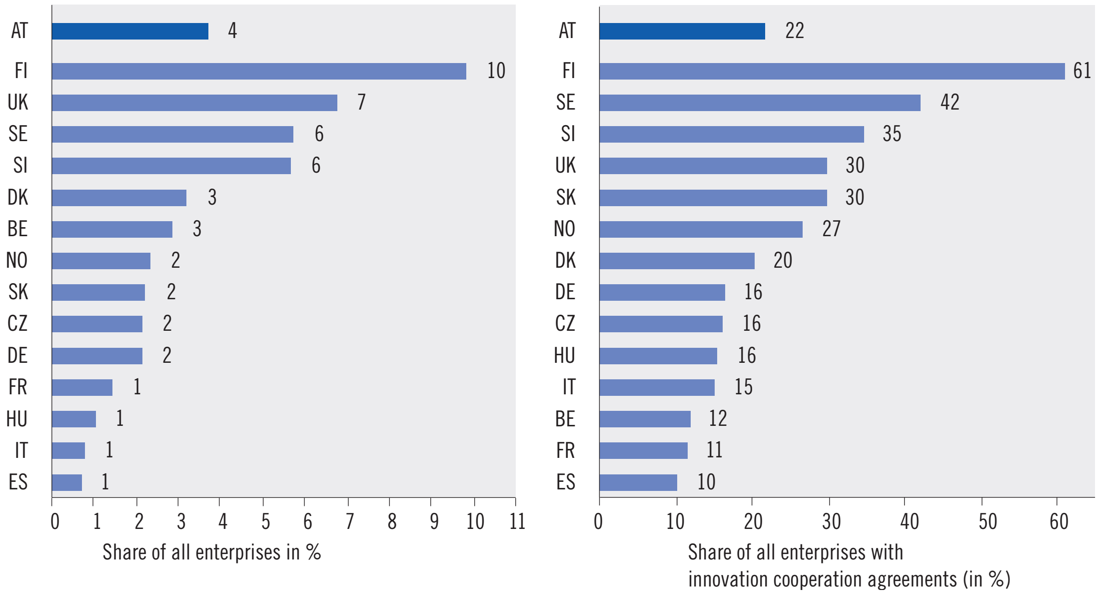
Fig. 5-18: Share of enterprises that used customers or clients from the public sector as sources of information for their innovation activities[1] during 2010 to 2012



1) Activities in the development or introduction of product or process innovations.
All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39, 46, 49-53, 58-66, 71-73.

Sources: Eurostat: CIS 2012. Calculations: ZEW.

Fig. 5-19: Share of enterprises with innovation cooperation agreements during 2010 to 2012 that cooperated with customers or clients from the public sector



All information refers to enterprises with ten or more employees in the (NACE) economic sectors 5-39, 46, 49-53, 58-66, 71-73.
Sources: Eurostat: CIS 2012. Calculations: ZEW.

mercial procurement, and financial incentives to stimulate commercial procurement of innovation are just a few examples of many. As the results of the Community Innovation Survey (CIS) show, PPPI is supported by an Austrian economy that is well placed to promote innovation activities through targeted demand for innovative solutions. The share of enterprises that receive public procurement contracts in Austria is very high in European comparison. The public sector's demand for goods and services touches nearly every area of the Austrian economy, albeit at different intensities. This also applies to SMEs. The specific demand for innovation in the context of public procurement contracts can still develop further. This holds true in particular for the SME target group.

Because the barriers to entry are high for SMEs in large-volume procurement, SMEs and public institutions should proactively approach one another. On the one hand, SMEs should orient themselves towards more innovative offers to public institutions. On the other hand, public procurement processes should be designed to be more SME-friendly, which means keeping order values low, taking decisions rapidly, less bureaucracy for offer submissions, and an SME-friendly credit check process. From the policy side, the existing commitment to RTI strategy should be upheld further and intensified because experience has shown that it is not easy to motivate public institutions to engage in PPPI. One possibility would be to embed a PPPI target in Austria (for example, dedicating a certain percentage of public procurement volume to go to projects that support innovation). Countries such as France, Spain, the United Kingdom, and the Netherlands can serve as learning models concerning reasonable numbers (i.e. shares of public procurement volumes).

6 Evaluations

Evaluations are an indispensable part of the process of introducing and implementing research and technology policy support measures today, both from a legal perspective and in daily practice. The relevant statutory foundations are provided by a series of laws in Austria, including the Research and Technology Promotion Act (FTF-G), the 2004 Act for Creation of the Austrian Research Promotion Agency (FFG-G), the Research Organisation Act (FOG; reporting standards: sections 6-9), and guidelines for research funding[1] based on these laws and for the promotion of economic-technical research and technology development, the so-called 'RTD guidelines'.[2] The FTF-G (section 15, para. 2) in particular creates a legal standard for the principals of evaluation, stipulating a set of minimum requirements for the guidelines. The guidelines stipulate that *"a written evaluation plan must be created for all subsidy programmes and measures based upon the RTD Guidelines. This plan must include the purpose, objectives, and procedures, as well as deadlines for evaluating the achievement of the funding objectives, and must define appropriate indicators"*.[3]

This statutory basis has played no small part in the fact that nearly all research and technology programmes use evaluations in their programme planning (ex-ante evaluations), programme implementation (monitoring and interim evaluations) and programme conclusion (ex-post evaluation), and it is seen as essential to providing direction to the further strategic development of Austria's research funding portfolio.

The following section will provide an overview of the evaluative activities of Austrian research funding programmes. These have been selected according to the following criteria:

- The evaluations are primarily relevant to federal policy.
- An approved evaluation report is available.
- The evaluation report is available to the public, which essentially means that the report has been published on the Austrian Platform for Research & Technology Policy Evaluation's homepage.[4]

The results of some of the evaluations commissioned by the Federal Ministry are presented in summary below. They are the ex-post evaluation of the austrian electronic network (AT:net) funding programme (on behalf of the Federal Ministry for Transport, Innovation and Technology – BMVIT); the evaluation of the FHplus programme (Federal Ministry for Transport, Innovation and Technology – BMVIT); the Impact Evaluation of the Erwin Schrödinger Fellowship with Return Phase (Austrian Science Fund – FWF); the interim evaluation of Talents (Federal Ministry for Transport, Innovation and Technology – BMVIT); the Austrian security research programme KIRAS (Federal Ministry for Trans-

1 See the federal government's guidelines on offering and implementing funding mechanisms as in paragraphs 10–12 of the Research Organisation Act (FOG), Federal Law Gazette. No. 341/1981.
2 See guidelines for supporting commercial-technical research and technology development (Research and Technology Funding guidelines) as in paragraph 11, lines 1 through 5 of the Research and Technology Funding Act (FTFG) from the offices of the Federal Minister for Transport, Innovation and Technology, dated 27 September 2006 (GZ 609.986/0013-III/I2/2006), and the Federal Minister of Economics and Labour, dated 28 September 2006 (GZ 97.005/0012C1/9/2006).
3 See Research and Technology Funding guidelines (FTE-Richtlinien), section 2.2., p. 4.
4 See www.fteval.at

port, Innovation and Technology – BMVIT); the Doctoral Programme DK-plus (the Austrian Science Fund – FWF); the evaluation of the Sparking Science programme (the Federal Ministry of Science, Research and Economy – BMWFW); the evaluation of the Research Expertise for Industry programme (Federal Ministry of Science, Research and Economy – BMWFW); and the evaluation of the creative industries initiative "evolve" (Federal Ministry of Science, Research and Economy – BMWFW).

The Austrian Science Fund (FWF), as sponsor of both the Erwin Schrödinger Fellowship and the DK-plus Doctoral Programmes, has publicly discussed and provided comments on the evaluations of these two programmes. These practices reflect the growing international trend towards public engagement and discussion of RTI funding and support mechanisms and are similar to the practices of agencies such as the German Research Foundation (DFG) and the Swiss National Science Foundation (SNF). Comments on the evaluations has been integrated into the descriptions below.

6.1 Final evaluation of the austrian electronic network (AT:net) funding programme

Objective of the evaluation

After a seven-year run, the austrian electronic network (AT:net) programme was subjected to a comprehensive ex-post evaluation[5] in 2013. Whereas the interim evaluation[6] conducted in 2010 focused on the conception and implementation of the programme, the final evaluation was concerned with reflecting on the programme's course by means of centralised evaluative criteria, taking stock of the programme's success in meeting its goals, and its impacts. Recommendations for the eventual continuation or new version of AT:net were drafted based on the evaluation's findings and resulting final conclusions.

Programme objectives and key information

The programme was conceived in 2007 as a continuation of the Federal Ministry for Transport, Innovation and Technology's broadband initiative begun in 2003, which aimed to improve the provision, expansion and use of and access to broadband technology in Austria, to introduce related services and applications, and to provide impetus to innovative applications of relevant research outcomes. As a part of the national ICT Master Plan, another aim was to strengthen the domestic economy's innovative potential and to secure a leading place for Austria in the information economy.

While the broadband initiative was primarily focused on expanding the infrastructure, AT:net prioritised the innovative and competitive use of this infrastructure and aimed to assist in introducing ICT applications and solutions to the market "*through the use of broadband technology and in the public interest*". The project's overarching aim was a blanket coverage for Austria with high performance bandwidths and the reduction of the so-called "digital gap" amongst the country's population. The programme's thematic focuses included innovative forms of technological access, electronic government services (e-government), electric health services (e-health), digital integration (e-inclusion), online learning (e-learning), electronic services targeted towards increasing traffic safety, security and trust, support services for small and medium-sized enterprises (SMEs) and other topics related to increasing the use of broadband applications. Funds from the stimulus package were utilised during the second project phase (2009–2010) to finance infrastructure projects.

In total, the programme provided support to 230 organisations through 208 AT:net projects. One hundred and fourteen projects were funded and managed through the Austrian Research Promotion Agency (FFG) in the first phase, 63 in

5 See Ruhland and Wolf (2014).
6 See Ruhland et al. (2010).

the second, and 42 in the third. An evaluation committee, with the support of the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Austrian Research Promotion Agency (FFG), assessed project proposals submitted to the programme. Organisations were invited to submit proposals individually or in the form of cooperative efforts.

Results of the evaluation

In seeking to increase use of and expand broadband provision in Austria, AT:net, with its flexible and open design, explicitly met the call for organisations that needed support and funding in market transition. Committee members welcomed its attention to economic development and promotion, as opposed to a more limited concern with innovation policy, especially since innovative, marketable ideas in the ICT sector are rarely the result of standard R&D projects.

The evaluators found that the goals which had been set by the individual funding recipients were successfully met, at least to some extent. Respondents rated AT:net's significance with respect to economic performance and competitiveness highly, noting that the majority of the funded projects played a decisive role in the marketing of a new service or new product. Increases in revenue or employment were rare; instead, funded projects tended to secure revenue streams and safeguard jobs. The dead-weight effect was found to be minimal. The programme played only a minor role in directly advancing research activities.

Effects of individual projects on society-wide targets were hardly visible or could not be quantified by indicators. This means that it is impossible to say whether the funded projects contributed to reducing the digital gap. A direct impact is believed to be unlikely. The analysis highlighted the issue of whether and to what extent this and similar challenges can be effectively addressed through the use of funding that has been earmarked for research and innovation. Evaluators praised how the programme, thanks to its low threshold and uncomplicated administration, attracted and offered support to organisations that otherwise tend not to be recipients of RTI funding schemes.

If the AT:net programme is repeated, evaluators recommend that projects' operative goals be more overtly oriented towards supporting demonstrable, positive transformations in the organisations receiving funding (e.g. enterprise growth, competitiveness, export and market shares, moves into new technological areas or fields of application). Additionally, clearer connections to the 2020 Broadband Strategy and the EU Commission's Digital Agenda should be emphasised. In future, any top-down provision of themes and/or suggested fields of application should serve only as guidance for potential funding applicants. Explicit specifications are in conflict with the logic of market-based intervention on which the programme is based. The identification of milestones and marketing strategies—and plans for their implementation—should feature more prominently in the application phase and relate more directly to evaluation criteria. Opportunities to fund supplementary and consulting services as well as communications and public relations efforts suitable for the target group should be assessed.

6.2 Evaluation of the FHplus programme[7]

Objective of the evaluation

The primary objective of the ex-post evaluation[8] of the FHplus programme for universities of applied sciences was to provide a comprehensive analysis of the programme's impacts on two levels: the strategic, in which the significance of

7 An additional evaluation of the universities of applied sciences sector, the "Evaluation of Research Funding for Austrian Universities of Applied Sciences", commissioned by the Federal Ministry of Science, Research and Economy (BMWFW), was completed in April 2015 and will be discussed in the next Research and Technology Report.

8 See Dinges et al. (2014).

FHplus on the strategies and focuses of individual universities of applied sciences were to be evaluated, and the project level, in which factors in a project's success and the effects of funding on the scale of the individual project were to be identified. Attention was turned to analysing the impacts of funding on the relevant organisations and identifying the factors contributing to the success of those organisations.

Programme objectives and key information

The FHplus programme, founded in 2002, was conceived as part of the legal mandate that universities of applied sciences and their respective degree programmes contribute to application-oriented research and development (R&D) in Austria. The programme was designed to assist universities of applied sciences, which are relatively new in Austria, through (1) supporting the establishment and improvement of R&D capacity and (2) providing better opportunities and structures for cooperation on the part of these universities and their respective degree programmes with private sector application-oriented R&D activities. The programme's implementation involved conceptualising (1) plans to create new structures and (2) plans for cooperation to contribute to successfully meeting the programme's goals.

A total of 44 projects were funded through FHplus with a total of €18.1 million over the period between 2002 and 2012. Around 76% of the total funding, or €13.8 million, was dedicated to creating structures, while cooperation projects were funded with the remaining €4.3 million. Some 107 organisations participated 156 times in the 44 projects that were funded through FHplus. Enterprises (85 instances of participation) and universities (16 instances of participation) were the primary cooperative partners for the participating universities of applied sciences. Few non-university research institutions or competence centres, or similar organisations, participated in FHplus projects. Aside from the universities of applied sciences, participating organisations of other types were rarely involved in more than one FHplus project.

Results of the evaluation

The evaluation demonstrates that the R&D capacities at all universities of applied sciences in the sector were exceptionally limited before the programme's start in 2002 and that these universities had very limited resources available to them for establishing and sustainably supporting this type of research. The analyses undertaken as part of the evaluation confirm that FHplus was a necessary and effective programme for strengthening R&D capacities and creating sustainable research infrastructure in the universities of applied sciences sector as a whole. FHplus was instrumental in laying the foundation for the sustainable creation of R&D capacity at many universities of applied science and contributed to a rise in R&D expenditures and the number of R&D positions throughout the universities of applied sciences sector as well as the increased significance of universities of applied science to Austria's R&D profile.

The majority of the FHplus projects that were evaluated were responsible for initiating ongoing cooperative efforts with existing and new enterprises and with other research institutions. Many of these cooperative efforts, especially those with SMEs, provided for the direct transfer of knowledge related to research findings to the private sector. The FHplus programme was particularly adept at creating new, sustained cooperation with enterprises in those places where the regional economy already possessed sufficient R&D capacity and thus where local organisations appreciated both the value of the research infrastructures and existing competencies for driving new cooperative projects. This type of outcome was especially successful at those universities of applied sciences and in those FHplus projects in which cooperation was incorporated from the beginning of the planning phase and was consistently implemented throughout. The evaluation revealed that these projects all prioritised areas that strongly correlated to needs related to teaching and to needs expressed by participating enterprises.

All of the participating universities of applied sciences position themselves as particularly application-oriented research hubs. The identification of research priorities, however, is closely tied to specific individuals since the universities possess limited funds themselves that can be applied to developing research focuses. The development of research priorities at universities of applied sciences is therefore overwhelmingly dependent on project-based financing. FHplus's project-based, competitive financing structure contributed significantly to creating the structure and allowing for the development of new research priorities at universities of applied sciences.

In addition, the evaluation found that the programme contributed to the improvement in the overall capacity and quality of the research being conducted, though the sector's heterogeneity was not reduced as a result. The continuing success of universities of applied sciences in securing research funds was interpreted by the evaluators as an indicator that FHplus led to improved professionalisation in applications for third-party funding.

In considering the future of the universities of applied sciences sector, the evaluation recommends further provision of financing for research infrastructure at these institutions since they continue to lack a base level of funding for R&D activities. This financing itself need not be dedicated to programmes specifically at universities of applied sciences. An alternative would be to initiate programmes that are open to a variety of stakeholders and that address the challenges related to the financing of research infrastructure.

6.3 Impact Evaluation of the Erwin Schrödinger Fellowships with Return Phase

Objective of the evaluation

The evaluation of the effectiveness[9] of the Erwin Schrödinger Fellowship (with a return phase) was commissioned by the Austrian Science Fund (FWF) in order to provide information about the programme's results and to identify areas for further development.

Programme objectives and key information

The Erwin Schrödinger Fellowship (with a return phase) is an Austrian Science Fund (FWF) programme that is targeted towards highly qualified, young, Austrian researchers in all fields of study. The programme's goal is to promote cooperation with leading research institutions abroad, to provide postdocs with experience abroad, and to assist new scientists and academics in establishing their careers in a new research field, who will in turn positively contribute to research and higher education in Austria upon their return. Since 1985, 2,271 researchers have spent periods between 10–24 months abroad thanks to Erwin Schrödinger Fellowships. The programme is the largest funder of research stays abroad for Austrian postdocs. The European Commission has co-financed the programme since 2009. It additionally allows for applications for up to twelve months of funding for the return phase.

Results of the evaluation

According to the evaluation, the Erwin Schrödinger Fellowships have had a strong positive effect on the levels of individual research-

9 See Bührer and Meyer (2014).

ers, the research institutions and the Austrian and European research landscape as a whole.

The evaluation found that many individual researchers would not have otherwise had an opportunity to spend a significant time abroad without access to the Erwin Schrödinger Fellowships. In many cases, their career development would have been notably limited without this opportunity since research stays abroad have a profoundly positive impact on research output and a researcher's career path. In addition, bibliometric analyses revealed that the Schrödinger programme, when compared to a control group (researchers with demographic characteristics similar to those who received funding: age, research field and stays abroad, amongst others), had a slightly positive effect on publication output. The significant research output and the good reputation attributed within the Austrian research sector to alumni of the Schrödinger programme help to explain, according to the evaluation's findings, the impressive career paths of those researchers who received funding. An online survey found that within twelve years of the end of their Schrödinger grants, 60% of all Schrödinger alumni had been promoted to a full professor position.

The evaluation identified positive effects for both the Austrian and Europe-wide research sectors with regard to an increase in the transfer of knowledge and qualifications. Bibliometric co-production analyses illustrate the positive effect the programme has had on integrating Austria into international research networks.

But although the programme's positive effects are evident, their full impact has been notably reduced by significant impediments that the evaluation has identified within the Austrian research system. Both Schrödinger alumni and respondents from the control group point to unattractive career prospects in research in Austria. And this is particularly notable amongst women, according to the evaluation, in spite of the significant efforts made over the past decade. Insecure career prospects are one reason that two-thirds of all Schrödinger fellowship recipients do not return to Austria following their funded research stay abroad. However, they are not fully lost for the Austrian Innovation system. Bibliometric analyses show that Schrödinger fellows act as "bridge heads", who help to improve the integration of Austrian research institutions into international networks.

According to the funder, the Austrian Science Fund (FWF), the evaluation demonstrates that the Schrödinger programme offers an ideal postdoc programme with which young researchers from all fields of study can gain important research experience abroad[10]. The Austrian Science Fund (FWF) regards the evaluation as confirmation of the importance of certain elements to the success of academic careers: international mobility, time to dedicate oneself to one's research, international networks and cooperation, and international publications output. The Schrödinger programme addresses all of these factors in an exemplary fashion. Given the motivations of young researchers to stay abroad (better career perspectives) or to return to Austria (personal reasons and family), the Austrian Science Fund (FWF) concludes that there is more that can be done to improve these and related conditions for young researchers.

6.4 Interim evaluation of the funding priority "Talents"

Objective of the evaluation

The evaluation[11] intended to analyse and reflect on the results to date of the funding priority "Talents" with respect to the funding period 2011–2013. The analysis examined the funding concept, its implementation and the discernible

10 Austrian Science Fund (FWF) commentary on the 2014 Schrödinger evaluation (in German); https://www.fwf.ac.at/fileadmin/files/Dokumente/Ueber_den_FWF/Publika tionen/FWF-relevantePublikationen/fwf-kommentar-schroedinger-evaluation_2014.pdf

11 See Heckl et al. (2014).

impacts (so far). The results of the analysis and the concluding recommendations provided the basis for further development steps.

Programme objectives and key information

Since 2011, all of the Federal Ministry for Transport, Innovation and Technology's funding priorities related to human potential are pooled under the roof of "Talents". The effort's primary goal is to increase and improve the effective utilisation of human potential in application-oriented RTI activities in the natural sciences and technological fields. Researchers (or potential future researchers) in all career stages are targeted by the programme, starting with children from pre-school through primary and secondary school, university students, postgraduates and early career researchers. Activities and measures are not only focusing on the individual researchers. The aim is also to improve general conditions, for instance raising awareness in enterprises and research institutions for the development of human potential. In addition, the programme aims to increase awareness and interest in RTI amongst less research-minded people.

The funding priorities are divided into three areas of intervention (Discovering Talent, Utilising Talent, Finding Talent) that are deployed throughout all phases of a researcher's career via a variety of instruments and related mechanisms. These include, for example, increasing awareness in pre-schools and schools (Regional Talents), supporting schoolchildren in obtaining internships, funding projects and training sessions related to gender and equal opportunity (FEMtech Research Projects, FEMtech Career, FEMtech Internships for Students, FEMtech Dissertations), the establishment of an Austrian job database for research, development and innovation, and career grants to be used for costs related to interviewing in and/or moving to Austria. Every career stage (with the exception of pre-school children) is targeted by at least two schemes that are closely integrated with one another. Gender is a common factor that receives attention in almost every scheme.

The funding priority was developed by the Austrian Research Promotion Agency (FFG) within the framework of its Structural Programme (SP). Between 2011 and 2012, funds amounting to about €15.4 million were spent on these activities. Of the some 1,200 organisations that have received funding from the initiative so far, around half are enterprises, 17% were universities and universities of applied sciences, and 8% were non-university research institutions. The remainder were individual researchers who received career grants.

Results of the evaluation

The evaluation's authors praised the effectiveness of bundling together precursor programmes and the more extensive later schemes in a "funding chain". This was also clear to and appreciated by funding recipients. The broad but well-coordinated array of offerings was able to provide support in all career phases, with gender enjoying a secure place across all of the programme's schemes. The schemes' participants, especially children and young adults, expressed high levels of satisfaction and increased interest in research in the natural sciences and technological fields. The concept of "Talents" should be more widely promoted and communicated to the public. Since most of the instruments are targeted towards individuals and are only infrequently aimed at creating structural change, it might be a good idea to promote funding support for structural and sustainable mechanisms more directly to funding recipients.

The schemes themselves provide an array of opportunities for future development steps. With respect to fostering internships for schoolchildren, more attention should be paid to those children who have not yet demonstrated an interest in future studies or careers in the natural sciences or in technological fields. This might be done through a more comprehensive information campaign in schools, for example, particularly in schools preparing students for the Austrian A-level equivalent. The internship database should also be better promoted. It has been suggested that the budget be increased for the Regional Talents scheme to account for high coordination costs, that the application and awards process be adjusted to match the school year, and that more precisely targeted offerings be developed.

FEMtech programmes raise awareness of gender issues, aid in further developing additional gender competences and secure the topic's significance in research undertakings. A modified, more simplified version of the FEMtech scheme ("light") might speak to a broader audience and reduce barriers for young professionals and small and medium-sized enterprises (SMEs). The evaluation team believes that this type of scheme, especially one concerned with supporting emerging talents, is indispensable as long as gender-relevant themes continue to be insufficiently addressed by other research funding programmes.

6.5 Ex-post evaluation of the Austrian security research programme KIRAS

Objective of the evaluation

The ex-post evaluation[12] of the security research programme KIRAS was undertaken with the intent of identifying and analysing the programme's medium- and long-term impacts and effects in relation to its strategic objectives. The evaluation discussed here therefore builds on and complements the ongoing programme evaluation and the two interim evaluations conducted in 2010 and 2011/12.

Programme objectives and key information

KIRAS was established in 2005 as a national research programme meant to support security research activity and is based on six strategic objectives: to improve the subjective perception & objective level of security of Austrian citizens; to support the generation of knowledge needed for security policy; to promote security related technology leaps; to support the growth of the Austrian security industry; to achieve excellence in security research; and to integrate relevant societal questions in every project. An integrated approach is necessary if these objectives are to be met, one that applies methodologies from the social sciences and humanities in addition to the search for technological solutions. The incorporation of key security policy stakeholders in the form of joint projects ensures that the programme's focus on applicability remains central. Funded projects must also aim to create and maintain a skilled workforce in Austria.

Up until 2011 the programme issued calls for tenders along four programme lines. As a result of the first interim evaluation[13] and a general thematic restructuring of research funding, the programme was then reorganised into three instruments: "R&D Services", "Cooperative R&D Projects" and "Exploration". The last has not accepted new applications since 2011. Whereas "Cooperative R&D Projects" aimed to create concrete security technology applications, the "R&D Services" scheme financed user-oriented studies and similar surveys relevant to security issues. Both instruments were targeted equally towards enterprises, universities of applied sciences and research institutions, while programmes funded through the "Cooperative

12 See Heinrich et al. (2014).
13 See JOANNEUM RESEARCH et al. (2010) and JOANNEUM RESEARCH et al. (2012).

R&D Projects" scheme were required to create a consortium involving relevant stakeholders. To ensure optimal integration between technological research and broader social concerns regarding security, consortia formed with the support of "Cooperative R&D Projects" were required to involve at least one partner from the humanities and/or social sciences. Since the programme's start in 2005, 21 tenders have resulted in 150 projects receiving funding grants that amount to €73.8 million.[14] Of this funding amount,[15] 38% went to research institutions and enterprises (33%) and universities of applied sciences (25%). Around 2% went to public authorities, which included local authorities and not-for-profit organisations.[16]

Results of the evaluation

According to the evaluators, KIRAS has successfully achieved its stated objectives. Positive emphasis was given to the adaptation of the programme based on the findings of the interim evaluation. The security of the Austrian population was found to have been improved by the number and broad thematic scope of the projects that received funding targeting a variety of specific, concrete security threats, in particular crime in general, but also terrorism and natural catastrophes. The thematic diversity represented by the programme, combined with the high quality of the funding applications, resulted in the identification and reinforcement of key focuses and strengths in Austrian security research.

