ERAWATCH COUNTRY REPORT 2010: Austria

ERAWATCH Network – Zentrum für soziale Innovation (ZSI, Centre for Social Innovation)

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Executive Summary

Austria is one of the smaller EU Member States accounting for less than 1.7% of the population of the EU-27. Although the Austrian economy has been severely impacted by the financial and economic crises in 2008 and especially 2009, it is among those EU countries with a less severe recession and with earlier signs of recovery.

Austrian GDP contracted 3.5% in 2009[1], but Austria will probably see positive growth of more than 1% in 2010. GDP in 2010 is expected to be around €282.42b. GDP per capita in Austria was €33,100 in 2009. The government debt was 69.9% in 2009[2]. Unemployment remains considerably lower in Austria than elsewhere in Europe, partly because the Austrian Government has subsidized reduced working hour schemes to allow companies to retain employees. The unemployment rate as defined by ILO definition was 4.4% in the second quarter of 2010. This is 0.3 percentage points less than in the same quarter of 2009. Stabilization measures, stimulus initiatives, and the government's income tax reforms pushed the budget deficit to about 3.5% of GDP in 2009, from only about 1.3% in 2008.

Austria's total investment in research and development in 2009 amounted to €7.546b or 2.73% of GDP. It is estimated that GERD in % of GDP will be at 2.76% in 2010, significantly higher than the EU average of around 2%. Regarding the six 'routes' identified in the policy mix project to stimulate R&D investments, the findings of the ERAWATCH country report 2009 are still valid. Especially the policy portfolio addressing science-industry linkages through collaborative projects has been at the centre of policy development over the last years. Austria experienced the fastest GERD/GDP growth rate among all EU countries aiming to advance from an innovation follower to an innovation leader (BMWF, BMVIT and BMWFJ, 2010). A comprehensive R&D system's evaluation of Austrian R&D funding highlighted several of the lessons to be learnt to enhance this transformation (Aiginger, K., Falk, R. and Reinstaller, A., 2009). Probably most fundamental in this respect were the strategic recommendations

- to enlarge from a narrow innovation policy towards a broader approach which pro-actively includes linkages between science and research, technology policy, educational policies and other social and economic framework conditions;
- to transform from fragmented to coordinated and consistent public interventions based on a shared vision and a joint strategy;
- and to advance from an imitation to a more radical innovation strategy characterised by the notion of excellence and thematic and economic leadership both *"in niches and high quality segments, increasing market shares in sophisticated industries and technology fields, and in areas or missions of particular relevance to society"* (Aiginger, K., Falk, R. and Reinstaller, A., 2009, p. 6).

[1] Statistics Austria, http://www.statistik.at/web_en/statistics/Public_finance_taxes/maastricht_edp_indicators/government_deficit/index.html, accessed on 4 November 2010

[2] Statistics Austria, http://www.statistik.at/web_en/statistics/Public_finance_taxes/maastricht_edp_indicators/government_debt/index.html, accessed on 4 November 2010

The catching-up process experienced in Austria was accompanied by considerable public and private investments in R&D, especially during the last 10 years, and an emphasis on establishing and funding science-industry cooperation. The political ambition to advance to an European frontrunner country based on a sustainable innovation-based growth strategy with a high dynamic in establishing new businesses and an accelerated economic structural change with a high locational attraction for research headquarters requires a broad mix of subsidies and supporting framework conditions, including strong HEI, competition intense product markets and a strong private risk capital sector. The successful catching-up strategy of the last years characterised by constantly increasing direct and indirect funding rates without structural adjustments of the framework conditions, especially in terms of quantity and quality of HRST, would, however, result in decreasing public revenues (Janger et al, 2010). Thus, most expert in Austria call for a comprehensive reform of education in Austria and a stronger advancement of the HES towards excellence in education and research as a basic pillar to secure the R&D location Austria in a mid-term perspective by supplying highly employable HRST and cutting-edge scientific knowledge and infrastructures.

The last one and a half years, however, were not characterised through an active implementation of the recommendations of the R&D system's evaluation. On contrary, the expected consequences of the financial and economic crisis and the subsequent prioritised management of the consolidation of public budgets, have not only led to a postponement of the overall governmental S&T strategy, which should have been presented mid 2010, but also brought insecurity on the future of R&D development in Austria triggered by announced public R&D budget cuts and a slump of foreign private R&D investments in Austria. The situation has been aggravated by severe conflicts in the field of education, including massive student protests.

Knowledge Triangle

Results of last year's R&D system's evaluation indicated clearly a need for more inter-sectoral alignment and an enhancement of links within the knowledge triangle (Aiginger, K., Falk, R. and Reinstaller, A., 2009). Several important steps in this direction have already been implemented during the last decade. Most successful were the approaches for a stronger interlocking between the fields of research and innovation. A comprehensive portfolio of competition based R&D&I instruments has been developed and is widely used. Projects are regularly selected on the basis of the quality of proposals. In the field of competitive basic research programmes, all proposals are subject to international external peer review. Nonetheless, research funding allocation to universities is dominated by block funding and competition-based intra-university funding allocations are still little developed. In addition, many R&D programmes disadvantage the public and private non-university sector due to arbitrary limited overhead allowances. However, scientific, teaching and management performance of HEI are regularly evaluated on basis of international criteria whereas a comprehensive regular evaluation of non-university public and private non-profit research organisations has not been installed yet.

R&D&I cooperation and knowledge transfer between HEI, public and private non-profit research organisations and companies is broadly supported by numerous structural and thematic oriented R&D programmes and support structures. Although the offered public measures and interventions at the interface between the industrial and academic research sector are satisfactorily employed, the system is characterised by high complexity in terms of governance and administration as well as fragmentation with a prevalence of many small-scale interventions and a yet missing 'theme management' which also aims to consider policy-instruments beyond core R&D programmes (Aiginger, K., Falk, R. and Reinstaller, A., 2009; Mayer et al., 2009). Moreover, a risk-adverse tendency towards more radical undertakings and limited support for non-technological innovations can be observed (Aiginger, K., Falk, R. and Reinstaller, A., 2009; Mayer et al., 2009).

The most pressing knowledge-triangle problem, however, is a better integration of education policies into the knowledge-triangle. Here structural problems start already in earlier phases of the education system and do not stop in the phase of doctorate education, whose transformation towards qualitatively and quantitatively sufficient professional structures and instruments has just begun and is far from being solved. In general, the situation is still characterised by low tertiary education rates, low enrolment rates in technical and natural sciences and yet little systematically developed innovation-oriented training and education. Alignments with other policies, such as migration and integration policy, (innovation-oriented) public procurement or regional policy, which are important for a further successful development of R&D&I in Austria are gradually advancing, although on different levels and at different pace. The financial sector embedding into the knowledge triangle in terms of provision of private risk and seed-capital has even deteriorated during the last two years due to the economic and financial crisis (Friesenbichler and Hake, 2009).

Despite actual budget cuts, however, the area of R&D is preferentially treated compared to other policy fields. Public investment in R&D seems predictable, but not necessarily adequate given the ambition to transform to a European frontrunner country in S&T and the challenges ahead. An explicit, politically unambiguous strategic framework ("Überbau") with a long-term perspective and a vision and mission supported by all (or at least most) stakeholders, which provides guidance for a systemic further development of R&D&I is still missing. The long expected government's '2020 S&T strategy' has been postponed, but is expected to be published beginning of 2011.

Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	A new minister has been appointed early 2010 who basically follows previous tracks. End of October, budget cuts in the fields of science were announced with severe potential impact on scientific offspring, R&D internationalisation, the sector of private non-profit R&D institutions and also the further engagement of Austrian research organisations in FP7. Universities are confronted with budget cuts in the next performance contract period as of 2013 and the budget of the Academy of Sciences will be frozen. R&D funding in the corporate sector has stagnated and R&D inflow from abroad decreased substantially. New members for the Austrian Council for RTD have been nominated in the second half of 2010.	Austria has a robust research base. The inflow of foreign R&D funding is remarkable and Austrian R&D is very competitive within the ERA. The Austrian funding agencies work professionally and have been endowed with increasing resources. The development of universities is based on performance contracts which provide mid-term funding security. Nevertheless, the system still lacks excellence in many respects. Structurally problematic is the mostly unstructured doctoral education and the lack of larger cutting-edge R&D infrastructures. The political attempt to clear-cut the private non-profit R&D sector in Austria, with many institutes in the field of social sciences due to budgetary restrictions without any evaluation has caused discontent. Thematic programmes are increasingly introduced, but they are only partly responding to grand challenges. A conceptual 'theme management' incl. social sciences is still to come.

	Recent policy changes	Assessment of strengths and weaknesses
Innovation policy	No major policy changes in 2010. At programme level an initiative to support more innovation in the service sector was launched by FFG ("Dienstleistungsinitiative"). A decision was taken to increase the research premium for companies to 10% as of 1. January 2011, while the temporary increase of the de-minimis threshold, which was justified by the economic and financial crisis, will be terminated end of 2010. To counterbalance the stagnation in BERD, R&D development programmes for the automotive sector and a SME support package have been introduced and a further emphasis has been put on collaborative science-industry based RTDI programmes.	Although business expenditures for R&D have greatly expanded in the past two decades, a fundamental transformation of industry structures towards high-tech and new industries has happened only to a small degree (Friesenbichler and Hake, 2009). Productivity gains and technological capabilities have rather benefited traditional industries in Austria often operating in medium-high tech sectors, while the high-tech sector is still comparatively small. Knowledge transfer is actively supported by many R&D programmes operating at the science-industry interface. Measures range from low-key (e.g. innovation cheques) to challenging structural interventions (e.g competence centres). The relatively high public R&D budget appropriations in Austria for companies are also critically perceived as 'funding culture' instead of 'innovation culture' (CREST 2008).
Education policy	Also in 2010 education policy remained one of the most disputed policy fields in Austria. Student protests calmed down at the beginning of 2010, but were re-emerging late 2010. Debate focussed on study access regulation, whether or not to introduce tuition fees and on a reduction of the years for obtaining family allowance. The MINT-initiative was launched to increase enrolment in engineering, technical and natural sciences. A political agreement to implement more joint secondary schools ("gemeinsame Mittelschule") to avoid too early separation of children into different school types and life perspectives could be achieved.	A remarkable number of persons with only secondary school attainment are engaged in R&D in Austria. This indicates a high level of technical and professional attainment at secondary schools in Austria. At the same time Austria ranks among those countries with the lowest share of university graduates in Europe. University education has been transformed along the Bologna principles, but structural doctoral education is still rather the exception than the rule. Quality assurance at the knowledge outcome level of students is insufficient. The average length of studying is still high as is the number of drop-outs. The number of graduates in science, engineering and technical (SET) fields remains very low, especially among women. Recently introduced programmes to motivate pupils to study SET fields are continuing.
Other policies	No major changes in the last year. To counterbalance economic demand slumps, economic stimulus packages were continued in 2010. A few R&D relevant thematic foci were supported such as on the energy-saving and energy-research sector. The financial sector remains restrained.	Alignment processes between R&D&I and industrial policy, structural policy and regional policy continue. Until recently R&D was not in the focus of labour market policy, but immigration procedures for foreign researchers were facilitated. Innovation oriented public procurement remains an issue, although not high on the agenda. The financial sector for R&D, especially risk capital appropriations and start-up funding, remains a structural weakness, which is counterbalanced through public initiatives (and money), which are under budgetary pressure and partly terminated (e.g. uni:invent programme). A private equity law is still missing in Austria. Generically, impact oriented new public management principles are stepwise introduced throughout different policy fields, including research and innovation policy.

European Research Area

The ERA concept has gained increasing attention in national strategies and objectives in recent years. It is first and foremost participation in the Framework Programmes that attracts most attention, but ERA instruments such as ERA-NETs or joint programming initiatives are also increasingly in the focus of R&D policy making in Austria. To safeguard the supply for human resources in S&T mobility barriers are steadily removed and (im)migration from researchers from third countries was facilitated. Initiatives to attract youth for S&T, to increase the low share of women in science, engineering and technology fields and to remove the 'glass ceiling' are in place, but require also a cultural change. Austria is still humble in terms of large research infrastructures, but makes use of the ESFRI roadmap to enable access of Austrian researchers to RIs, although the need to consolidate the public budget could provoke some reluctance in this respect. National R&D programmes are based on the territorial principle but are rather liberally implemented regarding their openness towards researchers from other countries and nationals working abroad. After the breakthrough of the University Act 2002, which made universities de facto autonomous, a further modernisation of non-university public and private non-profit research organisations has only been carried out to limited extent, Performance contracting with public research organisations progresses rather moderately. Some of the major social challenges are tackled by thematic programmes, but a more integrated theme management, which conceptually advances the operational level of instruments, is yet to be implemented. In its internationalisation attempts Austria still lacks a published strategy across the ministries involved in S&T. International EU instruments are actively used to advance the internationalisation of S&T, but the need to consolidate public R&D budgets led to first financial cuts for some internationalisation support programmes and structures.

The main challenge for Austria remains to increase the performance of high quality research, which also requires more efforts to modernise doctoral education, and to continue providing an attractive environment for foreign companies to base their R&D activities in.

Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	**Main national policy changes**	**Assessment of strengths and weaknesses**
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• No major policy changes; • The MINT initiative to promote mathematics, natural studies and technical and engineering studies has been launched.	Strengths • Overall attractive working conditions for researchers (incl. high salaries); • Comparatively large number of doctoral students; high inflow of foreign students at all levels; comparatively high immigration of HRST; • Liberated immigration regime for researchers. Weaknesses • Lack of structured doctorate education; • Glass ceiling for women in S&T; • Low number of students graduating in SET.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
2	Increase public support for research	• Anti-cyclical public R&D spending to compensate the declining investment of companies and to improve the financial basis of HES (partly to replace the cancellation of study fees); • Budgets for major public non-university R&D organisations frozen; • Announcement of drastic budget reductions for private non-profit R&D organisations (partly already effective in 2010); • Introduction of a rather low overhead allowance for FWF projects.	Strengths • Overall, high levels of R&D expenditure, slightly affected by the crisis; • Professional funding organisations in place. Weaknesses • Too limited funding for tertiary education; • Too limited funding for excellent research based on competitiveness.
3	Increase European coordination and integration of research funding	• No major policy changes; • Termination of the FP7 project preparation subsidy by end of 2010.	Strengths • Strong national ERA governance in place; • National funding organisations are experienced in ERA. Weaknesses • National/European integration of research funding partly still ad hoc and not fully mainstreamed; • National co-financing has to be secured; • Participatory approaches to include research communities in priority setting need to be improved.
4	Enhance research capacity across Europe	• No major policy changes.	Strengths • Austria is well integrated into ERA; • Favourable environment for corporate R&D; • National programmes open for international cooperation. Weaknesses • HRST, especially in SET, are scarce and qualitatively uneven; • Social scientific research is under pressure due to funding cuts for non-university based research organisations.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• IST Austria fully operational.	Strengths • Sufficient basic RI; Weaknesses • High (financial) demand for RI not secured by budgets; • Lack of large RI; • RI roadmap prepared, but not finalised.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
6	Strengthen research institutions, including notably universities	• Public R&D budgets for HES considerably increased; • Public support for private not-profit R&D organisations considerably reduced (incl. termination of the 'dynamic quality assurance' programme for social sciences).	Strengths • High number of public, private and cooperative research institutions. Weaknesses • Not enough budget to increase excellence through competitive funding programmes (esp. in the field of basic research); • Scientific offspring not sufficiently educated and sobering perspectives of young researchers.
7	Improve framework conditions for private investment in R&D	• Decision to increase research premium to 10% as of 1.1.2011 taken.	Strengths • Many science-industry programmes in place; • Attractive direct and indirect funding mechanisms. Weaknesses • Dependency on foreign R&D inflows.
8	Promote public-private cooperation and knowledge transfer	• Enhanced public support for R&D relevant PPP and knowledge transfer between universities of applied sciences and the corporate sector; • uni:invent programme terminated.	Strengths • Public-private cooperation and knowledge transfer is a systemic strength.
9	Enhance knowledge circulation (KC) across Europe and beyond	• Budget to secure financial room for manoeuvre to connect to promising European and international initiatives and trends to enhance knowledge circulation across Europe and beyond further downsized; • Implementation stop for initially planned new science liaison structures abroad and reduction of already existing ones.	Strengths • Austria is well integrated in the European KC. Weaknesses • Austria is only sub-critically integrated in overseas KC.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• New R&D cooperation with India and Korea consolidated and partly aligned with European programmes.	Strengths • Austria engaged in joint European initiatives. • Good take-up and domestic use of European instruments. Weaknesses • Severe budget constraints and under-critical programmes.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• New members of the Austrian Council appointed; • Coordination between minister of research and minister of education enhanced.	Strengths • Council for R&D implemented by the government. Weaknesses • R&D&I agenda segmented across three ministries; • Ministry of finances has a stronger position in times of crisis; • Global challenges related 'theme management' across policy levels and policy areas not fully developed.
12	Develop and sustain excellence and overall quality of European research	• No major policy changes.	Strengths • Developed R&D evaluation culture Weaknesses; • Austrian universities are placed at moderate positions in the Shanghai ranking.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• No major policy changes.	Strengths • Good knowledge base in high- and medium- tech industries and in knowledge-intense service sector; • Innovative companies are found in all sectors (even in traditional low-tech branches). Weaknesses • Industrial R&D mostly incremental.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• R&D relevant economic support programme for energy and energy-efficiency issues further developed.	Strengths • Societal challenges are also tackled in bottom-up research programmes. Weaknesses • Some societal challenges are not sufficiently tackled (e.g. aging society, poverty, migration/integration).
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• Budgets to commission external studies in sector ministries reduced; • Public debate about the ad-hoc decision of the minister of science and research to cut subsidies for private non-profit research organisations led to bottom-up establishment of the "Wissenschafts-konferenz" ('Science Conference').	Strengths • Advanced S&T evaluation culture; • Increasing media interest for R&D; • Instruments to reach out to the public are tested and available. Weaknesses • Top-down research policy decisions sometimes ad hoc.

TABLE OF CONTENTS

1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the '**interlinkage**' between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter of the reports is to assess the performance of the national research system, the 'interlinkages' between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Reports 2009, being mainly an update of the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section will identify the main societal challenges addressed by the national research and innovation system and will assess the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national research and innovation system and its governance

This section gives the main characteristics of the structure of the national research and innovation systems, in terms of their wider governance.

Austria is one of the smaller EU Member States accounting for less than 1.7% of the population of the EU-27. GDP in 2010 is expected to be around €282.42b. Austria belongs to the richest EU Member States with a GDP per capita of €33,100 in 2009. At the input side, Austria belongs also to the EU countries with the highest

GERD/GDP rate, which is 2.76% in 2010, thus significantly higher than the EU average of around 2%.

Main actors and institutions in research governance

The main actors in research and innovation governance are to be found at the state level, namely the Federal Ministry of Science and Research (BMWF), the Federal Ministry of Transport, Innovation and Technology (BMVIT), and the Federal Ministry of Economy, Family and Youth (BMWFJ) (see Fig. 1). There is no formal mechanism of co-ordination between these ministries. The Federal Ministry of Finance (BMF) governs the allocation of financial resources and sets framework standards for design, implementation and monitoring of programmes. Thus it plays an important role within the research policy system even though it is not directly responsible for the Austrian R&D policy (ERAWATCH Research Inventory Report Austria, 2010).

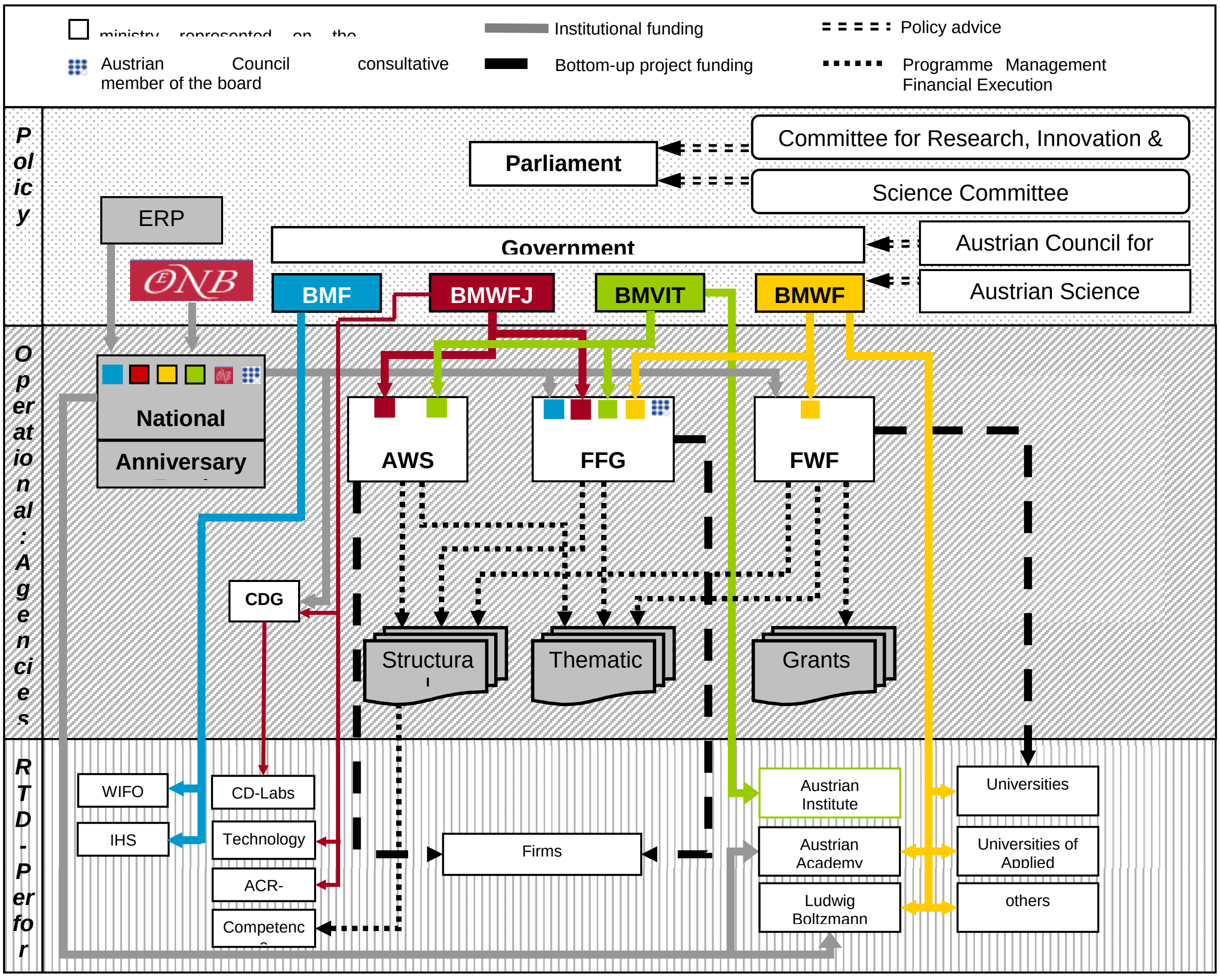
The BMWF is responsible for tertiary education and for basic research, i.e. for universities, universities of applied sciences and for non-university research institutions such as the Austrian Academy of Sciences and the Ludwig Boltzmann Society. It is also responsible for the Austrian Science Funds (FWF) and represents Austria at the European level on issues related to research and university education. The BMVIT is mainly in charge for applied research. It holds a stake in the Austria Wirtschaftsservice Gesellschaft (AWS) and in the Austrian Research Promotion Agency (FFG), to which it contributes the majority of application-oriented research funding. It is the majority shareholder of the Austrian Institute of Technology (AIT; the former Austrian Research Centers). The BMWFJ is responsible for innovation support, technology transfer and the promotion of entrepreneurship; it holds the remaining 50% of the FFG and the AWS and it supports the Christian Doppler Research Association (CDG) (Hofer, 2009). The activities of other, sectoral ministries (e.g. for agriculture, health etc.) are comparably small and basically focused on contracting research required by the respective ministry for the fulfilment of its responsibilities.