The evaluation team also found, based on online surveys, that KIRAS made a positive contribution to the general awareness of security issues that exists amongst the broader population. This effect was somewhat limited by the fact that only around a third of the projects involved direct measures to increase public awareness. Around a third of the funded projects said that they would not have been possible without KIRAS funding, which speaks positively to the programme's charge to provide top-up funding where needed. The evaluation team also found that the projects contributed to positive advances in knowledge, processes and new technologies as a result of work that was technically highly complex and given the number of innovations produced by the funded projects, especially those supported by the "Cooperative R&D Projects". The total economic effect of the KIRAS programme was found to be thoroughly positive on the basis of a simulation carried out using an input-output model. In addition, the evaluation found that the programme positively contributed to job creation. Slightly more than half of the project results were published, which helped build knowledge and competences in the field of security research. The evaluation team noted the positive contributions made by the humanities and social sciences to 120 of the 150 projects, which is an impressive number given that their participation is only required in the "Cooperative R&D Projects" scheme.

The evaluation team also pointed, however, to the programme's lower than expected results in stimulating growth in domestic commercial security at the time of evaluation. This is seen as evidence of the sector's reliance on public procurement activities and measures. Enterprises were able to enter new markets and customers only to a limited extent according to those surveyed at the time of the evaluation. At the

14 As at 24.04.2014.
15 The results of the input-output simulation demonstrate that the funding of €51 million and the total project volume of €74 million generated direct, indirect and secondary effects with a total value added of around €102 million.
16 Divisions of the Austrian federal government administration that feature as primary users in the majority of projects were not eligible for funding due to budgetary restrictions.

same time, the participation of public authorities was rated as having a positive effect on marketing activities.

6.6 Evaluation of the Austrian Science Fund (FWF) Doctoral Programme

Objective of the evaluation

The evaluation of the Austrian Science Fund's Doctoral Programme[17] aimed to provide a comprehensive empirical basis for the further development and redesign of the Doctoral Programmes. The analysis' focus was on aspects of the programme's implementation, on the one hand, and interrogating the role of and contributions made by the Doctoral Programme in relation to doctoral studies in Austria and the relevant funding structures in an international context. The funding body, the Austrian Science Fund (FWF),[18] believes a reorganisation of the Doctoral Programmes is necessary for a number of reasons. Primary amongst these are the programme's financing, aspects related to management, especially with regard to involving universities in the start-up and expansion phases and in funding the schools, and responding to the changed circumstances surrounding doctoral studies as a result of the Bologna process.

Programme objectives and key information

Doctoral Programmes form centres of education for highly qualified young scientists/scholars from the Austrian and international scientific community as well as supporting the development of key research focuses at universities and contributing to research fields' continuity and significance across Austrian research institutions. Doctoral Programmes may only be situated at research institutions that have the legal right to grant doctoral degrees and take between five and twenty doctoral students each. Prerequisites for their establishment include recognition by the institution in question as well as the provision of the infrastructure necessary to carry out highly qualified academic work. These doctoral programmes are established for a maximum of twelve years. Every four years, a review determines whether the programme should continue to operate.

Between the programme's founding in 2004 and 2013, 42 Doctoral Programmes were established with a total of 1,121 students and a total funding amount of €130.6 million. About one-half of the Doctoral Programmes (20, or 48%) were focused on the life sciences. Eight Doctoral Programmes (19%) were dedicated to the humanities and social sciences, and 14 (33%) were focused on natural sciences and engineering. The level of funding depends on the size of the school, which includes the number of participating faculty members and doctoral students. Those Doctoral Programmes focusing on life sciences received 58% of the total programme funding. This is in keeping with the fact that this field has a higher than average number of students pursuing doctoral studies.

Results of the evaluation

The evaluation team found that the programme was well received amongst researchers, which is also reflected in the growth in the number of applications. Furthermore, the Doctoral Programme has taken hold as an excellence programme at the nation's universities. According to the evaluation, the Austrian Science Fund (FWF) has been successful in creating an example of how to implement structured, research-based doctoral studies at universities in line with high international standards of quali-

17 See Ecker et al. (2014).
18 Austrian Science Fund (FWF) commentary on the Doctoral Programme evaluation.

ty. Because of the long-term nature of many research projects and cooperation with other institutionalised funding programmes, such as the FWF's special research areas or the Christian Doppler laboratories, the Doctoral Programmes are able to contribute in a significant way to the creation of "critical mass" in certain key focus areas. The high demands made of applicants are also responsible to a considerable degree for the programme's success. The Doctoral Programmes also played an important role in increasing the number of instances of international cooperation and the growing global networking of researchers and individual institutions. According to the evaluation team, Doctoral Programmes function as an important complementary instrument and catalyst for universities with respect to globally financed doctoral studies and training. These programmes contribute in a significant way to the further development and improvement of doctoral studies and to the further development of structured training of doctoral students in Austria.

The ongoing monitoring of the programme is viewed as an area of potential improvement. Related recommendations include an improved means of tracking data related to Doctoral Programme participants, including time to finish the programme, completion rates and post-doctoral career paths. In addition, evaluators recommended simplifying the programme's guidelines. Overall, evaluators also questioned the future role of the Doctoral Programmes, especially in light of the possible introduction of a funding based on the number of students in any particular field, which could have an effect on the way doctoral training is conducted in Austria.

The funding body, the Austrian Science Fund (FWF),[19] believes that the results of the evaluation contributed to identifying areas in need of work as well as measures to further develop and improve the programme. This is especially true in the case of reformulating and streamlining the programme's guidelines. The Austrian Science Fund (FWF) also shares the opinion of the evaluators that, if university funding is linked to capacity planning and particular academic fields, conclusions for the future development of the programme have to be drawn in discussions with the responsible federal ministry. The Austrian Science Fund (FWF), however, finds that more empirical data must be generated before specific conclusions and courses of action, especially those related to the role of doctoral studies in the domestic higher education sector in general and the related possible redesign of the programme, can be established.

6.7 Evaluation of Sparkling Science – Analysis of educational impacts

Objective of the evaluation

The impact analysis[20] undertaken of the Sparkling Science programme was tasked with surveying participation in projects funded by the programme targeted towards schoolchildren and teachers and the long-term effects of that participation. The analysis was essentially interested in the impacts and take-aways from participation in the projects by children and teachers, identifying (positive and negative) influences on what schoolchildren and students gained from participation and how learning processes were designed in the respective projects.

Programme objectives and key information

With its Sparkling Science programme, the Federal Ministry of Science, Research and Economy (BMWFW) funds scientific projects that create opportunities for schoolchildren to actively participate in the research process and which help

19 Austrian Science Fund (FWF) commentary on the Doctoral Programme evaluation.
20 See Birke et al. (2014).

improve connections between schools and higher education institutions. So far two programme phases involving four calls for proposals have been completed. The third programme phase's projects (5th call for proposals) began in autumn 2014.

The first two phases were characterised by particular programme focuses, namely initiating diverse research undertakings and models for cooperation (first programme phase 2007–2009) and improving permeability between secondary and tertiary education systems by creating long-term, stable partnerships between schools and universities and better integration of school teachers in university-based research (second programme phase 2010–2013). The third phase is concerned with expanding and securing the programme's structural impact.

Results of the evaluation

The evaluation found that the Sparkling Science programme supported a number of diverse projects that created opportunities for children and teachers to profit from participation on multiple levels. Evaluators discovered that this diversity provided an extraordinary learning opportunity for children and teaching staff as well as interesting research niches for researchers that do not receive comparable funding from other sources. The report highlighted that there were significant gains in knowledge and changes of perceptions amongst schoolchildren in all projects, regardless of the form they took. These were especially related to personal development (e.g. social competences, such as working in a group, and communication competences), understanding personal interests and goals, knowledge about science and research and methods of scientific research. As a result, the evaluation recommends that this diversity of formats be maintained going forward inasmuch as possible.

Both teachers and researchers admitted that the Sparkling Science brand is not widely recognised. Whilst schoolchildren often enjoyed the projects on which they worked, they did not always realise that these were part of the Sparkling Science programme. The evaluation found that existing communication methods, e.g. in the media, were not sufficiently present or targeted in age-appropriate ways to reach schoolchildren. Final presentations, according to evaluators, could help to disseminate the founding idea behind Sparkling Science in addition to reviewing the concrete details of the project and its results. The report additionally drew attention to the positive benefits related to the close interaction between researchers and schoolchildren as part of the Sparkling Science programme. The scheme is particularly well suited to supporting young talent. It is worth further investigating how useful other existing programmes, such as the "Young Science" scheme for pre-university research, may be for the Sparkling Science programme and its participants. They might bring research and schools closer together outside the confines of this particular programme. The evaluation additionally recommends that certain target groups as identified by education policy, such as girls or children from less educated households, may be addressed more directly by Sparkling Science projects. The programme guidelines could provide additional support for such an initiative.

The evaluation concludes by asserting that Sparkling Science's concept of "Different than school" is important and helpful on a number of levels and that it represents concrete usefulness to schoolchildren. Of central note is the fact that the new learning environment interrupts known, established patterns. This awakens children's curiosity, improves motivation and makes learning fun. Knowledge, learning and doing are introduced in a context different from "just" school and experienced in a more meaningful way. As a result, the evaluation recommends that new forms of learning be introduced outside of the Sparkling Science scheme that go beyond the classic form of classroom learning and that may contain, for example, elements that take place outside of the school itself.

6.8 Evaluation of the Research Expertise for Industry programme

Objective of the evaluation

The evaluation[21] of the Research Expertise for Industry programme focuses on analysing and assessing the concept, organisation and management as well as the impacts of the individual funding schemes such as qualification seminars, qualification networks and innovation lectures (tertiary level). Given their shorter duration, final evaluations were made for the qualification seminars and qualification networks schemes, whilst an interim evaluation was completed for the innovation lectures scheme.

Programme objectives and key information

The Research Expertise for Industry programme, a key funding initiative by the Federal Ministry of Science, Research and Economy (BMWFW), was begun in 2011 and aims to (1) support enterprises in hiring and supporting research, technological, development and innovation personnel (RTDI) through obtaining higher qualifications and (2) more firmly establish private-sector-relevant teaching and research priorities at Austrian universities and universities of applied sciences and improve mobility in the sector, which has been the focus of some criticism. The funding programme makes use of the following instruments: the qualification seminars are meant to help SMEs access further development and educational possibilities for RTDI and provide an overview of relevant research areas (building competences). The medium-term qualification networks are meant to improve innovation and competences in high demand related to cutting-edge fields of technology by enabling employees to work towards qualifications (strengthening competences). The innovation lectures (tertiary level) are long-term qualification networks focused on sensitive, understaffed research areas that are meant to firmly establish qualifications in those areas that have thus far received insufficient attention and which are closely tied to private sector needs.

By October 2014 the priority scheme provided funding to 553 organisations (448 enterprises and 105 research institutions) with a regional concentration in Styria, Lower and Upper Austria and in Vienna. A total of 38 qualification seminars were supported, of which 25 have already been completed. Eleven of the 21 funded qualification networks have been concluded as well. None of the supported innovation lectures had been concluded by the time the evaluation was undertaken.

Results of the evaluation

The evaluation found that the programme had a very positive impact overall. A large proportion of the enterprises receiving support (42%) had never before taken part in the Austrian Research Promotion Agency's funding portfolio. The qualification seminars, according to the evaluators, have proven themselves to be an appropriate entry-level format in terms of their conception and practical organisation, and they speak directly to enterprises' needs. They deal with a number of themes important to enterprises' futures that have thus far been insufficiently addressed by relevant qualifications measures. Participation in the qualification seminar produced an improvement in the enterprise's innovation competence, which in turn improved its competitiveness. Academic partners were able to translate their experience in the seminars into useful tools for teaching and to plan projects for the students to undertake in the enterprises.

The qualification networks also enjoyed a strong reputation amongst the funding recipi-

21 See Heckl and Wolf (2015).

ents. The scheme's strengths were the adaptation of training material to the enterprises' needs, the lecturers' competence and the networking aspect. In addition, the opportunities for discussion with enterprises from other sectors, interaction and interfacing, and the close connection created between theory and practice were identified as positive aspects. Aside from enterprises enjoying an increased innovation competence by the time of the project's conclusion, many also witnessed the continuation of networking activities beyond that point. It is especially worth mentioning that a number of qualification offerings were firmly established based on experiences gathered in the qualification networks.

The three innovation lectures that have received support thus far have, according to the evaluators, contributed in a significant way to generating competences related to key enabling technologies and in those areas that are currently of increasing importance to business enterprises. Participants rated the trainings highly and funding recipients welcome the scheme since it provides further education and specialised training at a superior level. One of the scheme's particular strengths is its multilateral know-how transfer (from the academic partners to the enterprises, but also vice versa, as well as amongst enterprises). The related expansion of networks and increased informal cooperation are also evident. Given their long-term nature, the innovation lectures scheme could not yet be comprehensively assessed.

The evaluation did demonstrate that the instruments are appropriately designed for the target groups and meets their respective needs. The instruments not only attracted first-time funding recipients, but also managed to create a sustainable interest in R&D amongst them. The evaluators found that the programme closed a gap in the Austrian Research Promotion Agency's broader funding portfolio given its support for structural measures to promote knowledge transfer and provide further training in networks.

6.9 Evaluation of "evolve", an initiative for creative industries

Objective of the evaluation

The evaluation of the evolve[22] initiative for creative industries, commissioned by what was then the Federal Ministry of Economy, Family and Youth (BMWFJ) takes an ex-post perspective on the scheme's activities undertaken between 2008–2013. The analysis looked at the impacts of the measures undertaken as part of the initiative as well as investigating the cooperation amongst the activities of the programme's two funding bodies, Austria Wirtschaftsservice GmbH (aws) and creativ wirtschaft austria (cwa), part of the Austrian Economic Chambers (WKO). The evaluation also highlighted the future concept on which the follow-up programme, evolve 2.0, is to be based and the relevant experience collected during this phase that will provide a firm footing for the next steps in the programme's development.

Programme objectives and key information

At the time of the evaluation, the evolve initiative pursued the following objectives: the full utilisation of the potential for innovation in the domestic creative industries and increasing international competitiveness when it comes to innovation. The initiative was founded by the Federal Ministry of Economy, Family and Youth (BMWFJ). Responsibility has been assumed by the Federal Ministry of Science, Research and

22 Radauer and Dudenbostel (2014).

Economy (BMWFW). Austria Wirtschaftsservice GmbH (aws), with the aws Creative Industries, and creativ wirtschaft austria (cwa), part of the Austrian Economic Chambers (WKO), are supporting funding bodies. The initiative is specifically targeted towards small and medium-sized enterprises (SMEs).

The programme's activities were organised along three lines. The funding scheme, managed by the Austria Wirtschaftsservice (aws), including the impulse XS and impulse XL sub-programmes, provided financial support mechanisms to provide assistance from preliminary market analyses through to implementation and market transition for projects in the creative industries. The impulse LEAD funding mechanism sought to additionally support the networking of SMEs in the context of so-called performance clusters, which had the aim of promoting forward-thinking projects with model designs and, at the same time, increasing the sector's visibility through more pronounced professionalisation. During the entire period between 2008 and 2013, 93 impulse XL and 118 impulse XS projects received support, which is equivalent to a successful application rate of around 23% and 17% respectively.

The service line featured educational and professional development offerings within the field as well as networking events and the provision of other related services, including handbooks, an information hotline and, as part of the CreativDepots project, support in dealing with copyright law related to creative services. Educational and professional development offerings were organised by the Austria Wirtschaftsservice GmbH (aws) and included consultation services related to the funding scheme. The creativ wirtschaft austria (cwa), assumed responsibility for managing the remaining measures and instruments. The public awareness line included schemes for improving the creative industries' visibility overall and the services and support mechanisms offered by the programme.

Results of the evaluation

The evaluators assessed the programme positively overall. For one, this was due to its institutional embedding within Austria Wirtschaftsservice GmbH (aws) and creativ wirtschaft austria (cwa), which provided for continuity and consistency in its further development of aspects of earlier programmes. In addition, the clear division between the distinct programme lines and their transparent structure were judged positively. Stakeholders, who were surveyed as part of the evaluation, commended the professional programme management provided by creative wirtschaft austria (cwa) and the Austria Wirtschaftsservice (aws).

The impulse support mechanisms were deemed to have played an important role in ensuring the programme's success, providing a positive contribution to the supported enterprises' development and their respective business models. Supporting these enterprises also took the form of creating new jobs and securing existing ones, providing access to new financing sources and the improvement in reputation that resulted. In the evaluators' opinion, the more open understanding of the concept of innovation, with its focus on development instead of research and the less demanding technical requirements made on projects as a result, contributed – especially in the funding line – to the creation of more interesting innovative projects, in particular when compared with other funding schemes. This is also seen as a key factor in reaching the intended target groups. Highlighted is the indirect support of "business model innovations", as projects are assessed by the jury on the basis of the realistic chances of success for the underlying business model. The evaluation similarly praised the programme's service provision and consulting opportunities as well as its public awareness measures, all of which were similarly positively assessed by the programme's stakeholders. The evaluators judged the programme a success in having improved connections and the possibilities for exchange between funding organisations and their target groups. The activities and measures implemented by creativ wirtschaft austria (cwa) were seen as especially important in creating acceptance and improving the sector's visibility in general.

The evaluators found that improvements could be made in how rejected applications are explained and communicated. A revision of the impulse LEAD funding scheme was recommended, as it is potentially addressing too many objectives in its current form. Aspects that also deserve further attention are looking for possibilities for improving the networking amongst creative industries and other commercial sectors, increasing the visibility of evolve's concept, especially with respect to the cooperative work between creative wirtschaft austria (cwa) and the Austria Wirtschaftsservice (aws), and the programme's strategic orientation, especially in terms of its service provisions.

7 Literature

Acemoglu, D., Dorn, D., Hanson, G. H., Price, B. (2014): Return of the Solow Paradox? IT, Productivity, and Employment in US Manufacturing (No. w19837), National Bureau of Economic Research.

Acker, J. (1990): Hierarchies, Jobs, Bodies: A Theory of Gendered Organizations, Gender and Society, 4(2), 139–158.

Acs, Z.J., Audretsch, D.B. (1991): R&D, firm size and innovative activity, Innovation and technological change: An international comparison, 98(2), 451–56.

AG 7a der FTI-Task-Force (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 (July 2013) und (von der Bundesregierung zu beschließender) Österreichischer EU-Aktionsplan: Österreichs FTI-Akteure stärken – Europa aktiv nutzen – zur Gruppe der Innovation Leader aufsteigen. Fassung der Arbeitsgruppe 7b (Europa) (July 2013), last accessed on 31.03.2015.

Airaksinen, A., Panizza, A. de, Bartelsman, E., Hagsten, E., Leeuwen, G. van, Franklin, M., Maliranta, M., Kotnik, P., Stam, P., Rouvinen, P., Farooqui, S., Quantin, S., Svanberg, S., Clayton, T., Barbesol, Y. (2006): Information Society: ICT impact assessment by linking data from different sources, Eurostat Agreement No. 49102.2005.017-2006, 128.

Alm, H., McKelvey, M. (2000): When and why does cooperation positively or negatively affect innovation? An exploration into turbulent waters, CRIC Discussion Papers, 39.

Andrew, J.P., DeRocco, E.S., Taylor, A. (2009): *The Innovation Imperative in Manufacturing. How the United States Can Restore Its Edge*, Boston: Boston Consulting Group.

Arbeitsbehelf Wissensbilanz (2013): V.08, 10/2013, Vienna.

Astor, M., Glöckner, U., Heinzelmann, S., Riesenberg, D., Hartmann, H.-D., Beyer, K.-P., Tustanowski, M., Wiedenhöft, G., Knerr, S., Ploder, M., Niederl, A., Breitfuss, M., Wagner-Schuster, D. (2014): Wissenschaftliche Untersuchung und Analyse der Auswirkungen der Einführung von Projektpauschalen in die BMBF-Forschungsförderung auf die Hochschulen in Deutschland. Im Auftrag des Bundesministeriums für Bildung und Forschung (BMBF).

Atasoy, H. (2013): Effects of Broadband Internet Expansion on Labor Market Outcomes, Industrial and Labor Relations Review, 66(2), 315-345.

Atkinson, R.D., Andes, S.M. (2009): The Atlantic Century. Benchmarking EU & U.S. Innovation and Competitiveness, Washington: The Information Technology and Innovation Foundation.

Audretsch, D.B., Vivarelli, M. (1996): Firms size and R&D spillovers: Evidence from Italy; Small Business Economics 8(3), 249–58.

Baum, J., Calabrese, T., Silverman, B.S. (2000): Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology, Strategic Management Journal, 21(3) 267–94.

Bellak, C. (2004): How Domestic and Foreign Firms Differ and Why Does It Matter?, Journal of Economic Surveys, 18, 483–514.

Berger, R. (2014): Strategy Consultants, GreenTech made in Germany 4.0 Umwelttechnologie-Atlas für Deutschland, Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, Berlin.

Birke, B., Fettelschoß, K., Gerloff-Gasser, C. (2014): Sparkling Science – Analyse von bildungsseitigen Auswirkungen. AQ Austria, Agentur für Qualitätssicherung und Akkreditierung Austria und Deutsche Forschungsgemeinschaft DFG, Universität Zürich, Studie im Auftrag des BMWF Vienna.

BMLFUW, BMF (2010): Österreichischer Aktionsplan zur nachhaltigen öffentlichen Beschaffung (naBe). Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft & Bundesministerium für Finanzen. Vienna.

BMVIT (2005): Gender Booklet außeruniversitäre Forschung 2004, Vienna.

BMVIT (2009): Gender Booklet außeruniversitäre Forschung 2008, Vienna.

BMVIT (2010): Innovationsfaktor Humanressourcen: Brennpunkt NachwuchsforscherInnen, Vienna.

BMVIT (2013): Breitband-Offensive jetzt: Ein Masterplan zur Breitbandförderung, Bundesministerium für Verkehr, Innovation und Technologie, Vienna.

BMVIT, BMWA (2007): Richtlinien zur Förderung der wirtschaftlich-technischen Forschung und Technologieentwicklung (FTE Richtlinien). Bundesministerium für Verkehr, Innovation und Technologie; Bundesministerium für Wirtschaft und Arbeit. Vienna.

BMVIT, BMWFW (2015a): Richtlinie zur Förderung der wirtschaftlich–technischen Forschung, Technologieentwicklung und Innovation (FTI – Richtlinie 2015) Themen-FTI-RL. Bundesministerium für Verkehr, Innovation und Technologie & Bundesministerium für Wissenschaft, Forschung und Wirtschaft, Vienna.

BMVIT, BMWFW (2015b): Richtlinie zur Förderung der wirtschaftlich–technischen Forschung, Technologieentwicklung und Innovation (FTI – Richtlinie 2015) Struktur-FTI-RL. Bundesministerium für Verkehr, Innovation und Technologie & Bundesministerium für Wissenschaft, Forschung und Wirtschaft, Vienna.

BMVIT, BMWFW (2015c): Richtlinie zur Förderung der wirtschaftlich–technischen Forschung, Technologieentwicklung und Innovation (FTI – Richtlinie 2015) Humanressourcen-FTI-RL. Bundesministerium für Verkehr, Innovation und Technologie & Bundesministerium für Wissenschaft, Forschung und Wirtschaft, Vienna.

BMWF (2011): Österreichischer Hochschulplan, Der Gestaltungsprozess zur Weiterentwicklung des österreichischen Hochschulraums.

BMVIT, ÖBB-Infra, ASFINAG, FFG (2014): Ergebnisse: Verkehrsinfrastrukturforschung Austria aus der Ausschreibung 2011. Vienna.

BMWF (2012): Universitätsgesetz 2002. Österreichisches Hochschulrecht, Heft 14. Vienna.

BMWF, BMVIT, BMWFJ (2013): Austrian Research and Technology Report 2013. Status report in accordance with Section 8(1) of the Research Organisation Act on federally subsidised research, technology and innovation in Austria http://www.bmwfw.gv.at/rtr.

BMWFJ, BMVIT (2011): Ministerratsvortrag: Entwicklung eines österreichischen Leitkonzeptes für eine innovationsfördernde öffentliche Beschaffung (IÖB). Bundesministerium für Wirtschaft, Familie und Jugend & Bundesministerium für Verkehr, Innovation und Technologie. Vienna.

BMWFJ, BMVIT (2012a): Leitkonzept für eine innovationsfördernde öffentliche Beschaffung (IÖB) in Österreich. Bundesministerium für Wirtschaft, Familie und Jugend & Bundesministerium für Verkehr, Innovation und Technologie. Vienna.

BMWFJ, BMVIT (2012b): Ministerratsvortrag: Umsetzung des österreichischen Leitkonzeptes für eine innovationsfördernde öffentliche Beschaffung (IÖB). Bundesministerium für Wirtschaft, Familie und Jugend & Bundesministerium für Verkehr, Innovation und Technologie. Vienna.

BMWFW (2014): Universitätsbericht 2014. Vienna.

BMWFW, BMVIT (2014): Austrian Research and Technology Report 2014. Status report in accordance with Section 8(1) of the Research Organisation Act on federally subsidised research, technology and innovation in Austria. http://www.bmwfw.gv.at/rtr.

Bonaccorsi, A. (2014): Knowledge, Diversity and Performance in European Higher Education – A changing landscape, Edward Elgar.

Brandt, T., Breitfuss, M., Daimer, S., Dinges, M., Ecker, B., Egeln, J., Flink, T., Niederl, A., Rammer, C., Reidl, S., Rogge, J.C., Roßmann, S., Schiessler, P., Schubert, T. und Simon, D. (2012): Zur Situation der Forschung an Deutschlands Hochschulen – Aktuelle empirische Befunde; Studien zum deutschen Innovationssystem Nr.16-2012, im Auftrag der Expertenkommission Forschung und Innovation (EFI).

Brünner, H.-C., Buchinger, E., Jäger, D., Schieg, A., Steiger, M., Unger, J. (2012): 4 x Good practice: Public procurers as drivers of innovation AIT Austrian Institute of Technology. Vienna.

Brynjolfsson, E., McAfee, A. (2011): Race against the machine: How the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy.

Buchinger, E. (2012): Öffentliche Beschaffer als Innovationstreiber: Lernen von Good Practice. In Brünner, H.-C., Buchinger, E., Jäger, D., Schieg, A., Steiger, M. und Unger, J. (Eds.): Vienna: AIT Austrian Institute of Technology, 3-10.

Buchinger, E. (2014): Policy brief: Implementation of the Austrian innovation procurement action plan 2013/2014. Austrian Institute of Technology, Vienna.