The Austrian Parliament wields legislative power. Two committees deal with research related matters: the Committee on Science and the Committee on Research, Technology and Innovation which was established by the current coalition government in 2007. In practice, the policy debate and the development of new policy measures in S&T takes place outside the parliament to a large extent and the main drivers are the ministries in charge (Hofer, 2009).

There are two major advisory bodies: the Austrian Council for Research and Technological Development, which advises the government in all matters related to research, technology and innovation, and the Austrian Science Board, which is the main advisory body in all university-related matters. In November 2010, the ‘Science Conference’ was established bottom-up by private, mostly non-profit research organisations to articulate and promote the interests of this sector. Its influence and power will most probably be rather limited, because of the smallness of this sector.

At the operational level, most of the funding for R&D and innovation is managed by three agencies on behalf of the ministries: the FWF is the most important body for the funding of basic research, the FFG funds applied research and development, and the AWS is specialised in funding start-ups and innovation projects in companies.

Figure 1: Overview of the Austria's research system governance structure



Source: ERAWATCH Research Inventory

Main research performer groups

The largest research performers in terms of volume are the 22 public universities and the corporate sector with 2,521 enterprises active in R&D. The latter, however, is highly concentrated as almost elsewhere in Europe. In 2007, the corporate sector performed 70.6% of R&D in Austria. It also contains the co-operative sub-sector, a group of non-university applied research institutes organised as limited companies and, therefore, allocated to the corporate sector. They perform applied research and development and provide to various extents R&D services for industry. Together they account for approximately 6.6% of R&D performed in Austria. The largest player in this group of non-university applied research institutes is the AIT. The higher education sector performed 23.8% of R&D in Austria in 2007. The ratio of public financing for the corporate sector vis-à-vis the higher education sector in Austria is 1:3 and one of the highest in favour of the corporate sector in the EU. The scope and share of research carried out by non-university research institutes has increased in recent years, whereas the private non-profit sector accounts for a very small share. The state sector performance accounted for 5.3% in 2007 and the private non-profit sector 0.2%.[3]

[3] Statistics Austria, http://www.statistik.at/web_de/statistiken/forschung_und_innovation/f_und_e_in_allen_volkswirtschaftlichen_sektoren/index.html; accessed on 4 November 2010.

The institutional role of regions in research governance

Beginning in the mid 90s the Federal States ("Bundesländer" or provinces) started to implement their own RTI policies with a strong focus on innovation. In total, the Federal States together account for approximately 5% of the total Austrian R&D expenditures.[4] Some big national funding programmes, e.g. the competence centre programme COMET or the Austrian NANO-Initiative, are co-financed by the Federal States (Hofer, 2009) while the programmes themselves, are primarily implemented by state agencies. The "Plattform FTI Österreich" aims to improve communication and coordination between state agencies and federal states (Plattform FTI Österreich, 2010). While in general the regional level is not very important compared to the state level and the industrial sector both in R&D financing and R&D performance, there are spatial differences of R&D performance with a concentration of R&D in the capital city Vienna and in Styria. These two regions are both exceeding the Austrian average in terms of GERD in % of gross regional product.

2.2 Resource mobilisation

Since 2000, Europe has made evident progress towards ERA but at the same time it is clear that Europe's overall position in research has not improved, especially regarding R&D intensity, which remains too low. The lower R&D spending in the EU is mainly a result of lower levels of private investment. Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D investments.

This section will assess the progress towards national R&D targets, with particular focus on private R&D and of recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data, including Structural Funds. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment will include also the human resources for R&D. Main assessment criteria are the degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

The governing coalition followed most R&D policy objectives and priorities identified by its predecessors. The government initially aimed of reaching 3% GERD in GDP by 2010 as well as 4% by 2020. Austria's development path from a "follower" to an "innovation leader" was politically not questioned. In terms of quality, the primary objective according to the coalition programme was to accomplish a structural transformation of the Austrian research and innovation system. The aims of this transformation are excellence and higher shares of knowledge intensive services and high-tech products (Hofer, 2009).

The following table 1 shows Austria's gross expenditure on R&D vis-à-vis the EU-27 and the OECD over the period 1998-2008. Data indicate a rapid catching-up process during the last decade substantially surpassing the average EU and OECD levels. The process of catching-up was enhanced by substantial growth rates of business R&D until 2007, which were at least partially related to increases in public funding

[4] Data from Statistik Austria, 2008.

and the strong promotion of collaborative structural instruments as well as tax subsidies.

Table 1: Austria's Gross Expenditure on Research and Development in % of GDP, 1998-2008

	1998	2000	2002	2004	2006	2008
OECD	2.13%	2.21%	2.22%	2.19%	2.26%	2.29%
EU-27	1.67%	1.74%	1.76%	1.73%	1.76%	1.77%
Austria	1.78%	1.94%	2.14%	2.26%	2.47%	2.68%

Source: Eurostat, 2010

In 2009, Austria's gross domestic expenditure on R&D was 2.73% of GDP. It is estimated that the rate will even increase to 2.76% in 2010. This is mainly due to the R&D appropriations of the public sector, which increased substantially by 10.9% compared to 2009, while the expenditures by industry will stagnate (+0.1%). The R&D expenditures from abroad, which mainly benefit the industrial sector, will likely decrease at minus 0.6% compared to 2009.