Buchinger, E. und Steindl, C. (2009): Innovationsfördernde öffentliche Beschaffung: Ein neues Instrument der Innovationspolitik? Austrian Institute of Technology. Vienna.

Bührer, S., Meyer, N. (2014): Impact Evaluation of the Erwin Schrödinger Fellowships with Return Phase. Studie im Auftrag des Fonds zur Förderung der wissenschaftlichen Forschung (FWF).

Bundeskanzleramt (2015): Nationales Reformprogramm Österreich, Vienna.

Bundesministerium für Bildung und Forschung (BMBF) (2012): Bericht der Bundesregierung. Zukunftsprojekte der Hightech-Strategie (HTS Aktionsplan), Bonn and Berlin.

Burgel, O., Murray, G.C. (2000): The International Market Entry Choices of Start-Up Companies in High-Technology Industries, Journal of International Marketing, 8(2), 33–62.

Clement, W., Walter, E. (2010): Innovationsfördernde öffentliche Beschaffung in Österreich. Foresee. Vienna

Cohen, W.M. (1995): Empirical Studies of Innovative Activity, in Stoneman, P. (ed.): Handbook of Innovation and Technological Change, Blackwell: Oxford, 182–264.

Colombo, M.G., Grilli, L., Piva, E. (2006): In search of complementary assets: The determinants of alliance formation of high-tech start-ups, Research Policy, 35(8), 1166–99.

Colombo, M.G., Piva, E. (2008): Strengths and weaknesses of academic startups: a conceptual model, Engineering Management, IEEE Transactions, 55(1), 37–49.

Cornell University, INSEAD, WIPO (2014): The Global Innovation Index 2014: The Local Dynamics of Innovation, Geneva, Ithaca, and Fontainebleau.

Dachs, B., Stehrer, R., Zahradnik, G. (2014): The Internationalisation of Business R&D, Edward Elgar.

Danilda, I., Thorslund, J.G. (Ed.) (2011): Innovation and Gender. VINNOVA Information VI, Edita Västra Aros AB, Västerås, Sweden.

Deutsche Telekom Stiftung, BDI (2014): Innovationsindikator 2014, Bonn and Berlin.

Dinges, M., Leitner, K.H., Zahradnik, G. (2014): Evaluierung des Programmes FHplus. Endbericht. Studie im Auftrag des BMVIT.

EC (2010/C/546): Europe 2020 flagship initiative innovation union. European Commission, Brussels.

Ecker, B., Kottmann, A., Meyer, S. (2014): Evaluation of the FWF Doctoral Programme (DK Programme), IHS, CHEPS, AIT im Auftrag des FWF, Vienna.

Economist Intelligence Unit (2009): A New Ranking of the World’s Most Innovative Countries, London: Economist Intelligence Unit.

Elias, B., Pöchhacker, G. (2012): Drittmittelfinanzierung universitärer Forschung in Österreich. Entwicklungen, Rahmenbedingungen und Ansatzpunkte zur Stärkung der Drittmittelforschung an österreichischen Universitäten. Studie im Auftrag des Rates für Forschung und Technologieentwicklung.

EU (2014/25): Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors. Official Journal of the European Union. Brussels.

European Commission (2010): Digital Agenda for Europe. Brussels.

European Commission (2014): Research and Innovation performance in the EU. Innovation Union progress at country level 2014, Luxemburg.

European Commission (2015): Innovation Union Scoreboard 2015, Brussels.

European Commission (2010): Europe 2020 Flagship Initiative Innovation Union; COM(2010) 546 final: Brussels.

European Commission (2011): Connecting Universities to Regional Growth: A practical Guide.

European Commission (2013): Gendered innovations: How gender analysis contributes to research report of the expert group ‘Innovation through gender’, Luxembourg.

European Commission (2014): The Role of Universities and Research Organisations as drivers for Smart Specialisation at regional level, EC 2014.

European Commission (2014a): Vademecum on Gender Equality in Horizon 2020, Brussels.

European Commission (2014b): Horizon 2020: Work Programme 2014 – 2015: General Introduction, Luxembourg.

European Commission (2014c): Horizon 2020: Work Programme 2014 – 2015: Science with and for Society, Luxembourg.

European Commission (2014d): Gender Equality Policies in Public Research: Based on a survey among Members of the Helsinki Group on Gender in Research and Innovation, Luxembourg.

European Commission (2014e): Analysis of the state of play of the European Research Area in Member States and associated countries: focus on priority areas, Brussels.

European Commission (2014f): Horizon 2020: Work Programme 2014–2015: 19th General Annexes, Luxembourg.

EUROSTAT (2015a). Innerbetriebliche FuE-Ausgaben insgesamt nach Leistungssektor und Finanzierungsquelle. Downloaded on: 04.03.2015, [http://ec.europa.eu/eurostat/de/data/database].

EUROSTAT (2015b). Innerbetriebliche FuE-Ausgaben insgesamt nach Leistungssektor. Downloaded on: 04.03.2015, [http://ec.europa.eu/eurostat/de/data/database].

Evangelista, R., Guerrieri, P., Meliciani, V. (2014): The economic impact of digital technologies in Europe. Economics of Innovation and New Technology, 23(8), 802-824.

Forschungsunion Wirtschaft und Wissenschaft, Acatech (2013): Deutschlands Zukunft als Produktionsstandort sichern. Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0. Abschlussbericht des Arbeitskreises Industrie 4.0, Frankfurt am Main.

Freeman, C. (2005): The 'National System of Innovation' in historical perspective, Cambridge Journal of Economics 19, 5-24.

Freeman, J., Carroll, G., Hannan, M. (1983): The liability of newness: Age dependence in organizational death rates, American sociological review, 692–710.

Friesenbichler, K. (2012): Wirtschaftspolitische Aspekte des Breitbandausbaus in Österreich, WIFO, Vienna.

FTI-Strategie des Bundes (2011): Der Weg zum Innovation Leader. Potentiale ausschöpfen, Dynamik steigern, Zukunft schaffen. BKA: Vienna.

Gans, J., Hsu, D., Stern, S. (2000): When does start-up innovation spur the gale of creative destruction?, National bureau of economic research.

Gassmann, O., Enkel, E. (2011): Open Innovation. Die Öffnung des Innovationsprozesses erhöht das Innovationspotential, zfo–Zeitschrift Führung+ Organisation 3, 132-138.

genSET (2010): Recommendations for Action on the Gender Dimension in Science. genSET consensus report. In: http://www.genderinscience.org/index.php/consensus-seminars/recommendations-report [02.03.2015].

Hagedoorn, J., Link, A., Vonortas, N. (2000): Research partnerships, Research Policy, 29(4), 567–86.

Hagsten, E., Polder, M,. Bartelsman E., Kotnik P. (2013): The multifaceted nature of ICT, Final Report of the ESSnet on Linking of Microdata to Analyse ICT Impact.

Harrison, R., Jaumandreu, J., Mairesse, J., Peters, B. (2014): Does Innovation Stimulate Employment? A Firm-Level Analysis Using Comparable Micro-Data From Four European Countries, International Journal of Industrial Organization, 35, 29-43.

Headd, B. (2010): An analysis of small business and jobs. Office of Advocacy, US Small Business Administration.

Heckl, E., Sheik, S., Wolf, L. (2014): Zwischenevaluierung des Förderschwerpunkts Talente. Studie im Auftrag des BMVIT.

Heckl, E., Wolf, L. (2015): Evaluierung des Programms Forschungskompetenzen für die Wirtschaft. Endbericht. Studie im Auftrag des BMWFW.

Heinrich, R., Riesenberg, D., Ploder, M. (2014): Evaluierung des österreichischen Sicherheitsforschungsprogramms KIRAS, Ex-Post-Evaluation 2014, Vienna/Berlin.

Heller-Schuh, B., Kasztler, A., Leitner, K-H. (2015a): Forschungsinfrastrukturfinanzierung: FTI-politische Steuerung und Förderung im nationalen und internationalen Kontext. Auftragsprojekt für das Bundesministerium für Wissenschaft, Forschung und Wirtschaft, das Bundesministerium für Verkehr, Innovation und Technologie und dem Rat für Forschung und Technologieentwicklung, February, Vienna.

Heller-Schuh, B., Leitner, K-H., Züger, M.E. (2015b): Analyse der Daten zur Forschungsinfrastrukturerhebung an Universitäten III, Auftragsprojekt für das Bundesministerium für Wissenschaft, Forschung und Wirtschaft, AIT-IS-Report, Vienna.

Herstatt, C., Buse, S., Tiwari, R., Stockstrom, C. (2007): Innovationshemmnisse in KMU der Metropolregion Hamburg: Ergebnisse einer empirischen Untersuchung in ausgewählten Branchen. Hamburg University of Technology, online: http://www.tuhh.de/tim/ris-hamburg/befragung.

Hollenstein, H. (2013): Internationalisierung von Forschung und Entwicklung – Determinanten, Auswirkungen, Politik. WIFO-Monatsberichte 12/2013, 985-992.

Holzinger, F., Hafellner, S. (2014): Wachstum und Wandel in der außeruniversitären Forschung: Ergebnisse der Gleichstellungserhebung 2014, Vienna & Graz, POLICIES Working paper 78/2014.

Holzinger, F., Reidl, S. (2012): Humanressourcen Barometer: HR Monitoring in Wissenschaft und Technologie, Graz and Vienna.

Holzinger, F., Schaffer, N. (2011): Gender in der angewandten Forschung – FEMtech FTI Projekte. Vienna.

Industriellenvereinigung (2009): Internationale Leitbetriebe in Österreich. Eds.: Haidinger, W.; Riemer, G.; Schneider, H.W. Vienna.

IÖB-Servicestelle (2014): Zehn Beispiele für innovationsfördernde öffentliche Beschaffung, Bundesbeschaffung GmbH. Vienna.

Janger, J., Reinstaller, A. (2009): Innovation: Anreize, Inputfaktoren und Output im Spiegel der österreichischen Wirtschaftsstruktur, Monographien, 8, 603–17.

JOANNEUM RESEARCH, Prognos, Ifes (2010): Evaluierung des österreichischen Sicherheitsforschungsprogramms KIRAS. Interimsevaluation 2010, Vienna/Berlin.

JOANNEUM RESEARCH, Prognos, Ifes (2012): Evaluierung des österreichischen Sicherheitsforschungsprogramms KIRAS. Interimsevaluation 2011/12, Vienna/Berlin.

Katz, R., Suter, S. (2009): Estimating the Economic Impact of the Broadband Stimulus Plan.

Kletzan-Slamanig, D., Köppl, A. (2009): Österreichische Umwelttechnikindustrie, Entwicklung – Schwerpunkte – Innovationen, Studie des WIFO im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Bundesministeriums für Verkehr, Innovation und Technologie, Bundesministeriums für Wirtschaft, Familien und Jugend sowie der Wirtschaftskammer Österreich, Vienna.

Köppl, A. (2000): Österreichische Umwelttechnikindustrie, Studie des WIFO im Auftrag des Bundesministeriums für wirtschaftliche Angelegenheiten, Vienna.

Köppl, A. (2005): Österreichische Umwelttechnikindustrie, Branchenanalyse, Studie des WIFO im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft und der Wirtschaftskammer Österreich mit Unterstützung des Dachverbands Energie – Klima und des Bundesministeriums für Wirtschaft und Arbeit, Vienna.

Köppl, A., Kletzan-Slamanig, D., Köberl, K. (2013): Österreichische Umwelttechnikindustrie, Export und Wettbewerbsfähigkeit, Studie des WIFO im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Bundesministeriums für Verkehr, Innovation und Technologie, Bundesministeriums für Wirtschaft, Familien und Jugend sowie der Wirtschaftskammer Österreich, Vienna.

Köppl, A., Pichl, C. (1995): Wachstumsmarkt Umwelttechnologien. Österreichisches Angebotsprofil, Studie des WIFO im Auftrag des Bundesministeriums für wirtschaftliche Angelegenheiten, Vienna.

Lassnigg, L., Trippl, M., Sinozic, T., Auer, A. (2012): Wien und die "Third Mission der Hochschulen", Studie des IHS sowie der Wirtschaftsuniversität Wien im Auftrag der MA 23 der Stadt Wien.

Lind, I. (2013): Wissenschaft als „greedy occupation"?, in: Haller, M. (Ed.): Wissenschaft als Beruf: Bestandsaufnahme – Diagnosen – Empfehlungen, ÖAW: Forschung und Gesellschaft, Vienna, 95–109.

Linstone, H. A., Devezas, T. (2012): Technological innovation and the long wave theory revisited. Technological Forecasting and Social Change, 79(2), 414-416.

Lundvall, B.-Å. (Ed.) (1992): National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning, London.

Malerba, F. (2010): Knowledge Intensive Entrepreneurship and Innovation Systems: Evidence from Europe. London.

Mayerhofer, P. (2013): Wiens Industrie in der wissensbasierten Stadtwirtschaft: Wandlungsprozesse, Wettbewerbsfähigkeit, industriepolitische Ansatzpunkte, WIFO, Vienna.

Michaels, G., Natraj, A., Van Reenen, J. (2010): Has ICT polarized skill demand? Evidence from eleven countries over 25 years (No. w16138), National Bureau of Economic Research.

Mohr, V., Garnsey, E., Theyel, G. (2013): The role of alliances in the early development of high-growth firms. Industrial and Corporate Change, dtt056.

Musil, R., Eder, J. (2013): Wien und seine Hochschulen: Regionale Wertschöpfungseffekte der Wiener Hochschulen, ÖAW, Vienna.

Narula, R. (2004): R&D collaboration by SMEs: new opportunities and limitations in the face of globalisation, Technovation, 24(2), 153–61.

Niederl, A., Breitfuss, M., Ecker B., Leitner K.H. (2011b): Modelle der universitären Forschungsfinanzierung: Ausgewählte internationale Erfahrungen, JOANNEUM RESEARCH, AIT.

Niederl, A., Breitfuss, M., Linshalm, E., Wagner-Schuster, D. (2011a): Forschungsprofile der Österreichischen Bundesländer, JOANNEUM RESEARCH, im Auftrag des BMWF, Vienna/Graz.

OECD (1999): Managing National Innovation Systems, Paris.

OECD (2011): Demande-side innovation policies. Organisation for Economic Co-operation and Development, Paris.

OECD (2014): Intelligent demand: Policy rationale, design and potential benefits. Organisation for Economic Co-operation and Development. Paris.

OJEU (2014/C/198): Framework for state aid for research and development and innovation. Official Journal of the European Union.

Österreichischer Wissenschaftsrat (2009): Universität Österreich 2025. Analysen und Empfehlungen zur Entwicklung des österreichischen Hochschul- und Wissenschaftssystems, Vienna.

Patel, P., Pavitt, K. (1994): National innovation systems: why they are important, and how they might be measured and compared, Economics of Innovation and New Technology 3, 77–95.

Peneder, M., Wörter, M. (2014): Competition, R&D and innovation: testing the inverted-U in a simultaneous system, Journal of Evolutionary Economics, 24 (3), 653–87.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerna, P., Lissoni, F., Salter, A. and Sobrero, M. (2012): Academic engagement and commercialisation: A review of literature on university industry relations, Research Policy, 42, 423-442.

Peters, B., Dachs, B., Dünser, M., Hud, M., Köhler, C., Rammer, C. (2014): Firm Growth, Innovation and the Business Cycle. Background Report for the 2014 Competitiveness Report, Mannheim.

Pianta, M. (2005): Innovation and Employment, in: Fagerberg, J., Mowery, D. C., Nelson, R. R. (Ed.) The Oxford Handbook of Innovation Oxford, Oxford University Press, 568-598.

Pollitzer, E. (2011): Why Gender should be a Priority for our Attention in Science. Interdisciplinary Science Reviews, 36(2), 101-02.

Polt, W., Berger, M., Gassler, H., Schiffbänker, H., Reidl, S. (2014): Breites Innovationsverständnis und seine Bedeutung für die Innovationspolitik. Studie der JOANNEUM RESEARCH im Auftrag des Schweizerischen Wissenschafts- und Innovationsrats (SWIR).

Powell, W., Grodal, S. (2005): Networks of innovators, in: The Oxford handbook of innovation, 56–85.

Radauer, A.; Dudenpostel, T. (2014): Evaluierung der Kreativwirtschaftsinitiative „evolve“, Technopolis.

Rat für Forschung und Technologieentwicklung, Bericht zur wissenschaftlichen und technologischen Leistungsfähigkeit Österreichs 2015, Vienna.

Ratzer, B., Weiss, A., Weixelbaumer, B., Mirnig, N., Tscheligi, M., Raneburger, D., Popp, R., Falb, J. (2014): Bringing Gender into Technology: A Case Study in User-Interface-Design and the Perspective of Gender Experts, International Journal of Gender, Science and Technology, 6(1), 3-24.

Reichwald, R., Piller, F. (2006): Interaktive Wertschöpfung. Open Innovation, Individualisierung und neue Formen der Arbeitsteilung, Wiesbaden.

Reidl, S. (2014): The challenges and potentials of gendered innovation projects: an interdisciplinary perspective – a field report. Paper presented at the 8th European Conference on Gender Equality in Higher Education, Vienna.

Reinstaller, A. (2010): Die volkswirtschaftliche Bedeutung von Breitbandnetzwerken. Die Situation in Österreich und ein Vergleich wirtschaftspolitischer Handlungsoptionen. Vorträge – Lectures, 109/2010, WIFO, Vienna.

Reinstaller, A., Christen, E., Friesenbichler, K., Janger, J., Schwarz, G., Unterlass, F. (2014): WIFO-Unternehmensbefragung: Strategische Zusammenarbeit zwischen jungen Technologieunternehmen und Großunternehmen, August 2014. http://www.wifo.ac.at/publikationen?detail-view=yes&publikation_id=47440.

Riemann et al. (2013): Zusammenfassung der Ergebnisse des BMBF-Strategiegesprächs NMP zum 8. Forschungsrahmenprogramm der Europäischen Kommission.

Ruhland, S., Dörflinger, A., Dorr, A. (2010): Zwischenevaluierung des Programms austrian electronic network (AT:net). Studie im Auftrag des BMVIT.

Ruhland, S., Laurenz, W. (2014): Endevaluierung des Förderprogramms austrian electronic network (AT:net). Studie im Auftrag des BMVIT.

Schiebinger, L. (Ed.) (2008): Gendered Innovations in Science and Engineering. Stanford University Press, Stanford.

Schiebinger; L., Schraudner M. (2011): Interdisciplinary Approaches to Achieving Gendered Innovations. Interdisciplinary Science Reviews, 36 (2), 154-67.

Schneider, H.W., Lengauer, S.D., Brunner, P., Dorfmayr, R., Ramharter, C. (2013): Österreichische Leitbetriebe als Marktführer auf globalen Märkten. Endbericht. Studie im Auftrag der Industriellenvereinigung (IV). Vienna.

Schneider, H.W., Lueghammer, W. (2005): Leading Competence Units 2004 – Ihre Bedeutung für Wertschöpfung, Innovation und Strukturwandel in Österreich. Studie des Industriewissenschaftlichen Instituts (IWI).

Schraudner, M., Lukoschat, H. (Ed.) (2006): Gender als Innovationspotential in Forschung und Entwicklung, Munich. In: Leicht-Scholten, C. (Ed.): Gender and Science. Perspektiven in den Natur- und Ingenieurwissenschaften. Transcript Verlag, Bielefeld.

Schröder, K. (2010): Gender dimensions of product design. Paper presented at the Gender, Science, and Technology Expert Group meeting of the United Nations Division for the Advancement of Women (UN-DAW), 28 September – 1 October, Paris, France.

Schubert, T., Baier, E., Hufnagl, M., Meyer, N., Schricke, E., Stahlecker, T. (2012): Metastudie Wirtschaftsfaktor Hochschule; Fraunhofer-ISI im Auftrag des Stifterverbandes für die Deutsche Wissenschaft.

Shan, W. (1990): An empirical analysis of organizational strategies by entrepreneurial high-technology firm, Strategic Management Journal, 11(2), 129–139.

Statistics Austria (2011): Ergebnisse der Vierten Europäischen Innovationserhebung (CIS 2010), Vienna.

Statistics Austria (2011f): Daten zu Beschäftigten, verfügbar bis 2011. Ausgaben und Finanzierung des Hochschulsektors nach Wissenschaftszweigen und Bundesland.

Statistics Austria (2014): Input-Output-Tabelle 2010 inklusive Aufkommens- und Verwendungstabelle, Vienna.

Statistics Austria (2015): Formales Bildungswesen – Universitäten, Studium, http://www.statistik.at/web_de/statistiken/bildung_und_kultur/formales_bildungswesen/universitaeten_studium/index.html.

Steiner, M., Niederl, A., Ploder, M. (2014): University Systems in Europe: A Multi-Dimensional Efficiency Comparison. China-USA Business Review, 13(1) 60-71.

Street, C. T., Cameron, A.F. (2007): External relationships and the small business: A review of small business alliance and network research, Journal of Small Business Management, 45 (2), 239–66.

Thurik, A.R. (2009): Entreprenomics: entrepreneurship, economic growth and policy, Entrepreneurship, growth, and public policy, 219–49.

uni:data (2015). Datawarehouse Hochschulbereich. [https://oravm13.noc-science.at/apex/f?p=103:6:0::NO::P6_OPEN:N], last accessed on 17.03.2015.

Van Beers, C., Zand, F. (2014): R&D Cooperation, Partner Diversity, and Innovation Performance: An Empirical Analysis, Journal of Product Innovation Management 31(2), 292–312. doi:10.1111/jpim.12096.

Verdú-Jover, A.J, Lloréns-Montes, F.J., García-Morales, V.J. (2006): Environment–flexibility coalignment and performance: an analysis in large versus small firms, Journal of Small Business Management 44(3) 334–49.

Veugelers, R., Del Rey, E. (2014): The contribution of universities to innovation, (regional) growth and employment, EENEE Analytical Report No. 18, prepared for the European Commission.

Vivarelli, M. (2014): Innovation, Employment and Skills in Advanced and Developing Countries: A Survey of Economic Literature, Journal of Economic Issues, 48(1), 123-154.

Vonortas, N., Zirulia, L. (2010): Business network literature review and building of conceptual models of networks and knowledge-intensive enterprises. Working paper, European Project "Advancing knowledge-intensive entrepreneurship and innovation for economic growth a social well-being in Europe" (AEGIS), European Commission, DG Research.

Vonortas, N., Zirulia, L. (2015): Strategic technology alliances and networks, Economics of Innovation and New Technology, 1–20. doi:10.1080/10438599.2014.988517.

WEF (2014): The Global Competitiveness Report 2014–2015, World Economic Forum, Geneva.

Welan, M., Wulz, H. (1996): Grundzüge des österreichischen Universitätsrechts 1. Teil. Diskussionspapier No. 52-R-96. Vienna.

Yang, H., Zheng, Y., Zhao, X. (2014): Exploration or Exploitation? Small Firms' alliance strategies with large firms, Strategic Management Journal, 35, 146–157.

8 Annex I

8.1 Country codes

Country/region	Codes
Albania	AL
Argentina	AR
Austria	AT
Australia	AU
Belgium	BE
Bulgaria	BG
Brazil	BR
Canada	CA
Switzerland	CH
China	CN
Cyprus	CY
Czech Republic	CZ
Germany	DE
Denmark	DK
Estonia	EE
Greece	EL
Spain	ES
Finland	FI
France	FR
Hong Kong	HK
Croatia	HR
Hungary	HU
Ireland	IE
India	IN
Iceland	IS
Italy	IT
Japan	JP
South Korea	HR
Liechtenstein	LI
Lithuania	LT
Luxembourg	LU
Latvia	LV
Montenegro	ME
Malta	MT
Mexico	MX
Nigeria	NG
Netherlands	NL
Norway	NO
New Zealand	NZ
Poland	PL
Portugal	PT
Romania	RO
Serbia	RS
Russia	RU
Sweden	SE
Singapore	SG
Slovenia	SI
Slovakia	SK
Turkey	TR
Taiwan	TW
United Kingdom	UK
United States of America	US
South Africa	ZA

8.2 Expenditure on research and development (R&D) in all survey areas*, without company R&D sub-sector ("Firmeneigener Bereich") in 2011, by fields of science in selected regional governments

Fields of science	Vienna		Styria		Upper Austria		Carinthia		Tyrol		Salzburg	
	R&D expenditure in											
	€ millions	%	€ millions	%	€ millions	%	€ millions	%	€ millions	%	€ millions	%
Natural sciences	414.2	30.1	138.5	15.9	66.9	39.4	9.2	16.9	-	-	-	-
Natural sciences, engineering	-	-	-	-	-	-	-	-	-	-	42.8	40.3
Natural sciences, agriculture and forestry	-	-	-	-	-	-	-	-	80.5	27.2	-	-
Engineering	213.5	15.5	521.6	59.7	63.0	37.1	-	-	18.5	6.2	-	-
Human medicine	241.7	17.6	112.6	12.9	0.2	0.1	-	-	131.0	44.2	-	-
Agriculture and forestry	118.7	8.6	13.6	1.6	-	-	-	-	-	-	-	-
Human medicine, agriculture and forestry	-	-	-	-	-	-	-	-	-	-	12.1	11.4
Engineering; human medicine, agriculture and forestry	-	-	-	-	-	-	18.4	33.9	-	-	-	-
Social sciences	225.9	16.4	58.8	6.7	28.2	16.6	15.6	28.7	43.8	14.8	28.4	26.8
Humanities	160.4	11.7	28.4	3.3	11.4	6.7	11.1	20.4	22.6	7.6	22.8	21.5
Total	**1374.5**	**100.0**	**873.5**	**100.0**	**169.7**	**100.0**	**54.3**	**100.0**	**296.5**	**100.0**	**106.1**	**100.0**

* These include the R&D expenditure of the higher education sector, the government sector, the private charitable sector and the institutes' sub-sector ("Kooperativer Bereich"). Data for the R&D expenditures according to fields of science are not collected for the company R&D sub-sector ("firmeneigener Bereich").

Source: Statistics Austria: Survey of research and experimental development (R&D) in 2011. Calculations: JOANNEUM RESEARCH.

8.3 Business enterprise R&D expenditure in 2011, by sector/industry in selected regional governments

Sector or industry	Vienna		Styria		Upper Austria		Carinthia		Tyrol		Salzburg	
	R&D expenditure in											
	€ millions	%	€ millions	%	€ millions	%	€ millions	%	€ millions	%	€ millions	%
Agriculture and forestry, fisheries	0.0	0.0	1)	1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining and extraction of stones and soils	1)	1)	0.8	0.1	0.4	0.0	1)	1)	0.0	0.0	0.0	0.0
Manufacture of goods total	**646.0**	**42.8**	**557.1**	**47.9**	**966.4**	**84.1**	**345.2**	**81.7**	**346.8**	**83.3**	**136.9**	**76.9**
Food and feed products	6.0	0.4	6.1	0.5	4.9	0.4	0.3	0.1	0.9	0.2	0.9	0.5
Beverages	1)	1)	1)	1)	0.8	0.1	0.0	0.0	1)	1)	1)	1)
Tobacco processing	-	-	-	-	-	-	-	-	-	-	-	-
Textiles	1)	1)	3.5	0.3	1.4	0.1	1)	1)	0.0	0.0	0.0	0.0
Wearing apparel	1)	1)	0.0	0.0	1)	1)	0.0	0.0	0.0	0.0	0.0	0.0
Leather, leather products and shoes	0.0	0.0	1)	1)	0.6	0.0	0.0	0.0	1)	1)	0.0	0.0
Wood and products of wood and cork (except furniture)	-	-	3.0	0.3	2.3	0.2	2.7	0.6	3.4	0.8	1.7	1.0
Paper and paper products	2.7	0.2	12.3	1.1	2.4	0.2	1)	1)	1)	1)	1)	1)
Printing products; reproduction of recorded media and data carriers	1.9	0.1	0.0	0.0	0.0	0.0	1)	1)	1)	1)	1)	1)
Coke and refined petroleum products	-	-	-	-	-	-	-	-	-	-	-	-
Chemical products	11.2	0.7	12.7	1.1	76.2	6.6	5.5	1.3	8.7	2.1	2.6	1.5
Pharmaceuticals, medicinal chemicals and botanical products	18.1	1.2	18.1	1.6	4.4	0.4	1)	1)	123.0	29.5	1)	1)
Rubber and plastics	5.9	0.4	9.9	0.9	64.3	5.6	1)	1)	2.7	0.6	5.5	3.1
Glass, glass products, ceramics, and mineral products	0.6	0.0	2.1	0.2	3.5	0.3	4.4	1.0	55.4	13.3	1)	1)
Basic iron, steel and ferro-alloys, tubes, iron and steel casting	0.0	0.0	20.6	1.8	47.2	4.1	1)	1)	1)	1)	0.0	0.0
Non-ferrous metals, light metal and metal alloy casting	1)	1)	1)	1)	10.9	0.9	1)	1)	8.1	1.9	1)	1)
Metal products	4.9	0.3	28.8	2.5	39.3	3.4	3.3	0.8	7.6	1.8	8.4	4.7
Computers, electronic and optical products (without electronic components and circuit boards)	44.9	3.0	42.2	3.6	29.4	2.6	1)	1)	30.2	7.3	14.4	8.1
Electronic components and circuit boards	5.0	0.3	50.9	4.4	4.0	0.3	257.2	60.8	1)	1)	4.0	2.2
Electrical equipment	347.8	23.0	72.1	6.2	160.7	14.0	1.7	0.4	58.4	14.0	10.1	5.7
Mechanical engineering, machinery	89.4	5.9	97.4	8.4	217.2	18.9	51.4	12.2	43.3	10.4	46.9	26.3
Motor vehicles, trailers and semi-trailers	17.5	1.2	147.0	12.6	217.9	19.0	1)	1)	1)	1)	4.0	2.3
Manufacture of other transport equipment	38.7	2.6	1)	1)	57.3	5.0	0.0	0.0	0.0	0.0	1)	1)
Furniture for	0.0	0.0	1.1	0.1	4.4	0.4	0.0	0.0	1)	1)	1)	1)
Other goods (without medical or dental equipment and materials)	1.3	0.1	1)	1)	6.0	0.5	1)	1)	0.3	0.1	10.5	5.9
Medical and dental equipment and materials	1)	1)	0.9	0.1	1)	1)	1)	1)	0.8	0.2	9.3	5.2
Repair and installation of machines and equipment	35.5	2.3	5.5	0.5	7.8	0.7	0.1	0.0	1)	1)	1)	1)
Energy supply	3.4	0.2	1.0	0.1	1.7	0.1	1)	1)	1)	1)	1)	1)
Water supply; disposal of waste water and waste and removal of environmental pollution	1)	1)	2.0	0.2	1.3	0.1	0.1	0.0	1)	1)	0.0	0.0
Construction	8.0	0.5	1)	1)	1.8	0.2	1.7	0.4	13.0	3.1	1)	1)
Services total	**851.6**	**56.4**	**585.7**	**50.3**	**178.1**	**15.5**	**71.5**	**16.9**	**55.4**	**13.3**	**36.8**	**20.7**
Wholesale and retail trade; repair of motor vehicles	203.3	13.5	5.8	0.5	23.6	2.1	11.5	2.7	9.3	2.2	18.3	10.3
Transport and warehousing	3.4	0.2	1)	1)	0.6	0.1	1)	1)	0.0	0.0	1)	1)
Hotels and restaurants	-	-	-	-	-	-	-	-	-	-	-	-
Publishing; production, rental and distribution of films and TV programmes; movie theatres; sound studios and music publishing; broadcasting	8.6	0.6	1.3	0.1	6.7	0.6	1)	1)	4.7	1.1	0.0	0.0
Telecommunications	49.7	3.3	0.0	0.0	1)	1)	1)	1)	1)	1)	0.0	0.0
Information technology services	72.0	4.8	25.4	2.2	37.8	3.3	16.3	3.9	4.4	1.1	7.1	4.0
Information services	71.4	4.7	2.0	0.2	8.2	0.7	1)	1)	2.1	0.5	3.3	1.8
Finance and insurance services	29.8	2.0	0.0	0.0	1)	1)	0.0	0.0	0.0	0.0	1)	1)
Real estate and housing; freelance, scientific and techn. service providers (without architecture and engineering firms; technical, physical and chemical analysis; without R&D)	19.6	1.3	5.4	0.5	9.8	0.9	2.7	0.6	1.7	0.4	0.6	0.3
Architecture and engineering firms; technical, physical and chemical analysis Examination	25.2	1.7	358.2	30.8	10.1	0.9	24.6	5.8	17.1	4.1	3.4	1.9
Research and development in the biotechnology sector	239.9	15.9	21.4	1.8	1)	1)	1)	1)	6.6	1.6	0.0	0.0
Other R&D in the area of natural sciences, engineering, agricultural sciences and medicine	119.0	7.9	155.7	13.4	78.4	6.8	12.1	2.9	9.1	2.2	3.2	1.8
Research and development in the areas of legal, economic and social sciences as well as the areas of language, culture and art sciences	4.2	0.3	7.3	0.6	0.0	0.0	0.0	0.0	1)	1)	1)	1)
Other economic services	2.3	0.2	2.2	0.2	0.3	0.0	1)	1)	1)	1)	0.0	0.0
Public administration, defence; social security; education and teaching; health and social work; art, entertainment and recreation; other services	3.2	0.2	1)	1)	0.6	0.1	1)	1)	0.0	0.0	0.0	0.0
Business enterprise sector total	**1,510.2**	**100.0**	**1,164.1**	**100.0**	**1,149.6**	**100.0**	**422.7**	**100.0**	**416.3**	**100.0**	**178.1**	**100.0**

1) For confidentiality reasons, the data cannot be listed separately but are included in the total.

Source: Statistics Austria: Survey of research and experimental development (R&D) in 2011. Calculations: JOANNEUM RESEARCH.

8.4 Strategic and thematic RTI priorities of the regional governments based on current strategies

Regional government	Strategic priorities/fields of action or activities	Strategic research priorities/potential areas
Upper Austria	1) Manufacturing processes	Re. 1) Mathematical modelling, software architectures/control processes, data security, hardware, surface/ material development, testing systems, production/ process engineering and optimization, energy/ resource management
	2) Energy	Re. 2) Decentralised, customer-oriented systems (e.g. smart grids), network load management/ monitoring, renewable energies, building/ civil engineering
	3) Health/aging society	Re. 3) Medical information systems (eHealth) /software (e.g. virtual surgery, image analysis), equipment/ materials, telemetrics, personalized diagnostics, prevention, therapy
	4) Food/diet	Re. 4) Ingredients/modified food, materials/packaging, food quality/safety, measurement procedure, production engineering
	5) Mobility/logistics	Re. 5) Traffic, logistics, supply chain management, vehicle technologies and propulsion technology, lightweight structural construction
Styria	**Themes for economic strategy:**	
	1) Mobility	Re. 1) Clean mobility, niche technologies and products like aeronautics, train systems engineering
	2) Eco-tech	Re. 2) Wood technologies
	3) Health tech	Re. 3) Food and health technologies
	Theme corridors for RTI strategy:	
	1) Mobility	Potential of the humane, social and cultural sciences as well as arts as cross-section subjects to solve social/ economic challenges
	2) Energy/resources/ sustainability	
	3) Materials	
	4) Health/biotechnology	
	5) Information society	
Lower Austria	**RTI strategy:**	Currently being prepared.
	1) Agro-technology food/veterinary medicine	
	2) Society/culture	
	3) Health/medicine	
	4) Natural science/engineering	
	5) Environment, energy, resources	
Carinthia	**RTI strategy in general:**	
	1) Human resources	Re. 1) Technology/natural sciences
	2) ICT	Re. 2) Interdisciplinary networking of ICT with culture and social sciences, embedded system technologies
	3) Production technologies	
	4) Sustainability	Re. 4) Renewable energies/sustainable construction
	RTI strategy, objectives for higher education:	
	University of Klagenfurt	Promote a university education in natural science and technical disciplines
	Carinthia University of Applied Sciences	Promote education in engineering and economic sciences
Tyrol	**Future RTI fields:**	Development of concrete packages of measures with the participation of the regional RTI stakeholders
	1) Creative industries	
	2) Material science	
	3) Materials technologies	
	4) Alpine area	
Burgenland	1) Sustainable technology	Re. 1) Building materials and technologies, energy efficiency, sustainable/renewable energies, intelligent networks/regional consumption structures
	2) Sustainable quality of life	Re. 2) Ambient assisted living, health competence/operational health promotion, prevention/recreation, emotional health, product/ process optimization in food production, products and services in health, leisure, culture, tourism
	3) Intelligent processes, technologies and products	Re. 3) Optoelectronics, mechatronics, intelligent application of materials

Source: RTI and economic strategies of the regional governments in this study. Graphic: JOANNEUM RESEARCH.

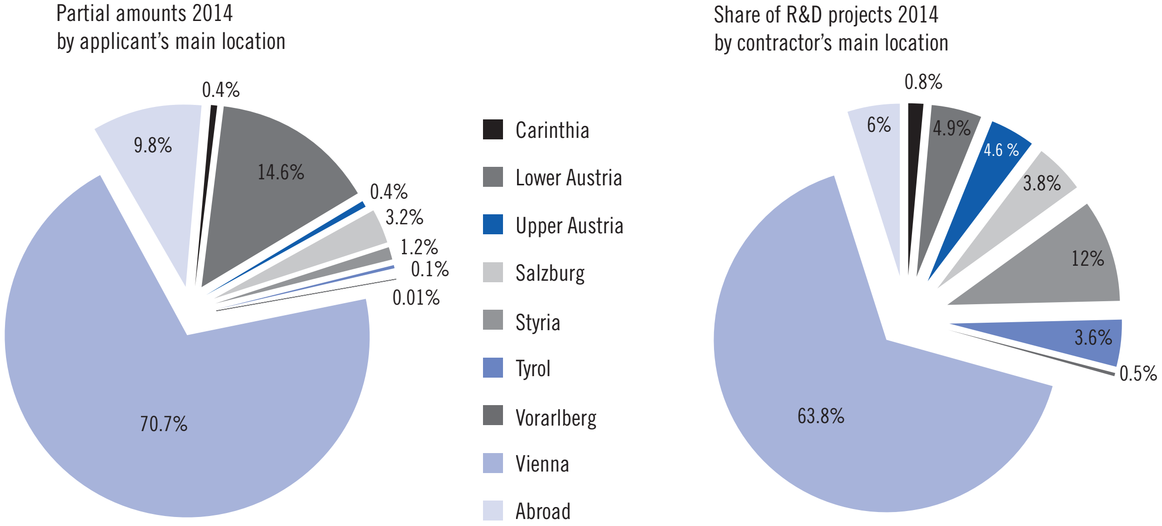
9 Annex II

Research funding and research contracts of the federal government according to the federal research database

Figures 9-1 to 9-3 provide an overview of R&D funding and contracts recorded in the federal research data base B_f.dat by the ministries in 2014. The database for recording research funding and contracts (B_f.dat) for the federal government has been in place since 1975, and was set up as a "documentation of facts by the federal government" in the then Federal Ministry of Science and Research. The mandatory reporting of the ministries to the relevant Science Minister is recorded in the Research Organisation Act (FOG), Federal Law Gazette No. 341/1981, last changed by the Federal Law Gazette I No. 74/2002. The last adaptation took place in 2008 with the migration to a database to which all ministries have access and in which they all enter their research-related funding and contracts independently. The B_f.dat database is not used for recording payments made. Instead, it is a documentation database which also records contextual information on the R&D projects. With regard to the relevant reporting year the database makes a distinction between ongoing and completed R&D projects, their overall funding volume and actual funds paid in the reporting year, thereby providing a current picture of the number of projects and of project financing.

For 2014 a total of 724 ongoing R&D projects and R&D projects completed in the reporting year can be found in the B_f.dat with an overall funding volume of around € 607 million. Of

Fig. 9-1: Share of R&D projects and partial amounts in 2014 by contractor's main location (in %)



Note: incl. "major" global financing for FWF, LBG, AIT, IHS, ISTA, ÖAW and WIFO.

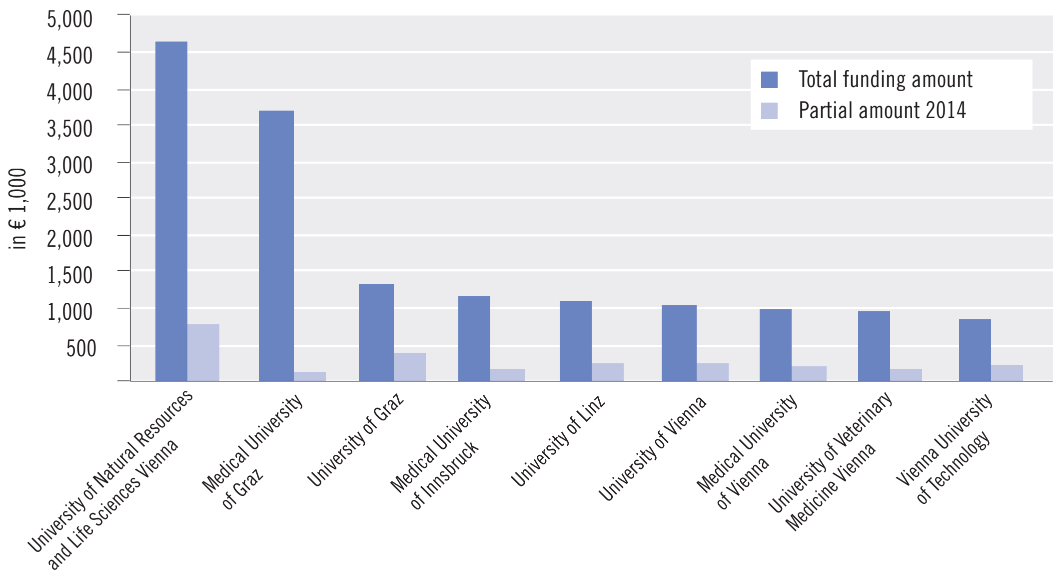
Source: Federal Ministry of Science, Research and Economy (BMWFW), Federal research database B_f.dat. Reference date April 22, 2015.

this, about €306 million were already paid by all ministries in 2014. When viewed according to regional governments, a strong dominance of the state capital can be noticed: Around 71% of the paid R&D funds or 64% of the projects are attributed to applicants whose main business location is in Vienna. About 10% of the amounts go abroad, primarily in the form of membership contributions in international organisations. No project was allocated to the regional government of Burgenland in 2014.

With an overall funding volume of more than €20 million, universities feature as contractors in a total of 226 of the projects ongoing or completed in 2014. Of this, partial amounts totalling around €3.8 million were paid out for 179 projects, that is about 28% of all the projects or about 1.3% of the total R&D funds. Broken down into the fields of science, it can be seen that around 60% of the R&D funds paid in 2014 can be attributed to the natural sciences and about 29% are received by the social sciences (cf. tab 12 in the statistical appendix).

A total of 240 R&D-related projects were funded by the federal ministries in the reporting year of 2014 with a funding volume of around €172.9 million newly approved, with about 30% of the funds paid out. Around 41% of these new projects were approved by the Federal Ministry of Science, Research and Economy (BMWFW), followed by the Federal Ministry of Science and Research (BMWF)[1] (10.8%) as one of the two predecessor ministries of the Federal Ministry of Science, Research and Economy (BMWFW) as well as of the Federal Ministry of Labour, Social Affairs and Consumer Protection (BMASK) and the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) at 10.4% each. As can be seen from in Fig. 9-3, almost 80% of the approved

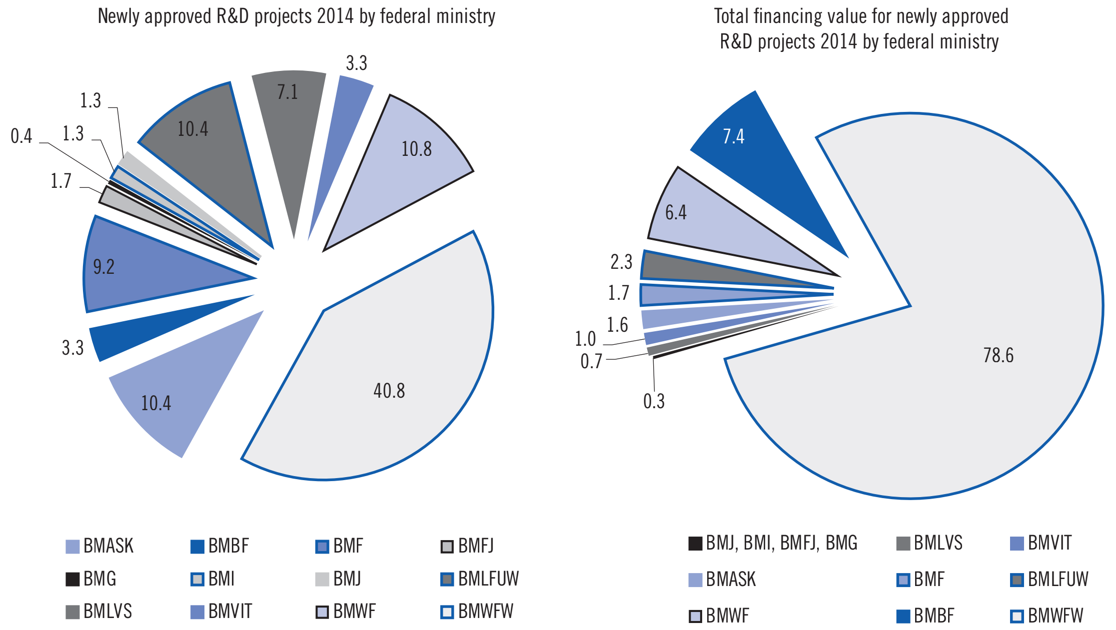
Fig. 9-2: Total financing volume and partial amounts in 2014 by selected universities (in €1,000)



Source: Federal Ministry of Science, Research and Economy (BMWFW), Federal research database B_f.dat. Reference date April 22, 2015.

1 In accordance with Act Governing Federal Ministries of the XXIV. Legislative period with effectiveness up to 28 February 2014.

Fig. 9-3: New approvals in 2014 by number and total financing amounts by ministry (in %)



Note: without "major" global financing for FWF, LBG, AIT, IHS, ISTA, ÖAW and WIFO.

Source: Federal Ministry of Science, Research and Economy (BMWFW), Federal research database B_f.dat. Reference date April 22, 2015.

funding totals are attributable to the Federal Ministry of Science, Research and Economy (BMWFW). The Federal Ministry for Transport, Innovation and Technology (BMVIT) features a low percentage (1%) due to the fact that the processing for the majority of R&D funds for the BMVIT is largely outsourced (e.g. to the Austrian Research Promotion Agency – FFG).

The annual documentation on the research funding and research contracts by the federal government shows the projects in the reporting year which have been newly awarded or are ongoing or completed, with the titles, contractors, funding contributions, scientific classifications, contract and completion dates classified according to the awarding party, and this can be found on the Federal Ministry of Science, Research and Economy's website at: http://www.bmwfw.gv.at/jb-bfda

10 Statistics

1 Financing of gross domestic expenditure on R&D 2015 (Tables 1 and 2)[1]

According to an estimate by Statistics Austria, more than € 10.10 billion in gross domestic expenditure are expected to be spent in Austria in 2015 on research and experimental development (R&D). This corresponds to a research intensity of 3.01% as a ratio of gross domestic product (GDP). Compared with 2014, the total amount of Austrian R&D expenditure will increase by an estimated 2.8% and exceed the value from 2013 by 6.1%. This estimate is primarily based on preliminary trends from the R&D Survey in 2013, which indicate above-average growth in expenditures for research in Austrian enterprises from 2011 to 2013.

The public sector will finance 37.3% of the total forecast for research expenditure in 2015 (around € 3.77 billion) financing. Of this the federal government, with € 3.21 billion (31.8% of total R&D expenditure), is the most important source of R&D funding. The regional governments contribute an estimated €443 million, with other public institutions (local government authorities, chambers, social security institutions) providing €110 million of research financing.

Estimated € 4.76 billion (approx. 47.2% of total gross domestic expenditure on R&D) is financed by domestic firms. As such the business enterprise sector continues to be the most significant national economic sector for financing research and development in Austria in terms of quantities. It showed above-average increases in the financing of R&D especially in the years from 2011 to 2013.

15.1% of R&D funding (around €1.53 billion) comes from abroad, with foreign firms representing the most significant sources of funding. The returns from the EU Research Programmes are also included in the foreign funding. The share of financing from abroad in the total national gross domestic expenditure should decline slightly, even if the absolute values are increasing somewhat.

The private non-profit sector features the lowest funding volume with around € 43 million (0.4% of total R&D expenditure).

Since the growth rates of the Austrian R&D expenditures are above those of the GDP, the research intensity for Austria has increased substantially in recent years. It increased from 2.74% in 2010 to 2.95% in 2013. Another increase to 3.01% can be expected for 2015.

1 On the basis of the results of the R&D statistical surveys and other currently available documents and information, in particular the R&D-related budget appropriations and outlays of the federal and regional governments, Statistics Austria annually creates the "Total estimate of the gross domestic expenditures for R&D." Under this annual compilation of the total estimate, any retroactive revisions or updates appear as based on the latest data. In accord with the definitions of the Frascati Manual, which is globally valid (OECD, EU) and thus guarantees international comparability, the financing of the expenditures for research and experimental development is presented as carried out in Austria. According to these definitions and guidelines, foreign financing of R&D done in Austria is included, although Austrian payments for R&D performed abroad are excluded (domestic concept).

In an EU comparison for 2013 (the last year for which international comparative figures are available for national research intensity) Austria is behind Finland, Sweden, Denmark ahead of Germany, and at 2.95% is well above the average for the EU-28 of 2.01%.

The budget appropriations and outlays of the federal government and the regional governments, current economic data and the results of the last R&D survey for the reporting year 2011 as well as recent preliminary trends from the R&D survey 2013 were taken into account in estimating the Austrian gross domestic expenditure on R&D in 2015.

2 Federal R&D expenditure in 2015

2.1. The federal expenditure shown in *Table 1* for R&D carried out in Austria in 2015 is composed as described below. According to the methodology used for the R&D global estimate, the core is the total amount of Part b of Annex T in the Auxiliary Document for the Federal Finances Act 2015. The estimate also includes the funds from the National Foundation for Research, Technology, and Development available for 2015, based on the currently available information, as well as the estimates of the 2015 payout for research premiums. (Source: BMF in each case).

2.2. In addition to its expenditures for R&D in Austria, in 2015 the federal government will pay **contributions to international organisations** aimed at research and the funding of research amounting to €100 million. They are shown in Annex T/Part a, but according to the domestic concept these are not included in the Austrian gross domestic expenditure on R&D.

2.3. The federal government expenditures summarised in **Annex T (Part a and Part b)** that impact research and which includes its research-effective share in contributions to international organisations (cf. above pt. 2.2), are traditionally included under the title **"Federal expenditure on research and research promotion."** These correspond to what is called the "GBAORD" concept[2] that is used by the OECD and the EU on the basis of the Frascati Manual, referring primarily to the budgets of the central government and/or federal state. It includes (in contrast to the domestic concept) research-related contributions to international organisations and provides the basis for classification of R&D budget data by socioeconomic objectives as required for reporting to the EU and OECD.

In 2015 the following socio-economic objectives will receive the largest portions of federal expenditure on research and research promotion:

- Funding of general advancement of knowledge: 32.8%
- Funding of trade, commerce, and industry: 24.7%
- Funding of the health care system: 20.0%
- Funding of social and socio-economic development: 4.7%
- Funding of research on the earth, oceans, atmosphere and space: 4.3%
- Funding of environmental protection: 3.0%

3. R&D expenditure of the regional governments

The research financing by the Austrian government as collated in Table 1 is listed from the state budget-based estimates of R&D expenditure reported by the offices of the regional governments. The R&D expenditure of the regional

2 GBAORD: Government Budget Appropriations or Outlays for R&D.

hospitals is estimated annually by Statistics Austria by a methodology agreed on with the regional governments.

4. An international comparison of 2012 R&D expenditure

Overview Table 13 shows Austria's position compared to the other European Union member states and the OECD in terms of the most important R&D-related indices (Source: OECD, MSTI 2014-2).

5 Austria's participation in the European Framework Programmes

Tables 14 through 18 provide an overview of Austria's participation in the European Framework Programmes for research and development.

6. Research funding by the Austrian Science Fund (FWF)

Tables 19 through 21 provide detailed information about funding and the number of projects in Austrian Science Fund (FWF) projects.

7. Funding by the Austrian Research Promotion Agency (FFG)

Tables 22 and 23 provide detailed information on funding approvals by the Austrian Research Promotion Agency (FFG).

8. The Austria Wirtschaftsservice (aws) technology programme

Table 24 shows an overview of disbursed funding under the auspices of the Austria Wirtschaftsservice (aws) technology programme.

9. Christian Doppler Gesellschaft

Tables 25 to 27 depict the status and historical development of the CD laboratories and the "Josef Ressel Centres (JR-Centres)" support programme for universities of applied sciences that was set up in 2013.