Direct financing of institutions consumes the highest volume in the R&D policy mix. This category comprises the General University Fund (GUF) as well as block funding granted to a number of research institutions, e.g. the Austrian Academy of Sciences, the AIT and others. It is dominated by the share of GUF, which accounts for 80% of R&D spending at universities in Austria. Although this is one of the highest rates in the EU, the importance of institutional funding decreased slightly compared to the share of direct competitive funding instruments which amount to approx. 20%. The major sources of direct competitive funding are the bottom-up project funding instruments offered through the FWF and the FFG. The bottom-up instruments cover nearly two thirds of the direct competitive funding budgets, whereas the multitude of thematic and/or structural programmes shares the rest: 17% go to structural programmes (e.g. COMET), 11% to thematic programmes and 5% to human resource measures and scholarships. The third important instrument is indirect funding. Fiscal incentives provided for R&D have significantly grown within only a couple of years. The number of companies making use of R&D tax incentive schemes increased significantly from 835 in 2001 to more than 2,500 because of extended eligibility criteria, especially caused by the introduction of the "research premium", which will increase to 10% in 2011. Most of the new users are comparatively small companies. Nonetheless, there is a heavily skewed size distribution in terms of absolute fiscal research subsidies which mirrors the high concentration of business R&D in Austria.

With regard to Structural Funds (SF), the Austrian provinces currently spend around 20% of the overall structural funds on R&D (without innovation). The financial breakdown published in the National Reform Programme 2008-2013 shows that the importance of R&D and innovation has increased tremendously to 43.5% of the total budget compared to 14% in the previous planning period. However, since Austria is not a cohesion country, the absolute appropriations from the structural funds are rather limited. Thus, less than 0.5% of total yearly R&D funding in Austria originates from this source.

Although securing long-term investment in R&D is one of the priorities of the Austrian National Reform Programme and one of the major conclusions of Austria's R&D system's evaluation, the initial ambitious 4% target for 2020 was reduced to 3.76%.

Also the since long announced overall governmental R&D strategy, which should provide the political orientation for the next couple of years was postponed due to the unclear financial situation.

The pressure on Government revenues arising from the decline in the economy and consequently the necessity to consolidate the budget resulted in the announcement of public spending cuts late October 2010. The public R&D sector is obliged to reduce its budget at the amount of €320m until 2014. R&D is affected in several ways, such as sharply reduced allocations to university infrastructure, ceasing of structural funding for non-university research organisations, termination of grants including the project-preparation funding for FP7, reduction of budgets of scientific liaison offices abroad and international mobility grants, reduction of money for scientific events and studies, subsidy cuts for the COMET-programme, reduction of appropriations to the Austrian Research Promotion Agency etc. On the other hand, the government agreed to allocate more money for the universities through its "offensive program" by annually €80m (2011-2014) and decided to increase the research premium for the corporate sector, which costs around €100m annually. In general, Austria aims to continue securing its R&D funding path, however, with some shifting in priority setting and severe hardship for many independent R&D performers, which are not directly owned by the state or the federal states.

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

The Austrian policy mix addresses a variety of R&D spheres and uses a rich portfolio of R&D policy instruments developed during the last three decades. Because of the growing concern about the coherence and efficiency of the R&D policy mix, a R&D system's evaluation was commissioned and a CREST policy mix review carried out. The main recommendations of the system's evaluation presented in May 2009 (Aiginger, Falk and Reinstaller, 2009) in terms of policy mix relevance are

- to advance from an imitation strategy to a frontrunner strategy characterised by the notion of excellence and thematic and economic leadership both in niches and qualitatively advanced businesses and industries;
- to transform from fragmented to coordinated and consistent public interventions based on a shared vision and a joint strategy;
- to enlarge the narrow innovation policy focus towards a stronger consideration of linkages towards educational policies and to put more emphasis on innovation framework conditions such as competition issues, international openness and mobility; and
- to change from a multitude of narrowly defined programmes to broader defined approaches based on prioritised fields of action (top-down).

Regarding the policy-mix, the CREST policy mix report (2008) raised further issues, such as

- a critical analysis whether to continue funding a broad spectrum of technological fields and industries rather than concentrating resources to key-priorities;
- a critical assessment concerning the dependency of companies on public subsidies and whether or not this might lead to a rather passive "funding culture" instead of an active innovation culture;

- a recommendation of continuing yielding synergies between national and European RTDI programmes (e.g. via ERA-NETs and 'joint programming');
- a recommendation for a streamlining of the existing funding portfolio; and
- a recommendation to shift from single company support towards collaborative R&D.

Little was followed-up yet of these recommendations because of the dominant necessity to tackle the budgetary consequences of the financial and economic crises. It is, however, expected, that the postponed governmental S&T strategy, which will most likely be presented early 2011, will affirm the goal to invest 3.76% of GDP in R&D, 2% of GDP in tertiary education and 1% of GDP in basic research. Even though, this would mean lower yearly growth rates than in the last decade (Janger et al., 2010). Evidently, more efficiency and efficacy in terms of research funding is required which calls for more selective priority setting, probably towards investments in areas with higher industrial leverage effects and more social profit. Also the share of public funding of R&D should be reduced to 33%.

In general, R&D in Austria is characterised by high shares of R&D performance by the corporate sector with a significant financing share coming from abroad (mainly foreign firms with Austrian subsidiaries). In 2007 (available data from the last complete inventory count), the R&D performing enterprises financed their expenditure mainly from own funds. 71% of all R&D expenditures were raised from the (domestic) business enterprise sector. 20% of the expenditures or €888m were inflows from abroad. 8.4% of total R&D expenditures or €368m were funded by the public sector; the largest part of this amount is due to the "research premium".[5]

Table 2 shows the evolution of R&D in the corporate sector during the last couple of years.

Table 2: Evolution of R&D in the corporate sector

	2002	2004	2006	2007
No of R&D performing units in the corporate sector	1,942	2,123	2,407	2,521
Expenditures in million €	3,131	3,556	4,449	4,846
In % of R&D performance	66.8%	67.7%	70.4%	70.6%

Source: Statistik Austria, 2010

Public financing of R&D performance in the business sector grew from 6% to 10% during 2002 and 2007, while the share of funding from abroad declined from 29 to 23%. In absolute terms, however, even though funding from abroad increased by 21%, but remained significantly below the overall increase in R&D funding of 55% during 2002 and 2007.

Publicly supported RTDI funding schemes for the business sector range from simple, easy accessible ones like "innovation cheques" or the "research premium", to qualitatively more demanding ones, which are in general straightforward in terms of application and implementation.

[5] Statistics Austria, http://www.statistik.at/web_en/press/pressemitteilungen_laufendes_jahr/7/037203?year=2009&month=7; accessed on 7 November 2010

The total gross finances for R&D in Austria grew at an average yearly rate of 7.8% between 1999 and 2007 and by 4.4% between 2007 and 2010. The average yearly growth rate of governmental R&D expenditures was 6.0% between 1999 and 2007 and 12.7% between 2008 and 2010. The average yearly rate of growth of business sector financed R&D was 10.1% in the period from 1999-2007 and stagnated almost since then (0.4% average yearly growth rate between 2007 and 2010). The appropriations from abroad grew correspondingly at a yearly average rate of 6.6% in 1999-2007, but declined by -1.5% between 2007 and 2010.

This indicates a shift in the dynamics of R&D financing in Austria. The federal government sector increased anti-cyclically its share in overall R&D expenditures from 28% in 2007 to 35% in 2010, while the percentage of gross R&D financed by industry decreased to 43% (compared to 49% in 2007). Together with its R&D financing from abroad, the percentage of gross R&D financed by industry in 2010 is expected to be around 60%. The remaining appropriations are from the Austrian provinces (5%) and from other sources (1%) (BMWF, BMVIT, BMWFJ, 2010).