List of Tables in the Statistical Annex

Table 1: Global estimate for 2015: Gross domestic expenditure on R&D Financing of research and experimental development carried out in Austria in 1998–2015

Financing	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gross domestic expenditure on R&D (in € millions)	**3,399.84**	**3,761.80**	**4,028.67**	**4,393.09**	**4,684.31**	**5,041.98**	**5,249.55**	**6,029.81**	**6,318.59**	**6,867.82**	**7,548.06**	**7,479.75**	**8,066.44**	**8,276.34**	**9,148.99**	**9,521.14**	**9,833.08**	**10,104.44**
of which financed by:																		
Federal government[1)]	1,097.51	1,200.82	1,225.42	1,350.70	1,362.37	1,394.86	1,462.02	1,764.86	1,772.06	1,916.96	2,356.78	2,297.46	2,586.43	2,614.29	2,986.87	2,967.43	3,169.34	3,214.03
Regional governments[2)]	142.41	206.23	248.50	280.14	171.26	291.62	207.88	330.17	219.98	263.18	354.35	273.37	405.17	298.71	416.31	426.91	428.43	443.23
Business enterprise sector [3)]	1,418.43	1,545.25	1,684.42	1,834.87	2,090.62	2,274.95	2,475.55	2,750.95	3,057.00	3,344.40	3,480.57	3,520.02	3,639.35	3,820.90	4,165.27	4,509.63	4,586.02	4,764.87
Abroad [4)]	684.63	738.91	800.10	863.30	1,001.97	1,009.26	1,016.61	1,087.51	1,163.35	1,230.24	1,240.53	1,255.93	1,297.63	1,401.67	1,435.97	1,470.26	1,499.37	1,529.31
Other [5)]	56.86	70.59	70.23	64.08	58.09	71.29	87.49	96.32	106.20	113.04	115.83	132.97	137.86	140.77	144.57	146.91	149.92	153.00
Gross domestic product (GDP) nominal [6)](in € billions)	195.83	203.42	213.20	220.10	226.30	231.00	241.51	253.01	266.48	282.35	291.93	286.19	294.21	308.67	317.21	322.59	329.00	335.33
Gross domestic expenditure on R&D as a % of GDP	***1.74***	***1.85***	***1.89***	***2.00***	***2.07***	***2.18***	***2.17***	***2.38***	***2.37***	***2.43***	***2.59***	***2.61***	***2.74***	***2.68***	***2.88***	***2.95***	***2.99***	***3.01***

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

1) 1998, 2002, 2004, 2006, 2007, 2009, 2011: Survey results (federal government including the Austrian Science Fund (FWF), the two research promotion funds (FFF/FFG) and in 1998 and 2002 also including ITF).
1999–2001, 2003, 2005, 2008, 2010, 2012 and 2013: Annex T/Part b for the Federal Finances Act 2001–2015 (in each case: outlays).
2014, 2015: Annex T/Part b for the Federal Finances Act 2015 (in each case: financing proposal).
2005: Additionally € 84.4 million National Foundation for Research, Technology and Development and € 121.3 million research premiums paid out.
2008: Additionally € 91.0 million National Foundation for Research, Technology and Development and € 340.6 million research premiums paid out.
2010: Additionally € 74.6 million National Foundation for Research, Technology and Development and € 328.8 million research premiums paid out.
2012: Additionally € 53.9 million National Foundation for Research, Technology and Development and € 574.1 million research premiums paid out.
2013: Additionally € 92.8 million National Foundation for Research, Technology and Development and € 378.3 million research premiums paid out.
2014: Additionally € 38.7 million National Foundation for Research, Technology and Development and € 493.2 million research premiums paid out.
2015: Additionally € 63.0 million National Foundation for Research, Technology and Development, as well as € 493.0 million for research premiums expected to be paid out based on information currently available (source: BMF, April 2015).

2) 1998, 2002, 2004, 2006, 2007, 2009, 2011: survey results. 1999–2001, 2003, 2005, 2008, 2010, 2012–2015: Based on the estimates of R&D expenditure reported by the state government offices.

3) Funding by business enterprises.
1998, 2002, 2004, 2006, 2007, 2009, 2011: survey results. 1999–2001, 2003, 2005, 2008, 2010, 2012–2015: Estimates made by Statistics Austria.

4) 1998, 2002, 2004, 2006, 2007, 2009, 2011: survey results. 1999–2001, 2003, 2005, 2008, 2010, 2012–2015: Estimates made by Statistics Austria.

5) Financing by local governments (excluding Vienna), chambers, social insurance institutions and other public financing and from the private non-profit sector.
1998, 2002, 2004, 2006, 2007, 2009, 2011: survey results. 1999–2001, 2003, 2005, 2008, 2010, 2012–2015: Estimates made by Statistics Austria.

6) 1998–2013: Statistics Austria, current as of April 2014. 2014: Austrian Institute of Economic Research (WIFO) on behalf of Statistics Austria. 2015: Austrian Institute of Economic Research (WIFO), economic forecast March 2015. GDP acc. to ESA 2010.

Table 2: Global estimate for 2015: Gross domestic expenditure on R&D Financing of research and experimental development carried out in Austria in 1998–2015 as a percentage of GDP

Financing	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1. Gross domestic expenditure on R&D (in % of GDP)	***1.74***	***1.85***	***1.89***	***2.00***	***2.07***	***2.18***	***2.17***	***2.38***	***2.37***	***2.43***	***2.59***	***2.61***	***2.74***	***2.68***	***2.88***	***2.95***	***2.99***	***3.01***
of which financed by:																		
Federal government[1)]	0.56	0.59	0.57	0.61	0.60	0.60	0.61	0.70	0.66	0.68	0.81	0.80	0.88	0.85	0.94	0.92	0.96	0.96
Regional governments[2)]	0.07	0.10	0.12	0.13	0.08	0.13	0.09	0.13	0.08	0.09	0.12	0.10	0.14	0.10	0.13	0.13	0.13	0.13
Business enterprise sector [3)]	0.72	0.76	0.79	0.83	0.92	0.98	1.03	1.09	1.15	1.18	1.19	1.23	1.24	1.24	1.31	1.40	1.39	1.42
Abroad [4)]	0.35	0.36	0.38	0.39	0.44	0.44	0.42	0.43	0.44	0.44	0.42	0.44	0.44	0.45	0.45	0.46	0.46	0.46
Other [5)]	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05
2. Nominal GDP [6)](in € billions)	195.83	203.42	213.20	220.10	226.30	231.00	241.51	253.01	266.48	282.35	291.93	286.19	294.21	308.67	317.21	322.59	329.00	335.33

As at: 21 April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

Footnotes cf. Table 1.

Table 3: Federal expenditure on research and research promotion, 2012–2015
Breakdown of Annex T of the Auxiliary Document for the Federal Finances Act 2014 and 2015 (financing proposal for each; Parts a and b)

Ministries [1]	Outlays				Budget appropriation			
	2012[2]		2013[3]		2014[3]		2015[3]	
	€ millions	%	€ millions	%	€ millions	%	€ millions	%
Federal Chancellery (BKA)[4]	2.125	*0.1*	2.943	*0.1*	33.091	*1.2*	39.360	*1.4*
Federal Ministry of the Interior (BMI)	0.790	*0.0*	0.812	*0.0*	1.067	*0.0*	1.067	*0.0*
Federal Ministry for Education, Arts and Culture (BMUKK)	73.446	*3.0*	77.426	*3.0*	.	.	.	.
Federal Ministry for Education and Women's Affairs	.	.	.	.	48.690	*1.8*	40.277	*1.5*
Federal Ministry for Science and Research (BMWF)	1,780.922	*72.6*	1,870.872	*72.4*	.	.	.	.
Federal Ministry of Science, Research and Economy	.	.	.	.	2,080.391	*75.9*	2,103.894	*76.3*
Federal Ministry for Labour, Social Affairs and Consumer Protection (BMASK)	6.450	*0.3*	5.854	*0.2*	5.649	*0.2*	5.462	*0.2*
Federal Ministry for Health (BMG)	7.068	*0.3*	7.390	*0.3*	7.379	*0.3*	7.307	*0.3*
Federal Ministry for European and International Affairs (BMEIA)	2.536	*0.1*	1.949	*0.1*	.	.	.	.
Federal Ministry for Europe, Integration and Foreign Affairs	.	.	.	.	2.234	*0.1*	2.305	*0.1*
Federal Ministry of Justice (BMJ)	0.125	*0.0*	–	–	0.130	*0.0*	0.130	*0.0*
Federal Ministry of Defence and Sports (BMLVS)	1.185	*0.0*	1.224	*0.0*	1.174	*0.0*	1.267	*0.0*
Federal Ministry of Finance (BMF)	31.720	*1.3*	30.475	*1.2*	34.224	*1.3*	34.350	*1.2*
Federal Ministry for Agriculture, Forestry, Environment and Water Management (BMLFUW)	78.410	*3.2*	91.581	*3.5*	81.100	*3.0*	70.679	*2.6*
Federal Ministry of Economy, Family and Youth	114.230	*4.7*	101.965	*3.9*	.	.	.	.
Federal Ministry for Family and Youth	.	.	.	.	1.654	*0.1*	1.654	*0.1*
Federal Ministry for Transport, Innovation and Technology (BMVIT)	353.948	*14.4*	395.226	*15.3*	439.521	*16.1*	450.314	*16.3*
Total	**2,452.955**	***100.0***	**2,587.717**	***100.0***	**2,736.304**	***100.0***	**2,758.066**	***100.0***

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) In accordance with the applicable version of the Act Governing Federal Ministries of 1986 (2012, 2013: Federal Law Gazette I No. 3/2009; 2014, 2015: Federal Law Gazette I no. 11/2014). - [2]) Auxiliary Document for the Federal Finances Act of 2014 (financing proposal). - [3]) Auxiliary Document for the Federal Finances Act of 2015 (financing proposal). [4])Including the highest executive bodies.

Table 4: Annex T of the Auxiliary Document for the Federal Finances Act 2015 (financing proposal)

Federal spending on research from 2013 to 2015 by ministry

The following tables for the years 2013 to 2015 are broken down according to

1. contributions from federal funds to international organisations whose goals include research and the promotion of research (**Part a**)

2. Other federal spending on research and research promotion (**Part b, federal research budget**)

This list has been drawn up primarily in consideration of research effectiveness, as based on the research concept defined by the Frascati manual of the OECD. This concept is also used by Statistik Austria as a benchmark in carrying out surveys of research and experimental development (R&D).

Please Note:
The notes for the following tables can be found in the annex of supplement T.

BUNDESVORANSCHLAG 2015

Beilage T: Forschungswirksame Ausgaben des Bundes

(Beträge in Millionen Euro)

a) Beitragszahlungen an internationale Organisationen - Finanzierungsvoranschlag

VA-Stelle	Konto	Ugl	Bezeichnung	Anm	Finanzierungsvoranschlag 2015			Finanzierungsvoranschlag 2014			Erfolg 2013		
					Insgesamt	hievon %	hievon Forschung	Insgesamt	hievon %	hievon Forschung	Insgesamt	hievon %	hievon Forschung
			Bundeskanzleramt										
			UG10										
10010100	7800	100	Mitgliedsbeiträge an Institutionen im Ausland		0,184	100	0,184	0,184	100	0,184	0,182	100	0,182
10010100	7800	101	Mitgliedsbeitrag für OECD		3,062	20	0,612	2,702	20	0,540	2,887	20	0,577
10010100	7800	102	OECD-Energieagentur (Mitgliedsbeitrag)		0,240	20	0,048	0,240	20	0,048	0,019	20	0,004
10010100	7800	103	OECD-Beiträge zu Sonderprojekten		0,010	20	0,002	0,010	20	0,002			
10010100	7800	110	Mitgliedsbeitrag AV-Infostelle		0,029	5	0,001	0,029	5	0,001	0,030	5	0,002
10010200	7800	100	Mitgliedsbeiträge an Institutionen im Ausland		0,006	30	0,002	0,006	30	0,002	0,006	30	0,002
			Summe UG10		**3,531**		**0,849**	**3,171**		**0,777**	**3,124**		**0,767**
			Summe Bundeskanzleramt		**3,531**		**0,849**	**3,171**		**0,777**	**3,124**		**0,767**
			BM für Europa, Integration und Äußeres										
			UG12										
12020200	7840	000	Internationale Atomenergie-Organisation (IAEO)		3,200	35	1,120	3,200	35	1,120	3,284	35	1,149
12020200	7840	002	Organisation der VN für industr.Entwicklung(UNIDO)		0,850	46	0,391	0,695	46	0,320	0,881	46	0,405
12020200	7840	003	Org. VN Erziehung,Wissensch.u.Kultur(UNESCO)		2,350	30	0,705	2,350	30	0,705	0,982	30	0,295
12020200	7840	030	Inst. der VN für Ausbildung und Forschung (UNITAR)		0,020	40	0,008	0,020	40	0,008	0,015	40	0,006
12020200	7840	054	Beitrag zum Budget des EUREKA-Sekretariates		0,001	52	0,001	0,001	52	0,001			
12020200	7840	056	Drogenkontrollprogramm der VN (UNDCP)		0,400	20	0,080	0,400	20	0,080	0,470	20	0,094
			Summe UG12		**6,821**		**2,305**	**6,666**		**2,234**	**5,632**		**1,949**
			Summe BM für Europa, Integration und Äußeres		**6,821**		**2,305**	**6,666**		**2,234**	**5,632**		**1,949**
			BM für Arbeit, Soziales und Konsumentenschutz										
			UG21										
21010100	7800	030	Europarat - Teilabkommen										
			Summe UG21										
			Summe BM für Arbeit, Soziales und Konsumentenschutz										
			BM für Gesundheit										
			UG24										
24010100	7800	000	Laufende Transferzahlungen an das Ausland		0,365	50	0,183	0,365	50	0,183	0,279	50	0,140
24010100	7800	040	Europ. Maul- u. Klauenseuchenkommission		0,012	50	0,006	0,012	50	0,006	0,010	50	0,005
24010100	7800	043	Europarat Teilabkommen		0,010	20	0,002	0,010	20	0,002	0,011	20	0,002
24010100	7840	082	Internat. Tierseuchenamt		0,130	50	0,065	0,130	50	0,065	0,119	50	0,060
24010100	7840	083	Weltgesundheitsorganisation		3,370	30	1,011	3,370	30	1,011	2,956	30	0,887
			Summe UG24		**3,887**		**1,267**	**3,887**		**1,267**	**3,375**		**1,094**
			Summe BM für Gesundheit		**3,887**		**1,267**	**3,887**		**1,267**	**3,375**		**1,094**

			BM für Bildung und Frauen										
			UG30										
30010300	7800	104	OECD-Schulbauprogramm		0,031	100	0,031	0,031	100	0,031	0,023	100	0,023
			Summe UG30		**0,031**		**0,031**	**0,031**		**0,031**	**0,023**		**0,023**
			Summe BM für Bildung und Frauen		**0,031**		**0,031**	**0,031**		**0,031**	**0,023**		**0,023**
			BM für Wissenschaft, Forschung und Wirtschaft										
			UG31										
31030100	7800	000	Laufende Transferzahlungen an das Ausland		0,500	100	0,500	0,400	100	0,400	0,403	100	0,403
31030100	7800	066	Forschungsvorhaben in internationaler Kooperation		1,701	100	1,701	1,940	100	1,940	0,799	100	0,799
31030100	7800	105	OECD-CERI-Mitgliedsbeitrag			100			100			100	
31030100	7800	200	Beiträge an internationale Organisationen		1,290	50	0,645	1,260	50	0,630	1,033	50	0,517
31030204	7260	000	Mitgliedsbeiträge an Institutionen im Inland										
31030204	7270	032	Verpflichtungen aus internationalen Abkommen										
31030204	7800	062	ESO		6,184	100	6,184	5,900	100	5,900	5,735	100	5,735
31030204	7800	063	Europ. Zentrum für mittelfristige Wettervorhersage		1,150	100	1,150	1,100	100	1,100	1,030	100	1,030
31030204	7800	064	Molekularbiologie - Europäische Zusammenarbeit		2,899	100	2,899	2,713	100	2,713	2,521	100	2,521
31030204	7800	065	World Meteorological Organisation		0,630	50	0,315	0,620	50	0,310	0,443	50	0,222
31030204	7800	200	Beiträge an internationale Organisationen		0,770	50	0,385	0,770	50	0,385	0,768	50	0,384
31030204	7800	242	Beitrag für die CERN		20,340	100	20,340	20,340	100	20,340	19,592	100	19,592
			Summe UG31		**35,464**		**34,119**	**35,043**		**33,718**	**32,324**		**31,203**
			UG40										
40020100	7800	100	Mitgliedsbeiträge an Institutionen im Ausland		1,000	16	0,160	1,000	16	0,160	0,898	16	0,144
			Summe UG40		**1,000**		**0,160**	**1,000**		**0,160**	**0,898**		**0,144**
			Summe BM für Wissenschaft, Forschung und Wirtschaft		**36,464**		**34,279**	**36,043**		**33,878**	**33,222**		**31,347**
			BM für Verkehr, Innovation und Technologie										
			UG34										
34010100	7800	200	Beiträge an internationale Organisationen		0,022	100	0,022	0,022	100	0,022	0,023	100	0,023
34010100	7800	600	ESA-Pflichtprogramme		17,400	100	17,400	17,400	100	17,400	17,541	100	17,541
34010100	7800	601	EUMETSAT		5,350	100	5,350	5,350	100	5,350	3,876	100	3,876
34010100	7800	602	OECD-Energieagentur		0,069	100	0,069	0,069	100	0,069	0,070	100	0,070
34010100	7800	603	ESA-Wahlprogramme		36,223	100	36,223	35,623	100	35,623	32,553	100	32,553
34010100	7830	000	Laufende Transfers an Drittländer		0,080	100	0,080	0,080	100	0,080	0,082	100	0,082
			Summe UG34		**59,144**		**59,144**	**58,544**		**58,544**	**54,145**		**54,145**
			UG41										
41010100	7800	200	Beiträge an internationale Organisationen	*	0,180	6	0,011	0,180	6	0,011	0,117	6	0,007
41020100	7800	200	Beiträge an internationale Organisationen	*	0,021	100	0,021	0,021	100	0,021			
41020402	7800	200	Beiträge an internationale Organisationen		0,060	15	0,009	0,060	15	0,009	0,046	15	0,007
41020500	7800	200	Beiträge an internationale Organisationen		0,020	15	0,003	0,020	15	0,003	0,034	15	0,005
41020500	7830	000	Laufende Transfers an Drittländer		0,442	15	0,066	0,442	15	0,066	0,410	15	0,062
41020601	7800	200	Beiträge an internationale Organisationen		0,050	50	0,025	0,050	50	0,025	0,004	50	0,002
41020700	7800	200	Beiträge an internationale Organisationen	*	0,530	20	0,106	0,530	20	0,106	0,526	20	0,105
			Summe UG41		**1,303**		**0,241**	**1,303**		**0,241**	**1,137**		**0,188**

			Summe BM für Verkehr, Innovation und Technologie		**60,447**		**59,385**	**59,847**		**58,785**	**55,282**		**54,333**
			BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft										
			UG42										
42010100	7800	100	Mitgliedsbeiträge an Institutionen im Ausland	*	0,005	50	0,003	0,005	50	0,003	0,065	50	0,033
42020202	7800	080	FAO-Beiträge		3,130	50	1,565	3,130	50	1,565	3,209	50	1,605
42020202	7800	081	FAO Welternährungsprogramm, Beiträge		0,350	50	0,175	0,350	50	0,175	0,213	50	0,107
			Summe UG42		**3,485**		**1,743**	**3,485**		**1,743**	**3,487**		**1,745**
			UG43										
43010500	7800	000	Laufende Transferzahlungen an das Ausland	*	0,043	50	0,022	0,043	50	0,022	0,043	50	0,022
43010500	7800	090	ECE-EMEP-Konvention/Grenzüberschr. Luftverunrein.		0,031	100	0,031	0,031	100	0,031	0,031	100	0,031
43010500	7800	091	Umweltfonds der Vereinten Nationen		0,400	30	0,120	0,400	30	0,120	0,399	30	0,120
			Summe UG43		**0,474**		**0,173**	**0,474**		**0,173**	**0,473**		**0,173**
			Summe BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft		**3,959**		**1,916**	**3,959**		**1,916**	**3,960**		**1,918**
			Teil a -Summe		**115,140**		**100,032**	**113,604**		**98,888**	**104,618**		**91,431**

b) Bundesbudget Forschung - Finanzierungsvoranschlag (ausgen. die bereits im Abschnitt a) ausgewiesen sind)

VA-Stelle	Konto	Ugl	Bezeichnung	Anm	Finanzierungsvoranschlag 2015			Finanzierungsvoranschlag 2014			Erfolg 2013		
					Insgesamt	hievon		Insgesamt	hievon		Insgesamt	hievon	
						%	Forschung		%	Forschung		%	Forschung
			Parlamentsdirektion										
			UG02										
02010500	7330	086	Nationalfonds für Opfer des Nationalsozialismus		3,500	11	0,385	3,500	11	0,385	3,500	23	0,792
			Summe UG02		**3,500**		**0,385**	**3,500**		**0,385**	**3,500**		**0,792**
			Summe Parlamentsdirektion		**3,500**		**0,385**	**3,500**		**0,385**	**3,500**		**0,792**
			Bundeskanzleramt										
			UG10										
10010100	7260	000	Mitgliedsbeiträge an Institutionen im Inland		0,658	50	0,329	0,658	50	0,329	0,453	50	0,227
10010100	7270	000	Werkleistungen durch Dritte		4,094	4	0,164	4,040	4	0,162	3,656	4	0,146
100102			Zentralstelle		2,109	100	2,109	1,698	100	1,698	0,066	100	0,066
10010200	7260	000	Mitgliedsbeiträge an Institutionen im Inland		0,002	50	0,001	0,002	50	0,001		50	
10010200	7270	000	Werkleistungen durch Dritte		4,626	4	0,185	4,640	4	0,186	4,446	4	0,178
10010401	7340	001	Pauschalabgeltung gem. § 32 Abs.5 BStatG		50,589	1	0,506	43,391	1	0,434	50,391	1	0,504
10010402			Österr. Staatsarchiv		14,282	2	0,286	12,935	2	0,259	13,153	2	0,263
			Summe UG10		**76,360**		**3,580**	**67,364**		**3,069**	**72,165**		**1,384**
			UG32										
32020300			Denkmalschutz		34,843	18	6,272	28,786	18	5,181			
32030100			Bundesmuseen		122,932	23	28,274	102,952	23	23,679			
			Summe UG32		**157,775**		**34,546**	**131,738**		**28,860**			
			Summe Bundeskanzleramt		**234,135**		**38,126**	**199,102**		**31,929**	**72,165**		**1,384**
			BM für Inneres										
			UG11										
11020600			Bundeskriminalamt	*	13,332	8	1,067	13,332	8	1,067	10,152	8	0,812
			Summe UG11		**13,332**		**1,067**	**13,332**		**1,067**	**10,152**		**0,812**
			Summe BM für Inneres		**13,332**		**1,067**	**13,332**		**1,067**	**10,152**		**0,812**
			BM für Justiz										
			UG13										
13010200	7667	002	Institut für Rechts- und Kriminalsoziologie		0,130	100	0,130	0,130	100	0,130			
			Summe UG13		**0,130**		**0,130**	**0,130**		**0,130**			
			Summe BM für Justiz		**0,130**		**0,130**	**0,130**		**0,130**			
			BM für Landesverteidigung und Sport										
			UG14										
14010100	4691	000	Versuche und Erprobungen auf kriegstechn. Gebiet		0,035	10	0,004	0,035	10	0,004			
14010202			Heeresgeschichtliches Museum		6,280	20	1,256	5,840	20	1,168	5,824	20	1,165
14020100	4691	000	Versuche und Erprobungen auf kriegstechn. Gebiet		0,070	10	0,007	0,020	10	0,002	0,589	10	0,059
			Summe UG14		**6,385**		**1,267**	**5,895**		**1,174**	**6,413**		**1,224**
			Summe BM für Landesverteidigung und Sport		**6,385**		**1,267**	**5,895**		**1,174**	**6,413**		**1,224**
			BM für Finanzen										
			UG15										
15010100	6430	001	Arbeiten des WIIW		0,750	50	0,375	0,900	50	0,450	1,000	50	0,500
15010100	6430	002	Arbeiten des WSR		1,439	50	0,720	1,235	50	0,618	1,307	50	0,654
15010100	6430	003	Arbeiten des Wifo		3,925	50	1,963	3,850	50	1,925	3,775	50	1,888
15010100	7661	002	Institut für Finanzwissenschaft und Steuerrecht		0,014	50	0,007	0,014	50	0,007	0,012	50	0,006
15010100	7662	002	Institut für höhere Studien und wiss. Forschung		3,523	50	1,762	3,387	50	1,694	3,257	50	1,629
15010100	7663	005	Forum Alpbach					0,001	50	0,001	0,030		

			Forschungswirksamer Lohnnebenkostenanteil		29,523	100	29,523	29,529	100	29,529	25,798	100	25,798
			Summe UG15		**39,174**		**34,350**	**38,916**		**34,224**	**35,179**		**30,475**
			Summe BM für Finanzen		**39,174**		**34,350**	**38,916**		**34,224**	**35,179**		**30,475**
			BM für Arbeit, Soziales und Konsumentenschutz										
			UG20										
20010201	7270	000	Werkleistungen durch Dritte										
20010201	7270	006	Werkleistungen durch Dritte (zw)		360,329	1	3,603	364,716	1	3,647	388,124	1	3,881
			Summe UG20		**360,329**		**3,603**	**364,716**		**3,647**	**388,124**		**3,881**
			UG21										
21010100	7270	000	Werkleistungen durch Dritte		2,104	5	0,105	4,875	5	0,244	1,980	5	0,099
21010100	7669	900	Zuschüsse für lfd.Aufwand an private Institutionen		0,001	100	0,001	0,001	100	0,001			
21010300	7270	000	Werkleistungen durch Dritte		1,080	16	0,173	1,080	16	0,173	1,005	16	0,161
21010300	7660	900	Zuschüsse f. lfd. Aufwand an private Institutionen		2,000	2	0,040	2,200	2	0,044	2,709	2	0,054
21010400	7262	001	Beitrag Europ. Zentrum Wohlfahrtspol.u.Sozialfor.		0,618	50	0,309	0,618	50	0,309	0,618	50	0,309
21010400	7270	000	Werkleistungen durch Dritte		2,247	7	0,157	2,249	7	0,157	1,531	7	0,107
21010400	7270	304	Werkleistungen EU-SILC		1,074	100	1,074	1,074	100	1,074	1,059	100	1,059
21040100	7261	001	Mitgliedsb. an Forschungsinst. Orthopädie-Technik			100			100		0,184	100	0,184
			Summe UG21		**9,124**		**1,859**	**12,097**		**2,002**	**9,086**		**1,973**
			Summe BM für Arbeit, Soziales und Konsumentenschutz		**369,453**		**5,462**	**376,813**		**5,649**	**397,210**		**5,854**
			BM für Gesundheit										
			UG24										
24010100			Zentralstelle		0,974	100	0,974	1,006	100	1,006	0,994	100	0,994
24010200	0806	001	Ernährungsagentur (Ges.m.b.H)		0,001	8		0,001	8			8	
24010200	7420	012	Transferzahlungen, Ernährungsagentur (Ges.m.b.H)		52,503	8	4,200	52,503	8	4,200	52,503	8	4,200
24030100	7270	000	Werkleistungen durch Dritte		1,935	2	0,039	2,434	2	0,049	2,491	2	0,050
24030100	7660	900	Zuschüsse f. lfd. Aufwand an private Institutionen	*	5,703	6	0,342	6,203	6	0,372	7,756	6	0,465
24030200	7270	000	Werkleistungen durch Dritte		4,411	11	0,485	4,411	11	0,485	5,332	11	0,587
			Summe UG24		**65,527**		**6,040**	**66,558**		**6,112**	**69,076**		**6,296**
			Summe BM für Gesundheit		**65,527**		**6,040**	**66,558**		**6,112**	**69,076**		**6,296**
			BM für Familien und Jugend										
			UG25										
25010500	7270	006	Werkleistungen durch Dritte (zw)		0,800	39	0,312	0,800	39	0,312	0,753	39	0,294
25010500	7420	013	Familie und Beruf Management GesmbH.										
25010500	7420	113	Familie und Beruf Management GesmbH.		2,140	33	0,706	2,140	33	0,706	2,137	33	0,705
25010500	7664	007	Forschungsförderung gem. § 39i FLAG 1967 (zw)		0,250	100	0,250	0,250	100	0,250	0,010	100	0,010
25020100	7270	000	Werkleistungen durch Dritte		0,991	20	0,198	0,991	20	0,198	1,706	20	0,341
25020200	7270	000	Werkleistungen durch Dritte		1,882	10	0,188	1,882	10	0,188	1,499	10	0,150
			Summe UG25		**6,063**		**1,654**	**6,063**		**1,654**	**6,105**		**1,500**
			Summe BM für Familien und Jugend		**6,063**		**1,654**	**6,063**		**1,654**	**6,105**		**1,500**
			BM für Bildung und Frauen										
			UG30										
30010100			Zentralstelle	*				0,338	100	0,338	1,866	100	1,866
30010400			Qualitätsentwicklung und -steuerung	*	33,384	8	2,671	33,384	8	2,671	34,896	8	2,792
30010400	7340	000	Transferzahlungen an sonst. Träger öffentl.Rechtes		5,130	100	5,130	6,982	100	6,982	7,700	100	7,700
30010400	7340	003	Basisabgeltung (BIFIE)		13,000	80	10,400	13,000	80	10,400	11,917	80	9,534
30010500			Lehrer/innenbildung		213,379	10	21,338	215,563	10	21,556	206,170	10	20,617
30010700	7669	400	Bildm.d.EU (ESF-3 nat.A) (F&E-Offensivprogramm)			100			100			100	

30020500			Berufsbildende mittlere und höhere Schulen								559,563		0,319
30020700			Zweckgebundene Gebarung Bundesschulen		23,558	3	0,707	23,558	3	0,707	30,498	3	0,915
30030300			Denkmalschutz					5,757	18	1,036	33,425	18	6,017
30040100			Bundesmuseen und Österreichische Nationalbibliothek	*		23		21,604	23	4,969	120,185	23	27,643
			Summe UG30		**288,451**		**40,246**	**320,186**		**48,659**	**1.006,220**		**77,403**
			Summe BM für Bildung und Frauen		**288,451**		**40,246**	**320,186**		**48,659**	**1.006,220**		**77,403**
			BM für Wissenschaft, Forschung und Wirtschaft										
			UG31										
31010100			Zentralstelle und Serviceeinrichtungen		53,991	20	10,798	53,387	20	10,677	49,097	20	9,819
31010100	7686	007	Vortragstätigkeit im Ausland										
31020100			Universitäten		3.030,486	48	1.454,633	3.005,019	48	1.442,409	2.943,973	48	1.413,107
31020100	7270	000	Werkleistungen durch Dritte		0,300	48	0,144	0,300	48	0,144	0,080	48	0,038
31020100	7342	900	Universitäten - F&E-Mittel			100			100		0,895	100	0,895
31020100	7353	440	Klinischer Mehraufwand (Klinikbauten)		48,642	50	24,321	61,549	50	30,775	31,101	50	15,551
31020100	7480	403	VOEST-Alpine Medizintechnik Ges.m.b.H. (VAMED)		0,001	50	0,001	0,001	50	0,001		50	
31020200			Fachhochschulen		264,940	15	39,741	255,420	15	38,313	245,826	15	36,874
31020300	7270	900	Werkleistungen durch Dritte		2,439	22	0,537	2,539	22	0,559	2,662	22	0,586
31030100			Projekte und Programme	*	14,371	100	14,371	13,614	100	13,614	13,131	100	13,131
31030100	7260	000	Mitgliedsbeiträge an Institutionen im Inland		0,001	100	0,001	0,001	100	0,001		100	
31030100	7270	031	Med Austron		5,500	100	5,500	13,279	100	13,279	5,366	100	5,366
31030100	7270	034	Ersatzmethoden zum Tierversuch		0,395	100	0,395	0,380	100	0,380	0,091	100	0,091
31030100	7270	900	Werkleistungen durch Dritte		6,832	100	6,832	6,584	100	6,584	4,796	100	4,796
31030100	7662	311	Institut für höhere Studien und wiss. Forschung		0,270	100	0,270	0,270	100	0,270		100	
31030100	7665	007	Stiftung Dokumentationsarchiv		0,180	100	0,180	0,180	100	0,180	0,180	100	0,180
31030100	7679	120	Lfd. Transfers an sonstige juristische Personen		24,807	100	24,807	24,151	100	24,151	14,217	100	14,217
31030201			Zentralanstalt für Meteorologie und Geodynamik		23,637	37	8,746	20,705	37	7,661	19,804	37	7,327
31030202			Geologische Bundesanstalt		10,915	47	5,130	10,349	47	4,864	9,978	47	4,690
31030203			Wissenschaftliche Anstalten		5,526	52	2,874	4,712	52	2,450	4,578	52	2,381
31030204			Forschungsinstitutionen		7,184	100	7,184	6,851	100	6,851	4,132	100	4,132
31030204	7332	352	FWF Programme		190,200	100	190,200	184,600	100	184,600	158,993	100	158,993
31030204	7332	452	FWF Geschäftsstelle		9,800	100	9,800	9,400	100	9,400	8,290	100	8,290
31030204	7340	004	ISTA		54,500	100	54,500	47,800	100	47,800	31,447	100	31,447
31030204	7340	006	ÖAW Globalbudget		80,200	100	80,200	76,200	100	76,200	83,505	100	83,505
31030204	7340	010	ÖAW Beauftragungen und Programme		15,000	100	15,000	14,900	100	14,900	14,045	100	14,045
31030204	7661	022	Ludwig-Boltzmann-Gesellschaft		9,702	100	9,702	6,702	100	6,702	8,702	100	8,702
31030204	7679	007	Verein der Freunde der Salzburger Stiftung		1,000	100	1,000	1,000	100	1,000	1,000	100	1,000
31030204	7679	008	Inst. für die Wissenschaften vom Menschen		0,506	100	0,506	0,506	100	0,506	0,506	100	0,506
			Summe UG31		**3.861,325**		**1.967,373**	**3.820,399**		**1.944,271**	**3.656,395**		**1.839,669**
			UG33										
33010100			Kooperation Wissenschaft-Wirtschaft		45,000	100	45,000	45,000	100	45,000	30,555	100	30,555
33010200			Innovation, Technologietransfer		39,600	100	39,600	39,600	100	39,600	48,407	100	48,407
33010300			Gründung innovativer Unternehmen		17,000	100	17,000	17,000	100	17,000	20,559	100	20,559
			Summe UG33		**101,600**		**101,600**	**101,600**		**101,600**	**99,521**		**99,521**
			UG40										
40020100	7270	000	Werkleistungen durch Dritte		5,770	7	0,404	5,770	7	0,404	3,660	16	0,600
40020100	7660	900	Zuschüsse f. lfd. Aufwand an private Institutionen		0,375	10	0,038	0,375	10	0,038			

40030100			Eich- und Vermessungswesen		83,558		0,200	82,076		0,200	83,190		0,200
			Summe UG40		**89,703**		**0,642**	**88,221**		**0,642**	**86,850**		**0,800**
			Summe BM für Wissenschaft, Forschung und Wirtschaft		**4.052,628**		**2.069,615**	**4.010,220**		**2.046,513**	**3.842,766**		**1.939,990**
			BM für Verkehr, Innovation und Technologie										
			UG34										
34010200	0801	122	Österreichische Forschungsförderungs GmbH, Wien		0,001	100	0,001	0,001	100	0,001		100	
34010200	0801	123	Austria Wirtschaftsservice GmbH, Wien		0,001	100	0,001	0,001	100	0,001	0,001	100	0,001
34010200	0801	360	AustriaTech-Ges.d.Bds. F. techn.polit. Maßn.mbH, W		0,001	100	0,001	0,001	100	0,001		100	
34010200	0806	122	Forschungsförderungs GmbH										
34010200	0806	123	Austria Wirtschaftsservice GmbH										
34010200	0806	360	Industrie u.Gewerbe (einschl. Bergbau)(Ges.m.b.H.)										
34010200	7273	000	Rat für Forschung und Technologieentwicklung										
34010200	7340	100	Rat f. Forschung und Technologieentwicklung		1,800	100	1,800	1,800	100	1,800	1,800	100	1,800
34010200	7413	001	Austrian Institute of Technology AIT-Förderungen		0,100	100	0,100	0,100	100	0,100	0,021	100	0,021
34010200	7413	002	Austrian Institute of Technology AIT		51,158	90	46,042	50,026	90	45,023	45,080	90	40,572
34010200	7413	003	Nuclear Engineering Seibersdorf NES		8,850	30	2,655	8,570	30	2,571	6,172	30	1,852
34010200	7414	001	Austria Tech - Förderungen		0,001	100	0,001	0,001	100	0,001		100	
34010200	7414	002	Austria Tech		2,300	100	2,300	2,300	100	2,300	1,531	100	1,531
34010200	7420	016	Lfd.Transferzahl.a.Untern.m.Bundes bet.(Techn.mill)										
34010200	7420	025	Austria Tech										
34010200	7422	004	AIT-Austrian Institute of Technology										
34010200	7422	005	Nukleare Dienste (NES)										
34010200	7430	000	Lfd. Transfers an übrige Sektoren der Wirtschaft		0,001	100	0,001	0,001	100	0,001		100	
34010200	7660	075	F&T-Förderung		0,600	100	0,600	0,600	100	0,600	0,257	100	0,257
34010200	7661	030	Österreichische Computergesellschaft		0,090	100	0,090	0,090	100	0,090	0,083	100	0,083
34010200	7662	340	Joanneum ResearchForschungsgesellschaft m.b.H.										
34010200	7662	341	Joanneum Research Forsch.ges.m.b.H(Techn.schwerp)		2,350	100	2,350	2,350	100	2,350	2,346	100	2,346
34010200	7663	104	Gesellschaft für Mikroelektronik		0,035	100	0,035	0,035	100	0,035	0,031	100	0,031
34010200	7666	005	Österreichisches Institut für Nachhaltigkeit		0,035	100	0,035	0,035	100	0,035	0,035	100	0,035
34010200	7667	006	Sonstige gemeinnützige Einrichtungen		0,845	100	0,845	0,745	100	0,745	1,344	100	1,344
34010200	7668	040	Salzburg Research		0,320	100	0,320	0,320	100	0,320	0,427	100	0,427
34010200	7668	050	Profactor		0,500	100	0,500	0,500	100	0,500			
34010200	7690	002	Preisverleihungen		0,018	100	0,018	0,018	100	0,018	0,011	100	0,011
34010300	7260	000	Mitgliedsbeiträge an Institutionen im Inland		0,020	100	0,020	0,020	100	0,020	0,006	100	0,006
34010300	7270	000	Werkleistungen durch Dritte		6,500	100	6,500	6,500	100	6,500	3,239	100	3,239
34010300	7280	030	FTI-Projekte, Beauftragungen an Dritte		3,407	100	3,407	3,407	100	3,407	1,892	100	1,892
34010300	7280	900	Werkleistungen (durch Dritte)(F&E Offensive)										
34010300	7330	352	Translational research (F&E)		3,500	100	3,500	3,500	100	3,500	4,611	100	4,611
34010300	7330	552	Fond z. Förd. wiss. Forsch. (F&E Offensive)										
34010300	7330	652	Fonds wissensch./Programmabw.		0,200	100	0,200	0,200	100	0,200	0,202	100	0,202
34010300	7330	661	ERP-Fonds (F&E-Offensive)										

34010300	7411	001	FFG - Basisprogramme		122,130	100	122,130	122,130	100	122,130	125,000	100	125,000
34010300	7411	002	FFG - FTI-Programme, Förderungen		126,888	100	126,888	124,000	100	124,000	99,382	100	99,382
34010300	7411	003	FFG - FTI-Programme (F&E-Dienstleist.,Sonst.WV)		15,000	100	15,000	15,000	100	15,000	9,975	100	9,975
34010300	7411	004	FFG - Administrative Kosten		12,500	100	12,500	12,500	100	12,500	10,845	100	10,845
34010300	7412	001	Austria Wirtschaftsservice GmbH AWS - Förderungen		4,998	100	4,998	4,998	100	4,998			
34010300	7412	002	Austria Wirtschaftsservice GmbH AWS		0,001	100	0,001	0,001	100	0,001		100	
34010300	7412	003	Austria Wirtschaftsservice GmbH AWS - Admin.Kost.		0,001	100	0,001	0,001	100	0,001	0,204	100	0,204
34010300	7420	900	Zahlungen an Untern. m. Bundesbet. (F&E-Offensive)										
34010300	7425	010	AWS										
34010300	7425	011	AWS - Administrative Kosten										
34010300	7425	012	AWS - Programmabwicklung										
34010300	7425	020	Forschungsförderungs GmbH										
34010300	7425	021	Leistungen der FFG (F&E)										
34010300	7425	022	FFG - Administrative Kosten										
34010300	7425	900	FFG - Programmabwicklung (F&E)										
34010300	7430	900	Forschung und Entwicklung (F&E-Offensive)										
34010300	7432	030	FTI-Projekte, Förderungen		2,000	100	2,000	2,000	100	2,000	0,496	100	0,496
34010300	7432	900	Lfd.Transfz.a.d.übr.Sektoren d. Wirtsch.(F&E Off.)										
34010300	7480	001	Forschungsschwerpunkte (Unternehmungen)										
34010300	7480	002	Technologieschwerpunkte (Unternehmungen)		3,000	100	3,000	3,000	100	3,000		100	
34010300	7680	030	FTI-Projekte, Förderungen an phys. Pers.		0,001	100	0,001	0,001	100	0,001	0,020	100	0,020
34010300	7680	900	Sonst.Zuw. ohne Gegenleistung an physische Pers.										
34010300	7830	000	Laufende Transfers an Drittländer		0,001	100	0,001	0,001	100	0,001			
			Summe UG34		**369,153**		**357,842**	**364,753**		**353,751**	**315,011**		**306,183**
			UG41										
41010200	7330	080	Transferzahlungen an Klima- und Energiefonds		65,000	39	25,350	50,000	39	19,500	81,031	39	31,602
41020100	7270	000	Werkleistungen durch Dritte		1,765	80	1,412	1,450	80	1,160	1,056	80	0,845
41020100	7270	800	Elektromobilität		0,200	80	0,160	0,200	80	0,160	0,008	80	0,006
41020100	7411	002	FFG - FTI-Programme, Förderungen		2,500	100	2,500	2,500	100	2,500	0,432	100	0,432
41020100	7411	003	FFG - FTI-Programme (F&E-Dienstleist.,Sonst.WV)		0,600	100	0,600	0,600	100	0,600		100	
41020100	7411	004	FFG - Administrative Kosten		0,200	100	0,200	0,200	100	0,200		100	
41020100	7420	000	Lfd. Transfers an Unternehm. m. Bundesbeteiligung		0,001	80	0,001	0,001	80	0,001		80	
41020100	7480	501	Progr.Kombinierter Güterverk.Straße-Schiene-Schiff		3,000	50	1,500	3,000	50	1,500	1,578	50	0,789
41020100	7481	800	Technologieprogramme allgemein (sonst. Anlagen)		0,045	80	0,036	0,045	80	0,036	0,016	80	0,013
41020100	7660	000	Zuschüsse f. lfd. Aufwand an private Institutionen		0,544	95	0,517	0,544	95	0,517	0,030	95	0,029
41020200	7270	000	Werkleistungen durch Dritte		0,636	100	0,636	0,636	100	0,636		100	
41020200	7270	118	Eisenbahnspezifische Angelegenheiten										
41020200	7270	800	Elektromobilität										
41020300	7270	000	Werkleistungen durch Dritte		0,084	80	0,067	0,084	80	0,067	0,137	80	0,110
41020300	7411	002	FFG - FTI-Programme, Förderungen		0,001	50	0,001	0,001	50	0,001	0,884	50	0,442
41020300	7411	003	FFG - FTI-Programme (F&E-Dienstleist.,Sonst.WV)		0,001	100	0,001	0,001	100	0,001		100	
41020300	7411	004	FFG - Administrative Kosten		0,001	50	0,001	0,001	50	0,001	0,187	50	0,094
41020300	7489	001	Breitbandinitiative (admin. Aufwand)		0,001	50	0,001	0,001	50	0,001	0,001	50	0,001
41020300	7489	002	Breitband - Förderungen		0,001	50	0,001	0,001	50	0,001	0,354	50	0,177

41020402	7270	000	Werkleistungen durch Dritte		1,050	5	0,053	1,050	5	0,053	0,458	5	0,023
41020402	7270	006	Werkleistungen durch Dritte (zw)		0,995	5	0,050	0,995	5	0,050	2,942	5	0,147
41020500	7270	116	Spezifische Luftfahrtangelegenheiten										
			Summe UG41		**76,625**		**33,087**	**61,310**		**26,985**	**89,114**		**34,710**
			Summe BM für Verkehr, Innovation und Technologie		**445,778**		**390,929**	**426,063**		**380,736**	**404,125**		**340,893**
			BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft										
			UG42										
42010100			Zentralstelle	*	1,051	100	1,051	1,001	100	1,001	0,953	100	0,953
42010200	7411	000	Lfd Transfers an verbundene Unternehmungen		66,303	19	12,598	65,303	19	12,408	62,185	19	11,815
42020300			Forschung und Sonstige Maßnahmen	*	2,013	90	1,812	6,300	90	5,670	4,200	90	3,780
42020300	7660	000	Zuschüsse f. lfd. Aufwand an private Institutionen		0,010	50	0,005	0,010	50	0,005	0,010	50	0,005
42020401			Landwirtschaftliche Schulen	*	43,342	21	9,102	70,466	21	14,798	68,320	21	14,347
42020402			Landiwrtschaftliche Hochschule		4,370	3	0,131	4,180	3	0,125	3,595	3	0,108
42020403			Landwirtschaftliche Bundesanstalten		2,900	68	1,972	2,800	68	1,904	2,703	68	1,838
42020405			Bundesanstalt f. alpenländ. Milchwirtschaft Rotholz		4,182	1	0,042	4,036	1	0,040	4,056	1	0,041
42020501			HBLA für Wein- und Obstbau Klosterneuburg	*	9,305	46	4,280	11,151	46	5,129	10,315	46	4,745
42020502			Bundesamt für Weinbau		4,900	9	0,441	4,750	9	0,428	4,698	9	0,423
42030101	7270	000	Werkleistungen durch Dritte		0,540	30	0,162	0,540	30	0,162	2,837	30	0,851
42030101	7700	003	Erosion (Rutschungen und Steinschläge) (zw)		7,000	10	0,700	7,000	10	0,700	5,275	10	0,528
42030104			Forschung und Sonstige Maßnahmen Forst	*	1,376	90	1,238	1,376	90	1,238	1,436	90	1,292
42030204			Planung, Forschung und Sonstige Maßnahmen		0,673	90	0,606	0,673	90	0,606	0,393	90	0,354
42030204	7270	000	Werkleistungen durch Dritte		1,127	90	1,014	1,227	90	1,104	1,371	90	1,234
42030205			Bundesamt für Wasserwirtschaft		5,000	38	1,900	5,200	38	1,976	4,911	38	1,866
			Summe UG42		**154,092**		**37,054**	**186,013**		**47,294**	**177,258**		**44,180**
			UG43										
43010200	7700	500	Investitionszuschüsse		48,868	1	0,489	49,154	1	0,492	57,640	1	0,576
43010300			Klima- und Energiefonds		49,167	39	19,175	50,000	39	19,500	84,381	39	32,909
43010500			Nachhaltiger Natur- und Umweltschutz		26,438	25	6,610	26,438	25	6,610	26,438	25	6,610
43010500	7420	021	Transferzahlungen an die UBA Ges.m.b.H		14,956	3	0,449	14,956	3	0,449	14,956	3	0,449
43010600			Strahlenschutz		18,500	7	1,295	18,056	7	1,264	15,902	7	1,113
43020200	7700	500	Investitionszuschüsse		34,600	1	0,346	10,489	1	0,105	43,944	1	0,439
43020300	7700	251	Investitionsförderungen (zw)		334,547	1	3,345	346,967	1	3,470	338,699	1	3,387
			Summe UG43		**527,076**		**31,709**	**516,060**		**31,890**	**581,960**		**45,483**
			Summe BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft		**681,168**		**68,763**	**702,073**		**79,184**	**759,218**		**89,663**
			Teil b -Summe		**6.205,724**		**2.658,034**	**6.168,851**		**2.637,416**	**6.612,129**		**2.496,286**
			Gesamtsumme Teil a + b		**6.320,864**		**2.758,066**	**6.282,455**		**2.736,304**	**6.716,747**		**2.587,717**

BUNDESVORANSCHLAG 2015

Beilage T: Forschungswirksame Ausgaben des Bundes

Anmerkungen

Allgemeine Anmerkungen

*) F& E Koeffizienten geschätzt

Die Beilage T ist aufgegliedert nach:

a) Beitragszahlungen aus Bundesmitteln an internationale Organisationen, die Forschung und Forschungsförderung (mit) als Ziel haben,

b) Bundesbudget-Forschung - Finanzierungsvorschlag (ausgen. die bereits im Abschnitt a) ausgewiesen sind)

Für die Aufstellung dieser Ausgaben ist in erster Linie der Gesichtspunkt der Forschungswirksamkeit maßgebend, der inhaltlich über den Aufgabenbereich 99 "Grundlagen-, angewandte Forschung und experimentelle Entwicklung" hinausgeht und auf dem Forschungsbegriff des Fascati-Handbuches der OECD beruht, wie er im Rahmen der forschungsstatistischen Erhebungen der STATISTIK AUSTRIA zur Anwendung gelangt.

Forschungswirksame Anteile bei den Bundesausgaben finden sich daher nicht nur bei den Ausgaben des Aufgabenbereiches 99 "Grundlagen-, angewandte Forschung und experimentelle Entwicklung" sondern auch in zahlreichen anderen Aufgabenbereichen.

Finanzierungsvoranschlag

VA-Stelle	Konto	Ugl	Anmerkung
			BM für Inneres
11020600			* Teilbetrag
			BM für Gesundheit
24030100	7660	900	Teilbetrag der Voranschlagsstelle
			BM für Bildung und Frauen
30010100			Teilbetrag der Voranschlagsstelle
30010400			Teilbetrag der Voranschlagsstelle
30040100			Teilbetrag der Voranschlagsstelle
			BM für Wissenschaft, Forschung und Wirtschaft
31030100			
			BM für Verkehr, Innovation und Technologie
41010100	7800	200	Teilbetrag des VA-Kontos
41020100	7800	200	Teilbetrag des VA-Kontos
41020700	7800	200	Teilbetrag des VA-Kontos
			BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft
42010100			Teilbetrag der Voranschlagsstelle.
42010100	7800	100	Teilbetrag der Voranschlagsstelle
42020300			Teilbetrag
42020401			Teilbetrag für 2015
42020501			Teilbetrag der Voranschlagsstelle.
42030104			Teilbetrag der Voranschlagsstelle.
43010500	7800	000	Teilbetrag der Voranschlagsstelle

Ergebnisvoranschlag

VA-Stelle	Konto	Ugl	Anmerkung
			Keine Anmerkungen erfasst.