There are several risks for not-attaining the 2% BERD: foremost, the comparatively high inflow of foreign R&D investment, from which several Austrian industries depend, needs to be secured. This requires attractive hard and soft locational factors and framework conditions. To reach the 2% BERD goal in the future, foreign R&D investments should not only follow production, but also excellence. The development of R&D excellence, however, requires additional efforts from both the private and the public side. Secondly, and in conjunction with the before mentioned, the business-enterprise sector needs to be more oriented towards high-tech and radical innovations with longer development phases and congruent risk-taking, which should be supported by adequate funding systems (Tichy, 2009). Thematic and market leadership has to be attained in productive and service-oriented fields, which cannot be easily copied by competitors. This would lead to higher and more sustained R&D expenditures of the frontrunner companies including positive trickle-down effects to subcontractors and new business investments. Thirdly, the business environment for new innovative companies must be improved, especially in the field of high-tech sectors. Attractive R&D infrastructures and qualitatively high-educated personnel need to be provided to meet the demands of innovators and to counterbalance structural market failures.

Regarding the six ‘routes’ identified in the policy mix project to stimulate R&D investments, the findings of the ERAWATCH country report 2009 are still valid. The Austrian system addresses all six routes. Most emphasis in budgetary terms is given to (a) the stimulation of greater R&D investment in R&D performing firms, (b) the increase of extramural R&D carried out in cooperation with the public sector and (c) the increase of R&D in the public sector (Hofer, 2009).

The issue of innovation-oriented public procurement policies in Austria was substantially activated by European deliberations and initiatives. The Austrian Federal Ministry of Economy issued a procurement guideline in 2007 which reflects the handbook of the EC and puts it into the Austrian context. Moreover, the BMVIT, which is Austria’s custodian of shares of a few state-owned enterprises with large procurement volumes, commissioned a study on good practices (Buchinger and Steindl, 2009) and kicked-off a dialogue with large infrastructure providers about innovation oriented infrastructure policy and public procurement in 2009.

According to the Austrian public procurement law innovation-oriented aspects can best be tackled through the choice of the award procedure, the formulation of the terms of reference and the admission of alternative offers (BMWF, BMVIT und BMWFJ, 2010). A promising way is also the introduction of non-discriminating pre-competitive dialogues to explore the market and innovation potentials for certain areas (Hörmann, 2010). The Austrian approach towards innovation-oriented public procurement is mission-oriented (also towards lead-markets), rather based on voluntary standards and still in an experimental phase.

In general, Austria as a small country with a high share of foreign trade has a competitive, open market business environment with favourable conditions for private investment in R&D, which is evidenced by the large R&D funding inflow from foreign companies. Both direct and indirect funding schemes for companies are sufficiently developed and professional agencies are in place to effectively enforce the resources provided. Eco-innovation has been promoted through a series of RTDI programmes in Austria since long in the construction sector. As a response to the crisis, the AWS implements a new measure with a budget of €20m to support investment in "green products" for the creation of "green jobs" in 2010. Target areas are energy efficiency, renewable energies and recycling. Statistic Austria estimates that 61.4% of all innovation active Austrian companies have been engaged in eco-innovation during 2006 and 2008.[6] For a further stimulation of eco-innovation, the persistent lack of sufficient private risk and venture capital is a weakness in the Austrian context.

Finally, also IPR protection and IPR enforcement are duly implemented in Austria and safeguarded by the Austrian Patent Act, the Austrian Copyright Act, the Austrian Industrial Design Act and the Austrian Trademark Protection Act. On an international level, protection of intellectual property is ensured by entering into international agreements. Austria has signed a series of treaties under the auspices of the World Intellectual Property Organisation as well as the Agreement on Trade-Related Intellectual Property Rights. Austria is also a member of the European Patent Office, the EU authority for registering trademarks and designs, UNESCO and the International Union for the Protection of Varieties of Plants.

2.2.3 Providing qualified human resources

The provision of enough qualified human resources, especially the supply of S&T graduates, remains one of the highest risks for a further advancement of R&D in Austria. If the core definition of human resources in science and technology (HRST) is applied, namely economically active population in the age group 25-64 with tertiary education *and* employed in academic jobs or as technicians in equal occupations, than the Austrian rate of 11.5% is the fourth-lowest in the EU in 2007 (compared to an EU average of 17.1%) (BMWF, BMVIT and BMWFJ, 2010). This low rate depends mostly on the low share of population with attained tertiary education. While 26% of the active population in the EU has a tertiary education achievement, the Austrian share was only 18% in 2007. If HRST are defined by occupation only, than the Austrian share of 29.7% correspond to the EU average of 29.9%. This is especially caused by the influx of graduates from secondary vocational education schools into the category of academic or technical jobs in particular in the private sector. In total, the share of people with secondary education in academic, technical and equal jobs in Austria is 56%, while the EU average is only 38% (BMWF, BMVIT and BMWFJ, 2010).

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[6] Statistics Austria, http://www.statistik.at/web_de/statistiken/forschung_und_innovation/innovation_im_unternehmenssektor/index.html; accessed on 7 November 2010

57.1% of HRST by core definition are employed in Austria in the (mostly public) education sector and non-market service sectors. This corresponds to the EU distribution (56.6%). 14.6% are employed in Austria in the productive sector (EU: 14.7%) and 28.3% in market-based services (EU: 28.7%). Specific differences between the EU average and Austria can be observed concerning the distribution of HRST defined by tertiary education attainment only. By this definition 56.0% work in the mostly private productive and market-based service sector, which is slightly higher than the EU average of 53.5%. This statistical overhang is especially caused by the higher relative rate of employment of human resources with tertiary education in the productive sector in Austria (25.0% versus 19.2% in the EU) (BMWF, BMVIT and BMWFJ, 2010).

The past human resource policy proved successful during Austria's catching up phase, but there are signs that a turning point may have been reached (OECD, 2007). Demand structures in industry and public research units, for instance, place more emphasis on qualifications from tertiary education (Hofer, 2009).

There are indications that providing qualified human resources for R&D is one of the key challenges faced in Austria: the 9.8% share of graduates in science and technology is lower than the EU average of 12.9%. This is aggravated by a severe gender bias. The share of women graduating in S&T in Austria is only 4.6 % compared to 8.2% in the EU[7]. Moreover, education expenditures are below the OECD average, especially for tertiary education. To overcome the low demand of students for the fields of mathematics, informatics, natural sciences and technology, the BMWF Research launched an information offensive in August 2010. This initiative has to be seen also in front of the discussions to limit or at least steer the access to some study programmes in Austria, since 60% of all freshmen enrol in only 10% of the study programmes offered.

Recent initiatives to make children aware of S&T and actions taken to ease the flow of researchers, whether by opening up the labour market or by supporting mobility, suggest positive development and a serious effort to tackle the problem of supplying enough HRST. Furthermore, the attraction of women into science, technology and engineering fields is a part of these efforts.

The ministries responsible for R&D have also recently launched two new initiatives addressing the 'next generation' of researchers: the 'sparkling science' programme of the BMWF to bridge between schools and (mostly) public research organisations and the 'Forschung macht Schule' programme of the BMVIT bridging between schools and applied, often industrial oriented research. The later also supports internships in companies or research organisations working in the field of SET.