Table 5: Federal expenditure from 2000–2015 for research and research promotion by socioeconomic objectives
Breakdown of Annex T of the Auxiliary Document for the Federal Finances Act (Parts a and b)

Reporting years		Total federal expenditure for R&D	of which												
			Funding of exploration and exploitation of earth and space:	Funding of agriculture and forestry	Funding of industrial production and industry	Funding of energy production, storage and distribution	Funding of transport, traffic and communica-tions	Funding of schools and education	Funding of the health care system	Funding of social and socio-economic development	Funding of environmental protection	Funding of urban and physical planning	Funding of defence	Funding of other objectives	Funding of general knowledge advancement
2000[1]	in € 1,000	1,287,326	86,343	79,177	194,247	21,365	29,644	14,299	291,038	89,881	43,301	10,006	336	11,502	416,187
	in %	*100.0*	*6.7*	*6.2*	*15.1*	*1.7*	*2.3*	*1.1*	*22.6*	*7.0*	*3.4*	*0.8*	*0.0*	*0.9*	*32.2*
2001[2]	in € 1,000	1,408,773	92,134	78,480	251,049	25,093	36,435	15,342	306,074	94,474	43,909	10,739	174	11,939	442,931
	in %	*100.0*	*6.5*	*5.6*	*17.8*	*1.8*	*2.6*	*1.1*	*21.7*	*6.7*	*3.1*	*0.8*	*0.0*	*0.8*	*31.5*
2002[3]	in € 1,000	1,466,695	94,112	85,313	243,301	26,243	42,459	16,604	315,345	97,860	45,204	11,153	21	12,579	476,501
	in %	*100.0*	*6.4*	*5.8*	*16.6*	*1.8*	*2.9*	*1.1*	*21.5*	*6.7*	*3.1*	*0.8*	*0.0*	*0.9*	*32.4*
2003[4]	in € 1,000	1,452,124	96,812	86,018	241,728	25,960	39,550	15,787	316,273	92,762	49,487	10,665	4	12,966	464,112
	in %	*100.0*	*6.7*	*5.9*	*16.6*	*1.8*	*2.7*	*1.1*	*21.8*	*6.4*	*3.4*	*0.7*	*0.0*	*0.9*	*32.0*
2004[5]	in € 1,000	1,537,890	84,670	61,182	308,316	25,716	41,489	10,846	362,961	73,670	41,336	13,260	163	15,724	498,557
	in %	*100.0*	*5.5*	*4.0*	*20.0*	*1.7*	*2.7*	*0.7*	*23.6*	*4.8*	*2.7*	*0.9*	*0.0*	*1.0*	*32.4*
2005[6]	in € 1,000	1,619,740	85,101	57,618	347,841	28,320	35,275	9,557	362,000	73,978	46,384	13,349	243	16,165	543,909
	in %	*100.0*	*5.3*	*3.6*	*21.5*	*1.7*	*2.2*	*0.6*	*22.3*	*4.6*	*2.9*	*0.8*	*0.0*	*1.0*	*33.5*
2006[7]	in € 1,000	1,697,550	76,887	57,698	411,462	20,951	42,795	18,997	379,776	81,812	53,279	9,602	126	-	544,165
	in %	*100.0*	*4.5*	*3.4*	*24.2*	*1.2*	*2.5*	*1.1*	*22.4*	*4.8*	*3.1*	*0.6*	*0.0*	-	*32.2*
2007[8]	in € 1,000	1,770,144	80,962	64,637	435,799	28,001	40,013	19,990	373,431	90,639	56,075	9,673	27	894	570,003
	in %	*100.0*	*4.6*	*3.7*	*24.6*	*1.6*	*2.3*	*1.1*	*21.1*	*5.1*	*3.2*	*0.5*	*0.0*	*0.1*	*32.1*
2008[9]	in € 1,000	1,986,775	87,751	66,273	525,573	24,655	39,990	37,636	422,617	90,879	57,535	12,279	142	-	621,445
	in %	*100.0*	*4.4*	*3.3*	*26.5*	*1.2*	*2.0*	*1.9*	*21.3*	*4.6*	*2.9*	*0.6*	*0.0*	-	*31.3*
2009[10]	in € 1,000	2,149,787	104,775	66,647	538,539	32,964	47,300	42,581	456,544	97,076	67,985	14,522	133	-	680,721
	in %	*100.0*	*4.9*	*3.1*	*25.1*	*1.5*	*2.2*	*2.0*	*21.2*	*4.5*	*3.2*	*0.7*	*0.0*	-	*31.6*
2010[11]	in € 1,000	2,269,986	103,791	67,621	587,124	39,977	56,969	50,648	472,455	99,798	67,114	12,792	123	-	711,574
	in %	*100.0*	*4.6*	*3.0*	*25.9*	*1.8*	*2.5*	*2.2*	*20.8*	*4.4*	*3.0*	*0.6*	*0.0*	-	*31.2*
2011[12]	in € 1,000	2,428,143	107,277	63,063	613,692	41,294	54,043	59,479	510,359	115,792	77,578	20,170	99	-	765,297
	in %	*100.0*	*4.4*	*2.6*	*25.3*	*1.7*	*2.2*	*2.4*	*21.0*	*4.8*	*3.2*	*0.8*	*0.0*	-	*31.6*
2012[13]	in € 1,000	2,452,955	103,432	60,609	607,920	55,396	47,934	65,537	499,833	121,570	86,776	20,338	120	-	783,490
	in %	*100.0*	*4.2*	*2.5*	*24.8*	*2.3*	*2.0*	*2.7*	*20.4*	*5.0*	*3.5*	*0.8*	*0.0*	-	*31.8*
2013[14]	in € 1,000	2,587,717	109,329	66,287	627,146	75,170	50,725	74,102	520,330	124,720	92,176	21,171	133	-	826,428
	in %	*100.0*	*4.2*	*2.6*	*24.2*	*2.9*	*2.0*	*2.9*	*20.1*	*4.8*	*3.6*	*0.8*	*0.0*	-	*31.9*
2014[15]	in € 1,000	2,736,304	115,724	69,751	675,133	67,461	56,483	75,813	556,527	128,105	81,775	21,715	83	-	887,734
	in %	*100.0*	*4.2*	*2.5*	*24.7*	*2.5*	*2.1*	*2.8*	*20.3*	*4.7*	*3.0*	*0.8*	*0.0*	-	*32.4*
2015[15]	in € 1,000	2,758,066	118,598	59,947	681,174	73,873	57,322	74,036	551,185	129,548	82,178	21,907	90	-	908,208
	in %	*100.0*	*4.3*	*2.2*	*24.7*	*2.7*	*2.1*	*2.7*	*20.0*	*4.7*	*3.0*	*0.8*	*0.0*	-	*32.8*

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) Annex T of the Auxiliary Document for the Federal Finances Act 2002, outlays. - [2]) Annex T of the Auxiliary Document for the Federal Finances Act 2003, outlays. - [3]) Annex T of the Auxiliary Document for the Federal Finances Act 2004, outlays. - [4]) Annex T of the Auxiliary Document for the Federal Finances Act 2005, outlays. -
[5]) Annex T of the Auxiliary Document for the Federal Finances Act 2006, outlays. Revised data. - [6]) Annex T of the Auxiliary Document for the Federal Finances Act 2007, outlays. - [7]) Annex T of the Auxiliary Document for the Federal Finances Act 2008, outlays. Revised data. - [8]) Annex T of the Auxiliary Document for the Federal Finances Act 2009, outlays. - [9]) Annex T of the Auxiliary Document for the Federal Finances Act 2010, outlays. - [10]) Annex T of the Auxiliary Document for the Federal Finances Act 2011, outlays. - [11]) Annex T of the Auxiliary Document for the Federal Finances Act 2012, outlays. [12]) Annex T of the Auxiliary Document for the Federal Finances Act 2013 (budget appropriation), outlays Revised data. - [13]) Annex T of the Auxiliary Document for the Federal Finances Act 2014, (financing proposal), outlays. - [14]) Annex T of the Auxiliary Document for the Federal Finances Act 2015, (financing proposal), outlays. - [15]) Annex T of the Auxiliary Document for the Federal Finances Act 2015, (financing proposal), budget appropriation.

Table 6: Federal expenditure in 2013 for research and research promotion by socioeconomic objectives and ministries[1]

Ministries		Total federal expenditure for R&D	of which												
			Funding of exploration and exploitation of earth and space:	Funding of agriculture and forestry	Funding of industrial production and industry	Funding of energy production, storage and distribution	Funding of transport, traffic and communications	Funding of schools and education	Funding of the health care system	Funding of social and socio-economic development	Funding of environmental protection	Funding of urban and physical planning	Funding of defence	Funding of other objectives	Funding of general knowledge advancement
BKA[2]	in € 1,000	2,943	-	-	-	4	2	-	-	2,123	-	551	-	-	263
	in %	*100.0*	-	-	-	*0.1*	*0.1*	-	-	*72.2*	-	*18.7*	-	-	*8.9*
BMI	in € 1,000	812	-	-	-	-	-	-	-	812	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMUKK	in € 1,000	77,426	5,142	-	319	-	-	41,581	-	6,017	-	-	-	-	24,367
	in %	*100.0*	*6.6*	-	*0.4*	-	-	*53.7*	-	*7.8*	-	-	-	-	*31.5*
BMWF	in € 1,000	1,870,872	77,382	22,624	312,424	10,157	24,038	31,367	479,371	96,768	31,367	20,284	74	-	765,016
	in %	*100.0*	*4.1*	*1.2*	*16.7*	*0.5*	*1.3*	*1.7*	*25.6*	*5.2*	*1.7*	*1.1*	*0.0*	-	*40.9*
BMASK	in € 1,000	5,854	-	-	-	-	-	-	184	5,670	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	*3.1*	*96.9*	-	-	-	-	-
BMG	in € 1,000	7,390	-	65	-	-	-	-	7,292	33	-	-	-	-	-
	in %	*100.0*	-	*0.9*	-	-	-	-	*98.7*	*0.4*	-	-	-	-	-
BMEIA	in € 1,000	1,949	-	-	-	1,149	-	-	-	794	-	-	-	-	6
	in %	*100.0*	-	-	-	*59.0*	-	-	-	*40.7*	-	-	-	-	*0.3*
BMJ	in € 1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	in %	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BMLVS	in € 1,000	1,224	-	-	-	-	-	-	-	-	-	-	59	-	1,165
	in %	*100.0*	-	-	-	-	-	-	-	-	-	-	*4.8*	-	*95.2*
BMF	in € 1,000	30,475	1,030	982	4,716	144	408	998	6,424	6,207	504	336	-	-	8,726
	in %	*100.0*	*3.4*	*3.2*	*15.5*	*0.5*	*1.3*	*3.3*	*21.1*	*20.4*	*1.7*	*1.1*	-	-	*28.5*
BMLFUW	in € 1,000	91,581	1,280	41,878	488	-	-	108	-	1,712	45,796	-	-	-	319
	in %	*100.0*	*1.4*	*45.7*	*0.5*	-	-	*0.1*	-	*1.9*	*50.1*	-	-	-	*0.3*
BMWFJ	in € 1,000	101,965	-	-	100,465	-	-	-	-	1,500	-	-	-	-	-
	in %	*100.0*	-	-	*98.5*	-	-	-	-	*1.5*	-	-	-	-	-
BMVIT	in € 1,000	395,226	24,495	738	208,734	63,716	26,277	48	27,059	3,084	14,509	-	-	-	26,566
	in %	*100.0*	*6.2*	*0.2*	*52.9*	*16.1*	*6.6*	*0.0*	*6.8*	*0.8*	*3.7*	-	-	-	*6.7*
Total	**in € 1,000**	**2,587,717**	**109,329**	**66,287**	**627,146**	**75,170**	**50,725**	**74,102**	**520,330**	**124,720**	**92,176**	**21,171**	**133**	**-**	**826,428**
	in %	***100.0***	***4.2***	***2.6***	***24.2***	***2.9***	***2.0***	***2.9***	***20.1***	***4.8***	***3.6***	***0.8***	***0.0***	**-**	***31.9***

As at: April 2015

Source: Statistics Austria

[1] Outlays. - [2]) Including the highest executive bodies.

Table 7: Federal expenditure in 2014 for research and research promotion by socioeconomic objectives and ministries[1]

Ministries		Total federal expen-diture for R&D	of which											
			Funding of exploration and exploitation of earth and space:	Funding of agriculture and forestry	Funding of industrial production and industry	Funding of energy production, storage and distribution	Funding of transport, traffic and communica-tions	Funding of schools and education	Funding of the health care system	Funding of social and socio-economic development	Funding of environmental protection	Funding of urban and physical planning	Funding of defence	Funding of other objectives	Funding of general knowledge advancement
BKA[2]	in € 1,000	33,091	4,404	-	-	48	1	-	-	6,794	-	678	-	-	21,166
	in %	*100.0*	*13.3*	-	-	*0.1*	*0.0*	-	-	*20.5*	-	*2.0*	-	-	*64.1*
BMI	in € 1,000	1,067	-	-	-	-	-	-	-	1,067	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMBF	in € 1,000	48,690	924	-	-	-	-	42,347	-	1,036	-	-	-	-	4,383
	in %	*100.0*	*1.9*	-	-	-	-	*87.0*	-	*2.1*	-	-	-	-	*9.0*
BMWFW	in € 1,000	2,080,391	79,765	23,079	421,696	10,594	24,521	32,231	511,971	99,079	32,231	20,650	77	-	824,497
	in %	*100.0*	*3.8*	*1.1*	*20.3*	*0.5*	*1.2*	*1.5*	*24.6*	*4.8*	*1.5*	*1.0*	*0.0*	-	*39.7*
BMASK	in € 1,000	5,649	-	-	-	-	-	-	-	5,649	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMG	in € 1,000	7,379	-	71	-	-	-	-	7,281	27	-	-	-	-	-
	in %	*100.0*	-	*1.0*	-	-	-	-	*98.6*	*0.4*	-	-	-	-	-
BMEIA	in € 1,000	2,234	-	-	-	1,120	-	-	-	1,105	-	-	-	-	9
	in %	*100.0*	-	-	-	*50.1*	-	-	-	*49.5*	-	-	-	-	*0.4*
BMJ	in € 1,000	130	-	-	-	-	-	-	-	130	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMLVS	in € 1,000	1,174	-	-	-	-	-	-	-	-	-	-	6	-	1,168
	in %	*100.0*	-	-	-	-	-	-	-	-	-	-	*0.5*	-	*99.5*
BMF	in € 1,000	34,224	1,165	1,076	5,432	166	470	1,073	7,382	6,454	581	387	-	-	10,038
	in %	*100.0*	*3.4*	*3.1*	*15.9*	*0.5*	*1.4*	*3.1*	*21.6*	*18.9*	*1.7*	*1.1*	-	-	*29.3*
BMLFUW	in € 1,000	81,100	1,496	44,693	503	-	-	125	-	1,740	32,205	-	-	-	338
	in %	*100.0*	*1.8*	*55.2*	*0.6*	-	-	*0.2*	-	*2.1*	*39.7*	-	-	-	*0.4*
BMFJ	in € 1,000	1,654	-	-	-	-	-	-	-	1,654	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMVIT	in € 1,000	439,521	27,970	832	247,502	55,533	31,491	37	29,893	3,370	16,758	-	-	-	26,135
	in %	*100.0*	*6.4*	*0.2*	*56.3*	*12.6*	*7.2*	*0.0*	*6.8*	*0.8*	*3.8*	-	-	-	*5.9*
Total	**in € 1,000**	**2,736,304**	**115,724**	**69,751**	**675,133**	**67,461**	**56,483**	**75,813**	**556,527**	**128,105**	**81,775**	**21,715**	**83**	**-**	**887,734**
	in %	***100.0***	***4.2***	***2.5***	***24.7***	***2.5***	***2.1***	***2.8***	***20.3***	***4.7***	***3.0***	***0.8***	***0.0***	**-**	***32.4***

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) Budget appropriation. - [2]) Including the highest executive bodies.

Table 8: Federal expenditure in 2015 for research and research promotion by socioeconomic objectives and ministries[1]

Ministries		Total federal expenditure for R&D	of which												
			Funding of exploration and exploitation of earth and space:	Funding of agriculture and forestry	Funding of industrial production and industry	Funding of energy production, storage and distribution	Funding of transport, traffic and communications	Funding of schools and education	Funding of the health care system	Funding of social and socio-economic development	Funding of environmental protection	Funding of urban and physical planning	Funding of defence	Funding of other objectives	Funding of general knowledge advancement
BKA[2]	in € 1,000	39,360	5,259	-	-	48	1	-	-	8,030	-	679	-	-	25,343
	in %	*100.0*	*13.4*	-	-	*0.1*	*0.0*	-	-	*20.4*	-	*1.7*	-	-	*64.4*
BMI	in € 1,000	1,067	-	-	-	-	-	-	-	1,067	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMBF	in € 1,000	40,277	-	-	-	-	-	40,277	-	-	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	*100.0*	-	-	-	-	-	-	-
BMWFW	in € 1,000	2,103,894	82,356	23,274	425,464	10,728	24,729	32,547	506,255	100,255	32,547	20,841	79	-	844,819
	in %	*100.0*	*3.9*	*1.1*	*20.2*	*0.5*	*1.2*	*1.5*	*24.1*	*4.8*	*1.5*	*1.0*	*0.0*	-	*40.2*
BMASK	in € 1,000	5,462	-	-	-	-	-	-	-	5,462	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMG	in € 1,000	7,307	-	71	-	-	-	-	7,211	25	-	-	-	-	-
	in %	*100.0*	-	*1.0*	-	-	-	-	*98.7*	*0.3*	-	-	-	-	-
BMEIA	in € 1,000	2,305	-	-	-	1,120	-	-	-	1,176	-	-	-	-	9
	in %	*100.0*	-	-	-	*48.6*	-	-	-	*51.0*	-	-	-	-	*0.4*
BMJ	in € 1,000	130	-	-	-	-	-	-	-	130	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMLVS	in € 1,000	1,267	-	-	-	-	-	-	-	-	-	-	11	-	1,256
	in %	*100.0*	-	-	-	-	-	-	-	-	-	-	*0.9*	-	*99.1*
BMF	in € 1,000	34,350	1,170	1,084	5,433	166	470	1,044	7,378	6,582	581	387	-	-	10,055
	in %	*100.0*	*3.4*	*3.2*	*15.8*	*0.5*	*1.4*	*3.0*	*21.5*	*19.2*	*1.7*	*1.1*	-	-	*29.2*
BMLFUW	in € 1,000	70,679	1,466	34,677	309	-	-	131	-	1,740	32,031	-	-	-	325
	in %	*100.0*	*2.1*	*49.0*	*0.4*	-	-	*0.2*	-	*2.5*	*45.3*	-	-	-	*0.5*
BMFJ	in € 1,000	1,654	-	-	-	-	-	-	-	1,654	-	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-	-
BMVIT	in € 1,000	450,314	28,347	841	249,968	61,811	32,122	37	30,341	3,427	17,019	-	-	-	26,401
	in %	*100.0*	*6.3*	*0.2*	*55.5*	*13.7*	*7.1*	*0.0*	*6.7*	*0.8*	*3.8*	-	-	-	*5.9*
Total	**in € 1,000**	**2,758,066**	**118,598**	**59,947**	**681,174**	**73,873**	**57,322**	**74,036**	**551,185**	**129,548**	**82,178**	**21,907**	**90**	**-**	**908,208**
	in %	***100.0***	***4.3***	***2.2***	***24.7***	***2.7***	***2.1***	***2.7***	***20.0***	***4.7***	***3.0***	***0.8***	***0.0***	**-**	***32.8***

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) Budget appropriation. - [2]) Including the highest executive bodies.

Table 9: General research-related university expenditure by the federal government (General University Funds), 2000–2015[1]

Years	General university expenditure	
	Total	R&D
	€ millions	
2000	1,956.167	842.494
2001	2,008.803	866.361
2002	2,104.550	918.817
2003	2,063.685	899.326
2004	2,091.159	980.984
2005	2,136.412	1,014.543
2006	2,157.147	1,027.270
2007	2,314.955	1,083.555
2008	2,396.291	1,133.472
2009	2,626.038	1,236.757
2010	2,777.698	1,310.745
2011	2,791.094	1,388.546
2012	2,871.833	1,395.130
2013	3,000.004	1,453.596
2014	3,094.520	1,500.980
2015	3,107.080	1,506.750

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) Based on Annex T of the Auxiliary Document for the Federal Finances Act.

Table 10: Research promotion schemes and contracts awarded by the federal government in 2014, broken down by sectors/areas of performance and awarding ministries
Analysis of the federal research database 1) without "major" global financing 2)

Ministries	Partial amounts 2014	of which awarded to																				
		Higher education sector						Government sector					Private non-profit sector			Business enterprise sector				Austrian Science Fund (FWF)	Austrian Research Promotion Agency (Forschungsförderungsgesellschaft - FFG)	Abroad
		Universities (including teaching hospitals)	Art universities	Austrian Academy of Sciences	Universities of applied sciences	Other higher education sector[3]	Total	Federal institutions (outside of the higher education sector)	Private non-profit facilities mostly run on public financing	Ludwig Boltzmann Gesellschaft	Other public sector[4]	Total	private non-profit institutions	Individual researchers	Total	Institutes' sub-sector ("Kooperativer Bereich") incl. competence centres (excluding AIT)	Austrian Institute of Technology GmbH - AIT	Company R&D sub-sector ("Firmeneigener Bereich")	Total			
	in €	in %																				
BKA	19,908	100.0	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BMASK	2,604,757	7.1	-	-	-	-	7.1	46.2	26.8	0.6	-	73.6	8.0	1.4	9.4	-	-	7.0	7.0	-	-	2.9
BMBF	8,731,472	0.2	-	-	-	-	0.2	98.4	0.7	-	-	99.1	0.7	-	0.7	-	-	-	-	-	-	-
BMEIA	96,508	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0	-	-	-
BMFJ	54,120	18.5	-	-	-	-	18.5	-	18.5	-	-	18.5	-	-	-	46.1	-	16.9	63.0	-	-	-
BMF	2,723,972	5.9	-	-	0.2	-	6.1	39.7	50.5	-	-	90.2	-	-	-	-	-	-	-	-	-	3.7
BMG	106,741	74.4	-	-	-	-	74.4	18.7	-	-	-	18.7	-	6.9	6.9	-	-	-	-	-	-	-
BMI	240,322	66.8	-	-	-	-	66.8	-	3.4	-	-	3.4	0.7	8.5	9.2	-	-	20.6	20.6	-	-	-
BMJ	45,110	-	-	-	-	-	-	-	100.0	-	-	100.0	-	-	-	-	-	-	-	-	-	-
BMLVS	786,038	12.7	-	0.9	23.5	-	37.1	-	0.6	-	-	0.6	-	2.9	2.9	26.5	16.4	16.5	59.4	-	-	-
BMLFUW	3,291,282	60.0	-	-	2.1	-	62.1	11.0	3.1	-	-	14.1	2.8	-	2.8	8.4	2.5	8.3	19.2	-	0.8	1.0
BMVIT	3,483,179	-	-	-	0.1	-	0.1	-	32.2	-	-	32.2	7.6	-	7.6	59.5	-	0.6	60.1	-	-	-
BMWFW	27,739,903	3.6	0.3	0.1	0.1	-	4.1	-	6.7	0.1	-	6.8	3.9	0.1	4.0	0.8	0.2	19.6	20.6	-	-	64.5
BMWF	30,668,277	1.3	-	0.2	0.1	-	1.6	0.2	12.2	-	-	12.4	3.1	-	3.1	-	-	44.3	44.3	-	0.2	38.4
BMWFJ	410,933	-	-	-	-	-	-	29.1	48.7	-	-	77.8	-	-	-	-	-	15.0	15.0	-	-	7.2
Total	**81,002,522**	**5.1**	**0.1**	**0.1**	**0.4**	**-**	**5.7**	**14.1**	**11.4**	**0.0**	**-**	**25.5**	**3.3**	**0.1**	**3.4**	**3.5**	**0.3**	**24.5**	**28.3**	**-**	**0.1**	**37.0**

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) As at: 22 April 2015.

[2]) i.e. excluding global financing for Austrian Science Fund (FWF), Ludwig Boltzmann Gesellschaft, Institute of Science and Technology Austria, Institute for Higher Studies (IHS) - Institute for Advanced Studies, Austrian Institute of Economic Research (WIFO).

[3])Private universities, pedagogical universities, testing agencies at technical federal colleges and other facilities categorised within the higher education sector.

[4]) State, local and chamber institutions as well as facilities of social insurance carriers.

Table 11: Research promotion schemes and contracts awarded by the federal government in 2014, broken down by socioeconomic objectives and awarding ministries
Analysis of the federal research database 1) without "major" global financing 2)

Ministries		Partial amounts 2014	of which											
			Funding of research covering the earth, the seas, the atmosphere, and space:	Funding of agriculture and forestry	Funding of trade, commerce, and industry	Funding of energy production, storage and distribution	Funding of transport, traffic and communications	Funding of schools and education	Funding of the health care system	Funding of social and socio-economic development	Funding of environmental protection	Funding of urban and physical planning	Funding of national defence	Funding of general knowledge advancement
BKA	in €	19,908	-	-	-	-	-	-	-	19,908	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-
BMASK	in €	2,604,757	-	-	-	-	-	15,000	-	2,589,757	-	-	-	-
	in %	*100.0*	-	-	-	-	-	*0.6*	-	*99.4*	-	-	-	-
BMBF	in €	8,731,472	-	-	-	-	-	8,677,725	-	51,547	-	-	-	2,200
	in %	*100.0*	-	-	-	-	-	*99.4*	-	*0.6*	-	-	-	*0.0*
BMEIA	in €	96,508	-	-	-	-	-	-	-	96,508	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-
BMFJ	in €	54,120	-	-	-	-	-	-	-	54,120	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-
BMF	in €	2,723,972	-	-	5,000	-	-	-	-	2,718,972	-	-	-	-
	in %	*100.0*	-	-	*0.2*	-	-	-	-	*99.8*	-	-	-	-
BMG	in €	106,741	-	89,885	7,380	-	-	-	-	9,476	-	-	-	-
	in %	*100.0*	-	*84.2*	*6.9*	-	-	-	-	*8.9*	-	-	-	-
BMI	in €	240,322	-	-	-	-	-	-	-	235,224	-	-	-	5,098
	in %	*100.0*	-	-	-	-	-	-	-	*97.9*	-	-	-	*2.1*
BMJ	in €	45,110	-	-	-	-	-	-	-	45,110	-	-	-	-
	in %	*100.0*	-	-	-	-	-	-	-	*100.0*	-	-	-	-
BMLVS	in €	786,038	-	10,034	8,000	120,450	-	-	81,500	108,580	5,000	-	213,160	239,314
	in %	*100.0*	-	*1.3*	*1.0*	*15.3*	-	-	*10.4*	*13.8*	*0.6*	-	*27.1*	*30.5*
BMLFUW	in €	3,291,282	242,655	1,641,650	747,000	-	-	-	130,000	182,626	247,981	-	-	99,370
	in %	*100.0*	*7.4*	*50.0*	*22.7*	-	-	-	*3.9*	*5.5*	*7.5*	-	-	*3.0*
BMVIT	in €	3,483,179	186,010	-	2,187,300	120,000	203,980	-	-	195,091	-	-	-	590,798
	in %	*100.0*	*5.3*	-	*62.8*	*3.4*	*5.9*	-	-	*5.6*	-	-	-	*17.0*
BMWF)	in €	27,739,903	7,133,965	2,880	48,150	-	60,267	138,388	574,282	1,392,210	21,000	-	-	18,368,761
	in %	*100.0*	*25.7*	*0.0*	*0.2*	-	*0.2*	*0.5*	*2.1*	*5.0*	*0.1*	-	-	*66.2*
BMWF	in €	30,668,277	451,351	1,740	36,149	46,454	21,596	13,751	14,908,426	809,657	57,277	-	-	14,321,876
	in %	*100.0*	*1.5*	*0.0*	*0.1*	*0.2*	*0.1*	*0.0*	*48.6*	*2.6*	*0.2*	-	-	*46.7*
BMWFJ	in €	410,933	-	-	-	-	-	-	-	207,633	-	-	-	203,300
	in %	*100.0*	-	-	-	-	-	-	-	*50.5*	-	-	-	*49.5*
Total	**in €**	**81,002,522**	**8,013,981**	**1,746,189**	**3,038,979**	**286,904**	**285,843**	**8,844,864**	**15,694,208**	**8,716,419**	**331,258**	**-**	**213,160**	**33,830,717**
	in %	***100.0***	***9.9***	***2.2***	***3.8***	***0.4***	***0.4***	***10.8***	***19.3***	***10.8***	***0.4***	**-**	***0.3***	***41.7***

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) As at: 22 April 2015.

[2]) i.e. excluding global financing for Austrian Science Fund (FWF), Ludwig Boltzmann Gesellschaft, Institute of Science and Technology Austria, Institute for Higher Studies (IHS) - Institute for Advanced Studies, Austrian Institute of Economic Research (WIFO).

Table 12: Research promotion schemes and contracts awarded by the federal government in 2014, broken down by fields of science and awarding ministries
Analysis of the federal research database 1) without "major" global financing 2)

Ministries		Partial amounts 2014	of which					
			1.0 Natural sciences	2.0 Engineering	3.0 Human medicine	4.0 Agriculture and forestry, veterinary medicine	5.0 Social sciences	6.0 Humanities
BKA	in €	19,908	-	-	-	-	19,908	-
	in %	*100.0*	-	-	-	-	*100.0*	-
BMASK	in €	2,604,757	-	-	-	-	2,604,757	-
	in %	*100.0*	-	-	-	-	*100.0*	-
BMBF	in €	8,731,472	-	-	-	-	8,729,272	2,200
	in %	*100.0*	-	-	-	-	*100.0*	*0.0*
BMEIA	in €	96,508	-	-	-	96,508	-	-
	in %	*100.0*	-	-	-	*100.0*	-	-
BMFJ	in €	54,120	-	-	-	-	54,120	-
	in %	*100.0*	-	-	-	-	*100.0*	-
BMF	in €	2,723,972	777,500	-	-	-	1,946,472	-
	in %	*100.0*	*28.5*	-	-	-	*71.5*	-
BMG	in €	106,741	-	7,380	-	89,885	9,476	-
	in %	*100.0*	-	*6.9*	-	*84.2*	*8.9*	-
BMI	in €	240,322	-	-	-	-	235,224	5,098
	in %	*100.0*	-	-	-	-	*97.9*	*2.1*
BMJ	in €	45,110	-	-	-	-	45,110	-
	in %	*100.0*	-	-	-	-	*100.0*	-
BMLVS	in €	786,038	375,134	203,450	66,500	10,034	123,580	7,340
	in %	*100.0*	*47.7*	*25.9*	*8.5*	*1.3*	*15.7*	*0.9*
BMLFUW	in €	3,291,282	513,273	632,699	5,000	1,737,927	402,383	-
	in %	*100.0*	*15.6*	*19.2*	*0.2*	*52.8*	*12.2*	-
BMVIT	in €	3,483,179	317,010	2,838,280	-	-	327,889	-
	in %	*100.0*	*9.1*	*81.5*	-	-	*9.4*	-
BMWFW	in €	27,739,903	18,163,247	58,228	570,082	9,000	7,384,096	1,555,250
	in %	*100.0*	*65.5*	*0.2*	*2.1*	*0.0*	*26.6*	*5.6*
BMWF	in €	30,668,277	27,370,946	773,318	1,170,485	1,740	1,275,840	75,948
	in %	*100.0*	*89.3*	*2.5*	*3.8*	*0.0*	*4.2*	*0.2*
BMWFJ	in €	410,933	175,000	-	-	-	226,333	9,600
	in %	*100.0*	*42.6*	-	-	-	*55.1*	*2.3*
Total	**in €**	**81,002,522**	**47,692,110**	**4,513,355**	**1,812,067**	**1,945,094**	**23,384,460**	**1,655,436**
	in %	***100.0***	***58.9***	***5.6***	***2.2***	***2.4***	***28.9***	***2.0***

As at: April 2015

Source: Statistics Austria (Bundesanstalt Statistik Österreich)

[1]) As at: 22 April 2015.

[2]) i.e. excluding global financing for Austrian Science Fund (FWF), Ludwig Boltzmann Gesellschaft, Institute of Science and Technology Austria, Institute for Higher Studies (IHS) - Institute for Advanced Studies, Austrian Institute of Economic Research (WIFO).

Table 13: An international comparison of research and experimental development (R&D) in 2012

Country	Gross domestic expenditure on R&D as a % of GDP	Financing of gross domestic expenditure of R&D by		Employees in R&D in full-time equivalents	Gross expenditure on R&D by the			
		Government	Business		Business enterprise sector	Higher education sector	Government sector	Private non-profit sector
		in %			as a % of gross domestic expenditure on R&D			
Belgium	2.24[c]	23.4[3]	60.2[3]	64,732[c]	69.0[c]	21.8[c]	8.8[c]	0.4[c]
Denmark	3.02	29.1[c]	60.0[c]	58,657	65.7	31.6	2.4	0.4
Germany	2.88	29.2	66.1	591,261	68.0	17.7	14.3[o]	.[n]
Finland	3.43	26.7	63.1	54,047	68.7	21.6	9.0	0.7
France	2.23	35.0	55.4	412,003	64.6	20.9	13.1	1.3
Greece	0.69	50.4	31.0	37,361	34.3	39.9	24.8	1.0
Ireland [c]	1.58	27.3	50.3	22,501	72.0	23.1	4.8	.
Italy	1.26	42.5	44.3	240,179	54.2	28.0	14.8	3.0
Luxembourg	1.16[a]	30.5[3]	47.8[3]	4,880[a]	61.3[a]	15.4[a]	23.4[a]	.
Netherlands	1.97	35.0	48.2	122,588	57.8	31.4	10.8[o]	.[n]
Austria	**2.88**[5]	**38.3**[5]	**45.5**[5]	**61,170**[4]	**68.8**[4]	**25.6**[4]	**5.1**[4]	**0.5**[4]
Portugal	1.37	43.1	46.0	47,554	49.7	36.5	5.4	8.5
Sweden	3.28[c]	27.7[3]	57.3[3]	81,272[c]	67.8[c]	27.1[c]	4.8[c]	0.3[c]
Spain	1.27	43.1	45.6	208,831	53.0	27.7	19.1	0.2
United Kingdom [c]	1.63	28.7	45.6	356,484	63.3	26.7	8.0	1.9
EU 15 [b]	**2.06**	**32.9**	**55.5**	**2,367,226**	**63.8**	**23.2**	**11.9**	**1.1**
Estonia	2.16	38.3	51.3	5,855	57.5	32.1	9.3	1.1
Poland	0.89	51.3	32.3	90,716	37.2	34.4	28.0	0.4
Slovak Republic	0.81	41.6	37.7	18,127	41.3	34.0	24.5[d]	0.1
Slovenia	2.58	28.7	62.2	14,974	75.7	11.1	13.1	0.0
Czech Republic	1.79	36.8	36.4	60,329	53.6	27.5	18.4	0.5
Hungary	1.27	36.9	46.9	35,732	65.6[v]	18.4[v]	14.4[v]	.
Romania	0.48	49.9	34.4	31,135	39.0	19.7	40.9	0.4
EU-28 [b]	**1.92**	**33.5**	**54.3**	**2,669,968**	**62.7**	**23.6**	**12.7**	**1.0**
Australia	2.13[c,3]	34.6[2]	61.9[2]	137,489[2]	57.9[c,3]	28.1[c,3]	11.2[c,3]	3.0[c,3]
Chile	0.36[y]	36.0	34.9	14,631	34.4	34.3	4.1	27.2
Iceland [a,3]	2.49	40.0	49.8	3,244	53.1	26.4	17.7	2.8
Israel [d]	4.25	12.1	35.6	77,281[c]	82.4	14.4	2.1	1.1
Japan	3.35[y]	16.8[e]	76.1	851,132	76.6	13.4	8.6	1.4
Canada	1.71	34.3[c]	47.4	223,930	51.6[g]	38.6	9.3	0.5
Korea	4.03	23.8	74.7	395,990	77.9	9.5	11.3	1.3
Mexico	0.43[3]	59.6[3]	36.8[3]	70,293[1]	39.0[3]	28.9[3]	30.5[3]	1.6[3]
New Zealand [3]	1.27[y]	41.4	40.0	23,600	45.4	31.8	22.7	.
Norway	1.62	46.5[3]	44.2[3]	37,707	52.3	31.3	16.4	.
Switzerland	2.96	25.4	60.8	75,476	69.3	28.1	0.8[h]	1.8
Turkey	0.92[y]	28.2	46.8	105,122	45.1	43.9	11.0	.
United States [j,p]	2.81	30.8	59.1	.	69.8	13.8	12.3[h]	4.0[c]
OECD total [b]	**2.37**	**29.5**	**60.0**	**.**	**67.9**	**18.1**	**11.6**	**2.4**

Source: OECD (MSTI 2014-2), **Statistics Austria** (Bundesanstalt Statistik Österreich).

[a]) Break in the time series. - [b]) Estimate by the OECD Secretariat (based on national sources). - [c]) National estimate - [d]) R&D expenditure on national defence not included. - [e]) Results of national surveys, figures have been adjusted by the OECD Secretariat to fit the OECD standards. - [g]) Without research and development in the social sciences and humanities. - [h]) Only federal or central government funds. - [j]) Excluding investment expenditure. - [n]) Included elsewhere. - [o]) Includes other categories as well. - [p]) Preliminary values. - [v]) Sum of components does not equal total. - [y]) GDP according to System of National Accounts 1993.

[1]) 2007. - [2]) 2008. - [3]) 2011. - [4]) Statistics Austria; Results of the 2015 survey on research and experimental development 2011. - [5]) Estimate by Statistics Austria; April 2015.

Full time equivalent = person year.

Table 14: Austria's path from the 4th Framework Programme for research, technological development and demonstration activities up to Horizon 2020

	FP4	FP5	FP6	FP7	H2020
	1994–1998	1998–2002	2002–2006	2007–2013	Data as per 04/2015
Number of approved projects in which Austrian are participating	1,444	1,384	1,324	2,436	360
Number of approved Austrian participations	1,923	1,987	1,972	3,516	493
Number of approved projects coordinated by Austrian organisations	270	267	213	675	95
funding for approved Austrian partner organisations and researchers for which a contract has been signed, in € millions	194	292	425	1184	191
Percentage of approved Austrian participations among all approved participations	2.3%	2.4%	2.6%	2.6%	2.9%
Percentage of approved Austrian coordinators among all approved coordinators	1.7%	2.8%	3.3%	2.7%	2.5%
Austrian share of approved funds	1.99%	2.38%	2.56%	2.64%	2.90%

Sources: Proviso Overview report from fall of 2013 (FP4-FP6); EC 10/2014 (FP7); EC 04/2015 (H2020)

Processing and calculations: Austrian Research Promotion Agency (FFG)

Table 15: Austrian results in the 7th EU Framework Programme for research, technological development and demonstration activities

7. Framework programme	Total	AT Total	B	K	Lower Aust-ria	Upper Aust-ria	SA	ST	T	V	E	N/A
Projects	25,238	675	-	27	48	33	16	98	45	1	407	-
Participations	133,615	3,516	9	141	249	253	104	624	248	29	1,854	5
Universities, Higher education	49,886	1,288	-	30	51	86	53	259	142	5	662	-
Non-university research institutions	32,942	800	-	-	61	25	26	129	2	1	556	-
Business enterprises	40,491	1,186	9	110	132	134	22	230	100	21	423	5
including small and medium-sized firms (SMEs)	22,473	699	9	43	95	72	8	116	72	12	269	3
Other categories	10,296	242	-	1	5	8	3	6	4	2	213	-
Coordinations	25,238	675	-	27	48	33	16	98	45	1	407	-
Universities, Higher education	14,320	358	-	2	27	22	9	44	40	-	214	-
Non-university research institutions	6,982	156	-	-	7	1	6	24	-	1	117	-
Business enterprises	3,061	142	-	25	14	9	1	30	5	-	58	-
including small and medium-sized firms (SMEs)	1,596	74	-	18	10	7	1	11	5	-	22	-
Other categories	875	19	-	-	-	1	-	-	-	-	18	-

Note: The Austrian Research Promotion Agency (FFG) follows the logic of the European Commission, according to which a coordination is assigned to every project.

Source: EC 10/2014

Processing: Austrian Research Promotion Agency (FFG)

Table 16: Austrian results in Horizon 2020

Horizon 2020	Total	AT Total	Burgenland	Caruntia	Lower Austria	Upper Austria	Salzburg	STyria	Tyrol	Vorarlberg	Vienna
Projects	3,765	95	-	6	6	2	3	19	4	-	55
Participations	17,146	493	1	20	29	29	14	120	23	2	255
Universities, Higher education	6,038	158	-	1	6	5	4	38	13	-	91
Non-university research institutions	4,086	110	1	-	7	5	2	32	-	-	63
Business enterprises	5,013	162	-	18	14	17	7	44	9	2	51
including small and medium-sized firms (SMEs)	2,549	78	-	8	10	3	1	19	4	-	33
Other categories	2,009	63	-	1	2	2	1	6	1	-	50
Coordinations	3,765	95	-	6	6	2	3	19	4	-	55
Universities, Higher education	1,992	48	-	-	3	1	2	7	4	-	31
Non-university research institutions	919	19	-	-	2	-	-	6	-	-	11
Business enterprises	648	21	-	6	1	1	1	6	-	-	6
including small and medium-sized firms (SMEs)	477	13	-	4	1	1	-	3	-	-	4
Other categories	206	7	-	-	-	-	-	-	-	-	7

Note: Since not all of the contracts for the approved participations are available yet in Horizon 2020, there may be individual deviations here.
Source: EC 10/2015
Processing: Austrian Research Promotion Agency (FFG)

Table 17: Overview of projects and participations in the 7th EU Framework Programme for research, technological development and demonstration activities

7. Framework programme – projects	approved projects (total)	approved projects with AT participants	Percentage of approved projects (AT) of approved projects (as total)
European Commission	**25,100**	**2,427**	**9.7%**
Cooperation	7,834	1,629	20.8%
Ideas	4,525	124	2.7%
People	10,716	372	3.5%
Experts	2,025	302	14.9%
Euratom	**138**	**9**	**6.5%**
Total	**25,238**	**2,436**	**9.7%**

7. Framework programme – participations	approved participants (total)	approved participants (AT)	Percentage of approved participants (AT) of total approved participants
European Commission	**131,590**	**3,507**	**2.7%**
Cooperation	87,623	2,509	2.9%
Ideas	5,405	127	2.3%
People	19,515	444	2.3%
Experts	19,047	427	2.2%
Euratom	**2,025**	**9**	**0.4%**
Total	**133,615**	**3,516**	**2.6%**

Source: EC 10/2014

Processing: Austrian Research Promotion Agency (FFG)

Table 18: Overview of projects and participations in Horizon 2020

Horizon 2020 - projects	approved projects (total)	approved projects with AT participants	Percentage of approved projects (AT) of approved projects (as total)
EC Treaty	**3,743**	**357**	**9.5%**
Excellent Science	2,301	97	4.2%
Industrial Leadership	575	80	13.9%
Societal Challenges	730	163	22.3%
Spreading excellence and widening participation	133	15	11.3%
Science with and for Society	4	2	50.0%
Non-nuclear direct actions of the Joint Research Centre (JRC)	-	-	-
The European Institute of Innovation and Technology (EIT)	-	-	-
Euratom	**22**	**3**	**13.6%**
Total	**3,765**	**360**	**9.6%**

Horizon 2020 - participators	approved participants (total)	approved participants (AT)	Percentage of approved participants (AT) of total approved participants
EC Treaty	**16,732**	**488**	**2.9%**
Excellent Science	5,057	105	2.1%
Industrial Leadership	3,902	136	3.5%
Societal Challenges	7,122	229	3.2%
Spreading excellence and widening participation	621	16	2.6%
Science with and for Society	30	2	6.7%
Non-nuclear direct actions of the Joint Research Centre (JRC)	-	-	-
The European Institute of Innovation and Technology (EIT)	-	-	-
Euratom	**414**	**5**	**1.2%**
Total	**17,146**	**493**	**2.9%**

Note: Since not all of the contracts for the approved participations are available yet in Horizon 2020, there may be individual deviations here.

Source: EC 10/2015

Processing: Austrian Research Promotion Agency (FFG)

Table 19: Austrian Science Fund (FWF): Funding in the area of biology and medicine, 2014

	Total [in € millions]	Share in %
Biology	50.2	23.8
Medical/theoretical sciences, pharmaceutics	27.8	13.1
Clinical medicine	8.5	4.0
Health sciences	1.5	0.7
Medical biotechnology	0.4	0.2
Other human medicine, health sciences	0.4	0.2
Veterinary medicine	0.4	0.2
Total for biology and medicine	89.2	42.2
Total grants awarded	**211.4**	**100.0**

Source: Austrian Science Fund (FWF)

Table 20: Austrian Science Fund (FWF): Funding in the area of natural sciences and engineering, 2014

	Total [in € millions]	Share in %
Physics, astronomy	22.6	10.7
Mathematics	17.7	8.4
Computer science	14.6	6.9
Chemistry	8.0	3.8
Geosciences	5.1	2.4
Electrical engineering, electronics, information technology	1.9	0.9
Other natural sciences	1.6	0.7
Mechanical engineering, machinery	1.4	0.7
Construction	1.2	0.6
Agriculture and forestry, fisheries	1.1	0.5
Other engineering	0.8	0.4
Nanotechnologies	0.8	0.4
Industrial biotechnology	0.7	0.3
Environmental engineering, applied geosciences	0.6	0.3
Other agricultural sciences	0.5	0.2
Advanced materials	0.4	0.2
Chemical industry and petrol industry, basic materials chemistry	0.3	0.1
Livestock breeding, animal production	0.2	0.1
Medical engineering	0.2	0.1
Agricultural biotechnology, food biotechnology	0.0	0.0
Total natural sciences and engineering	79.7	37.7
Total grants awarded	211.4	100.0

Source: Austrian Science Fund (FWF)

Table 21: Austrian Science Fund (FWF): Funding in the area of humanities and social sciences, 2014

	Total [in € millions]	Share in %
Linguistics and literary studies	8.6	4.1
History, archaeology	8.6	4.1
Art sciences	4.6	2.2
Economics	3.9	1.9
Psychology	3.7	1.8
Sociology	3.7	1.7
Philosophy, ethics, religion	3.4	1.6
Other humanities	2.1	1.0
Jurisprudence	1.1	0.5
Other social sciences	1.0	0.5
Political science	0.7	0.3
Media and communication sciences	0.6	0.3
Pedagogy	0.3	0.2
Human geography, regional geography, spatial planning	0.1	0.0
Total humanities and social sciences	42.4	20.1
Total grants awarded	**211.4**	**100.0**

Source: Austrian Science Fund (FWF)

Table 22: Austrian Research Promotion Agency (FFG): Funding by regional government, 2014

Regional government	Participations	Total funding [in €1,000]	Cash value [in €1,000]
Burgenland	84	6,120	4,649
Carinthia	258	39,349	26,401
Lower Austria	713	63,734	56,456
Upper Austria	906	124,613	81,976
Salzburg	228	21,013	12,692
Styria	1,329	182,373	153,093
Tyrol	330	37,317	25,277
Vorarlberg	177	19,874	12,973
Vienna	1,696	118,604	100,603
Abroad	384	4,037	4,037
Total result	**6,105**	**617,033**	**478,158**

Source: Austrian Research Promotion Agency (FFG)

Table 23: Austrian Research Promotion Agency (FFG): Project costs and funding by Subject Index Code, 2014

Subject Index Code	Total costs [in €1,000]	Total funding [in €1,000]	Cash value [in €1,000]
Advanced materials	203,895	88,970	65,777
Industrial manufacturing	129,921	66,346	41,445
Electronics, microelectronics	145,186	58,802	38,971
Surface transport and technologies	75,935	40,131	31,928
ICT applications	73,766	38,096	28,222
Information processing, information systems	79,322	35,716	30,253
Energy savings	53,454	29,563	23,313
Energy storage, conversion and transport	38,395	24,926	23,940
Industrial biotechnology	69,543	23,923	22,595
Renewable energy sources	43,686	23,001	20,956
Biosciences	45,128	22,374	17,717
Medicine, health	43,272	21,849	18,382
Medical biotechnology	38,428	18,404	15,074
Construction engineering	23,589	12,858	9,097
Space	15,466	11,856	11,856
Measuring techniques	21,721	11,286	7,442
Environment	26,597	10,668	9,637
Other technologies	16,128	9,983	5,720
Waste management	14,113	8,103	6,173
Unclassified	13,077	7,404	7,404
Safety	10,094	7,326	7,100
Aviation and technologies	10,839	4,871	4,401
Robotics	6,881	4,766	1,813
Automation	18,052	4,713	4,612
Foodstuffs	5,009	3,609	2,354
Mathematics, statistics	4,900	3,142	2,032
Sustainable development	4,110	3,070	3,070
Geosciences	4,636	2,765	2,765
Telecommunications	5,327	2,446	1,711
Business aspects	5,139	2,442	1,696
Nanotechnologies and nanosciences	3,121	2,382	2,264
Economic aspects	4,413	2,100	1,975
Network technologies	2,773	1,856	872
Research on climate change and the carbon cycle	1,441	1,181	1,181
Agriculture	3,069	1,127	1,109
Information, media	1,539	1,027	613
Agricultural biotechnology	1,298	883	883
Other energy topics	924	702	372
Research ethics	1,387	693	124
Water resources and water management	360	360	136
Social aspects	467	359	359
Meteorology	620	345	263
Coordination, cooperation	298	211	211
Fossil fuels and power plant technologies	355	209	146
Innovation, technology transfer	149	141	141
Standards	40	40	40
Regional development	13	10	10
Total result	**1,267,874**	**617,033**	**478,158**

Source: Austrian Research Promotion Agency (FFG)

Table 24: Austria Wirtschaftsservice (aws): Grants for technology funding, 2014

	Funding commitments [Amount]		Total project volume [€ millions]		Funding [€ millions]	
	2014	2013	2014	2013	2014	2013
Austria Wirtschaftsservice (aws) start-up technology voucher	3	9	0	0	0	0
Austria Wirtschaftsservice (aws) cluster support internationalization	0	6	0	0.2	0	0.1
LISA PreSeed	4	10	0.8	2.2	0.7	1.9
LISA Seed	6	5	22.5	31.2	5.3	3.3
Austria Wirtschaftsservice (aws) time management	2	1	0.2	0.1	0.1	0
Austria Wirtschaftsservice (aws) PreSeed	6	13	1.7	2.6	0.9	1.8
Austria Wirtschaftsservice (aws) ProTrans	65	86	16.9	26.1	5.4	8.5
Austria Wirtschaftsservice (aws) Seedfinancing	11	21	48.6	78.3	5.6	12.1
FISA – Film location Austria	26	30	59.6	44	8	6.9
impulse	55	58	5.6	8.9	2.9	4.2
Austria Wirtschaftsservice (aws) creative industry cheque	215	613	9.1	5.9	1.1	3
Total	**393**	**852**	**165**	**199.5**	**30**	**41.9**

Source: Austria Wirtschaftsservice (aws)

Table 25: CDG: CD laboratories by university/research institution and JR Centres by university of applied sciences

University/research institution	Number of CD laboratories 2014	Budget 2014 [in €]
The University for Continuing Education Krems	1	219,333
Medical University of Graz	1	173,680
Medical University of Vienna	10	3,548,454
University of Leoben	6	2,029,154
Graz University of Technology	5	1,724,465
Vienna University of Technology	13	4,890,367
University of Natural Resources and Life Sciences, Vienna	10	3,593,535
University of Graz	1	377,821
University of Innsbruck	1	254,224
University of Linz	10	3,400,462
University of Salzburg	3	981,916
University of Vienna	2	443,221
University of Veterinary Medicine Vienna	2	732,500
Vienna University of Economics and Business	1	122,450
Austrian Academy of Sciences	1	298,667
Research Center for Non Destructive Testing GmbH	1	305,214
Forschungszentrum Jülich GmbH	1	270,045
Max-Planck-Institut für Eisenforschung GmbH	1	458,000
University of Bochum	1	422,599
University of Göttingen	1	322,000
University of Cambridge	1	364,906
Total	**73**	**24,933,013**
University of applied sciences	**Number of JR Centres 2014**	**Budget 2014 [in €]**
Carinthia University of Applied Sciences - non-profit foundation	1	275,907
Fachhochschule Salzburg GmbH	1	138,123
University of Applied Sciences Technikum Wien	1	331,512
Fachhochschule Vorarlberg GmbH	1	195,891
FH OÖ Forschungs und Entwicklungs GmbH	1	258,313
Total	**5**	**1,199,746**

Notes: The total amount of CD laboratories is 71; there are two CD laboratories with dual management at different universities.

Budget data 2014 are plan data as of 5 December 2014

Source: CDG

Table 26: CDG: Development of the CDG 1989–2014 or JR Centres, 2012–2014

Year	Expenditures of the CD laboratories and JR Centres [in €]	Active CD laboratories	Active JR Centres	Active member companies
1989	247,088	5		
1990	1,274,682	7		
1991	2,150,389	11		
1992	3,362,572	16		
1993	2,789,910	17		
1994	3,101,677	18		
1995	2,991,214	14		
1996	2,503,325	14		6
1997	2,982,793	15		9
1998	3,108,913	18		13
1999	3,869,993	20		15
2000	3,624,963	18		14
2001	4,707,302	20		18
2002	7,295,957	31		40
2003	9,900,590	35		47
2004	10,711,822	37		63
2005	11,878,543	37		66
2006	12,840,466	42		79
2007	14,729,108	48		82
2008	17,911,784	58		99
2009	17,844,202	65		106
2010	19,768,684	61		110
2011	20,580,208	61		108
2012	22,167,259	64	1	114
2013	23,666,522	73	4	131
2014	26,132,759	71	5	129

Note: Budget data 2014 are plan data as of 5 December 2014

Source: CDG

Table 27: CDG: CD laboratories and JR Centres according to thematic clusters, 2014

Thematic clusters	Number of CD laboratories and JR Centres	Budget in €*
Chemistry	12	4,568,447
Life Sciences and environment	14	4,917,490
Manufacture of machinery and equipment, instruments	5	1,272,620
Mathematics, informatics, electronics	19**	6,830,858
Medicine	10	3,292,269
Metals and alloys	9	3,468,032
Non-metal materials	5***	1,585,842
Industry-, Social- und Jurisprudence	2	197,200
Total	**76**	**26,132,759**

* Plan data as of 5 December 2014

** incl. 4 JR centres

*** incl. 1 JR centre

Source: CDG