Such initiatives are also applied to foster creativity, innovation and entrepreneurial thinking and understanding. Innovation is particularly supported at school level through the 'Jugend innovative'-Programme implemented to generate technological, business and design innovations (Schuch and Scheck, 2007). It is a cost-efficient programme, highly demanded by especially technical oriented secondary schools to implement school projects. Entrepreneurial education falls under the authority of the department of vocational education of the Austrian Federal Ministry of Education, Arts and Culture (BMUKK). It is an educational principle and embedded in different courses only taught in vocational schools ("Berufsschulen") and secondary business schools ("Handelsakademien") and practically complemented by virtual 'training

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[7] Eurostat, 2008.

firms'. For teacher training a course on 'entrepreneurship and management' is offered by Austrian pedagogical higher schools at the post-secondary level. To foster entrepreneurial spirit the BMUKK founded a competence centre on 'entrepreneurship education for school innovation'.

The attractiveness of scientific careers suffered from the implementation of the University Act 2002 and the subsequent lack of tenure track opportunities and clear career perspectives. According to a study on the remuneration of scientists in Europe (EC, 2007b), Austria has the highest remuneration level in Europe. However, despite this high average, there are significant variations in the employment status of researchers in the Austrian science system. Young researchers are often stuck in precarious contracting situations with constrained career perspectives. In 2009 a collective agreement for university employees – made between the association of Austrian universities and the labour union – was implemented after a six years negotiation period. However, the provision of PhD and post doctoral positions in combination with adequate career opportunities is still problematic, not at least through the practice of temporary contracting. Moreover, the budget consolidation measures will probably lead to a fierce labour market for researchers, especially at non-university research organisations in 2011.

In general, political debate over the future organisation and structure of the education system has been controversial and ideologically biased in Austria. A core issue is the early separation of pupils at the age of 10 into different school types which strongly influence the future job and life perspectives and may cause premature dysfunctional allocations and wasted potentials. The government has taken small initial steps towards reform, for instance by introducing a new type of comprehensive secondary school in 2008. To overcome the ideological stand-off in Austria, an across party-lines petition for a referendum has been kicked-off in November 2010.

2.3 *Knowledge demand*

As detailed in the ERAWATCH Policy Mix Report for Austria (2009), it has become common sense that the Austrian catching-up phase is coming to an end and Austria is becoming a top R&D performer in the EU. This was proclaimed and evidenced by a series of studies like the 'WIFO-Weißbuch' and the 'Excellence strategy' in 2007, the CREST policy-mix report in 2008 and the results of Austria's R&D system's evaluation in 2009, as well as within the 'Research Dialogue' in 2008, within which the opportunities and demands of the research and innovation system have been discussed. From the 'frontrunner's' perspective, the drivers of knowledge demand are expected to change and staying on top of the quality ladder ('to be excellent') will become more important than achieving success through imitative behaviour (Hofer, 2009). Together, these discussions have resulted in an orientation for future expenditure requirements referencing 3.76% of GDP on R&D, 2% on university research and 1% on basic research in order to achieve and secure a 'frontrunner position' in 2020.

A steady and steep increase in demand for 'business knowledge' was just one of the observable trends before the financial crisis. Highest relative R&D growth in terms of the gross value added was recorded in the high-tech knowledge intensive service sector, which almost doubled its share between 2002 and 2007. For the first time, the high-tech knowledge intensive service sector had a higher R&D-intensity (in % of gross value added) than the Austrian high-tech productive sector. The share of the productive sector in % of R&D expenditures of the total corporate sector slightly decreased in Austria from 73% in 2002 to 70% in 2007, while the share of the service sector in % of R&D expenditures of the total corporate sector slightly increased from 26% to 29% in the same period. The strongest growth in this respect was in the medium-tech productive sector (from 36% in 2002 to 44% in 2007) and in the high-tech knowledge intensive service sector (from 12% to 15%). This growth was at the (relative) expense of the high-tech sector, which declined from 33% in 2002 to 22% in 2007 (BMWF, BMVIT und BMWFJ, 2010).

However, the recent financial and economic crisis has substantially affected business R&D spending, which almost stagnated since 2008. While for many years the private sector was the main driver of Austria's growth in R&D, this trend abruptly ended in 2009. This is primarily caused by the decline of R&D funding from abroad (-5.4% in 2009), especially from appropriations of multinational corporations to their Austrian subsidiary enterprises. A high level of sensitivity and risk associated with foreign developments and decision making has to be ascertained.

A recent assessment published in 2010[8], concludes that the structural change of Austria's economy in terms of value added, production and employment proceeds at internationally average pace (Berger, 2010). The structural change regarding R&D expenditures in the productive sector is by way of comparison rather moderate. The increase of the corporate R&D quota in Austria has been mainly caused by an extension of R&D expenditures within established branches rather than by structural shifts towards more R&D intensive branches. The rising R&D quota during the last decade evidences that even without structural changes considerably growth in R&D is possible. However, the study clearly addresses a fundamental data and systematisation problem at the level of industries and economic branches. Although the highest absolute shares of R&D are continuously to be found in high-tech industries and increasingly also in the advanced business service sector, restrained dynamics due to the absence of 'gazelles' and a large supply of new technology-based companies can be observed. This situation is structurally aggravated by a lack of private risk capital provision.

Regarding the type of R&D activity, no indicative signs towards a paradigmatic shift of R&D in Austria could be observed: the expenditures for applied research and experimental research increased by 38% respectively 55% between 2002 and 2007; and those for basic research increased by 44% in the same period. In 2007 the share for experimental research in % of all research expenditures was 47%, followed by applied research at 35% and basic research (18%). While basic research is mostly performed in the higher education sector (HES), experimental research (with slightly above 60%) and applied research (around 1/3) dominate the corporate sector. Basic research increased in the corporate sector from 4% in 2002 to 6% in 2007.

The federal governmental budget appropriations for research and research promotion (GBAORD) grew from €1.986b in 2008 to €2.413b in 2010. In 2010, the BMWF allocates the highest share (72.2%) in this respect, followed by the BMVIT (15.5%) and the BMWFJ (4.5%). In 2010 contributions to international organisations aimed at research and research promotion amount to €71.4m. The highest shares of the federal expenditure for research and research promotion in 2010 by socio-economic objectives can be found in the categories promotion of the general

[8] BMWF, BMVIT and BMWFJ (2010)

advancement of knowledge (30.4%), promotion of industrial production and industry (26.0%), and promotion of health (21.6%).[9]

In the last 10 years, the socio-economic objective category 'promotion of industrial production and industry' showed a substantial growth in its relative share (from 15.1% in 2000 to 26.0% in 2010). The categories 'promotion of social and socio-economic development' (7.0% in 2000 to 4.6% in 2010), 'promotion of exploration and exploitation of earth and space' (from 6.7% to 4.5%), 'promotion of transport, traffic and communications' (from 2.3% to 1.7%) and 'promotion of urban and rural planning' (from 0.8% to 0.6%) decreased substantially in relative terms, although with positive absolute figures. The share of the category 'promotion of agriculture and forestry' declined from 6.2% to 2.9%. This category even declined in absolute federal budget appropriations during the last 10 years. All other categories remained stable.

In a European perspective, Austria ranges in a middle group of EU Member States concerning GBAORD as a percentage of GDP and total GBAORD in € per inhabitant, but with an above average growth rate (Eurostat, 2008). Austria belongs to the EU countries with highest relative appropriations to GUF.

Some of the main societal challenges are addressed by thematic research programmes in Austria, although thematic funding remains relatively small in terms of budget appropriations, despite the large number of programmes. Apart from few exceptions the thematic research programmes apply similar funding designs and selection procedures and normally offer funding for collaborative and individual applied R&D projects. According to the FFG' statistics for 2009, a total of €138.2m (€109m in 2008) funding were provided to thematic programmes by the responsible ministries. The budget addresses societal challenges allocated to the thematic priorities 'technologies for sustainable development (incl. energy) (€38.2m), ICT (€26.4m), transport technologies (incl. aeronautics) (€26.8m), genomic research (€21.5m), nano-sciences and nano-technologies (€14m) and security research (€11.4m). In addition, the Climate Change and Energy Fund (KLIEN) has been implemented in 2007. It provides funding, among other things, for R&D projects that develop sustainable energy technologies.

Despite these instruments, several societal challenges which are considered common sense in Austria are not sufficiently targeted yet, many of which would require the mobilisation of social sciences (e.g. in the field of ageing society, poverty, governance research, migration/integration).

In 2009, 40.3% of the budget of €76.33m for individual bottom-up R&D projects distributed by FWF has been earmarked for life sciences; another 37.1% for natural sciences and engineering sciences and 22.6% for humanities and social sciences.

2.4 Knowledge production

The production of scientific and technological knowledge is the core function that a research system must fulfil. While different aspects may be included in the analysis of this function, the assessment provided in this section will focus on the following dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve the knowledge creation.

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[9] Statistics Austria, http://www.statistik.at/web_en/statistics/research_and_development_r_d_innovation/government_r_d_budget_analysis/index.html; accessed on 8 November 2010

2.4.1 Quality and excellence of knowledge production

In terms of volume of R&D spending, the enterprise sector is in the lead position, but due to the financial crisis, substantial growth in R&D expenditure could only be observed in the public sector in 2009. The positive pre-crisis development with growing R&D expenditures in the three important financing and performing sectors (corporate sector, public sector and abroad sector) has been accompanied by an observed need to focus on excellence in the public research sector and the fostering of joint knowledge production between private and public research institutions. An important element was to broaden the research base in Austria by increasing the number of R&D performing firms (especially SMEs). According to the EIS (2009), 35 % of all large companies in Austria are cooperating with universities. This is the third rank in the EIS in this respect. Cooperation between SMEs and universities is much lower. This is partly caused by the lack of HRST without tertiary education working in SMEs, which impairs the entry of contact across the sectors (Janger et al., 2010). On the other hand, the inclusion of SMEs into cooperative programmes doubtlessly intensified cooperation between small companies and public R&D providers, even across borders (Dall et al., 2010).

According to a recent stock-tacking study on research infrastructures (RI) (Austin, Pock and Partners, 2010), Austria is comparatively well supplied with small research infrastructures, but a deficit concerning larger, internationally visible infrastructures is evident. More than half of the RI in Austria have had procurement costs below €0.5m and were predominantly funded through public subsidies. More than half of the existing RIs in Austria are also located in HES. Although slightly more than 50% were put into operation within the last 5 years, a huge demand for additional new infrastructure at the amount of at least €1b to 1.5b was declared by Austrian research organisations. Thematic priorities are in the fields of life sciences, nano and material sciences as well as in the field of environment, energy and sustainability (Austin, Pock and Partners, 2010).

The number of employees in R&D increased by 36% (2002 vs 2007) to almost 90,000. Drivers of this growth are the corporate and the university sector. The number of full-time equivalents reached 53,000 in 2007. The share of scientific personnel employed in R&D fell from 62% in 2002 to 59% in 2007, which was mainly caused by the corporate sector (BMWF, BMVIT und BMWFJ, 2010). Regarding the quality of human resources in R&D, Austria shows above average rates in doctorate graduates per 1000 population aged 25-34 years, but considerably below average graduate rates per 1000 population aged 20-29 and among the population with tertiary education aged 25-64 years. Participation in life-long learning per 100 population aged 25-64 is above average and the youth education attainment level is close to European average (EIS, 2009). Problematic is the general education level of migrants. Despite the above average importance of migrants working in R&D in Austria compared to the EU average, it also has to be noted that migrants with high-qualifications are considerably more often without jobs than comparable Austrian born persons (BMWF, BMVIT, BMWFJ, 2009).

Considering the publication output, Austria's share in scientific publications worldwide is at 0.6%, and as to speed and subject matter it depends – like all other small countries – on global mega-trends (Schibany and Gassler, 2010). Of the 758.000 publications worldwide in 2007 only 4.800 came from Austria. Although Austria had an above average growth rate, expressed in its share of scientific publications worldwide, which rose from 0.61% in 1995 to 0.64% in 2007, Austrian researchers are performing just average or below average. While the European average of publications per researcher between 1997 and 2006 was 6.94 and, thus, considerably below the US average of 11.19, the national average was just 4.48, ranging somewhere between Greece and Spain. In terms of citations, Austria supersedes Greece and Spain, but is still below the European average (44.18 for Austria vs. 73.62 for EU-15 average). Regarding the number of often-cited researchers, which is an indication for the excellence of the research system, Austria ranges with 12 often cited researchers among the first 20 countries, but within considerable distance to the top-countries (BMWF, BMVIT, BMWFJ, 2009). This inconclusive pattern is probably mainly caused by the relatively low budget appropriations for basic research in Austria (0.41% of the GDP in 2009 or only 17% of all R&D expenditures).

In terms of the concept of Revealed Comparative Advantage (RCA), which measures the relative specialisation advantages of a certain country in a certain scientific field, Austria shows above average impact in the fields of molecular biology and genetics, physics and mathematics. In the fields of neuro-sciences and micro-biology a weak comparative advantage can be attested. On a global level, one can conclude that Austria's scientific research has a specialisation in natural sciences and formal sciences (BMWF, BMVIT, BMWFJ, 2009). Comparatively better are the throughput statistics, which position the Austrian output in terms of EPO patents per million population, the community trademarks per million population and the community designs per million population significantly above the EU-27 average (EIS, 2009). This is a clear indication for the performance orientation of applied R&D in Austria.

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

In general, this assessment shows no differences from the 2009 ERAWATCH Country Report (Hofer, 2009). There are only two addendums: the first one refers to the recent dispute on the distribution of public R&D spending in front of the budget consolidation crisis in Austria. This dispute emphasises the company-friendly research and innovation policy during the last 10 years in Austria and the comparatively lagging behind of the appropriations for higher education in general and for basic research in particular (FWF, 2010b).

The second addendum refers to the planned budget cuts in R&D as presented by the Austrian government end of October 2010. Several of the categories which will be reduced affect measures to improve the quality and excellence of knowledge production.

It is highly unlikely, that the additional resources from the so called 'offensive programme' earmarked for universities can compensate these reductions.

As already featured in the 2009 ERAWATCH Country Report[10], several efforts encouraging excellence in the last few years can be cited. One of the most important policy changes in this regard is based on the University Act of 2002. A major milestone in the long process of its subsequent implementation was reached in early 2007, when the first performance contracts with the BMWF were signed. The implemented formula, on which 20% of the institutional funding is based, consists of indicators in three distinctive areas. The first area is based on indicators describing teaching activities (e.g. number of active students, number of graduates), the second area consists of R&D related indicators (e.g. Ph.D.s, project volume financed by the

[10] Hofer, R. (2009)

Austrian Science Fund, project volume financed by industry or other sources), and the third is based on societal indicators (e.g. share of women in Ph.D. programs, participation in outgoing mobility programs, number of foreign graduate students). It is not clear however, what overall impact this formula may have on the orientation towards excellence. This issue was also raised in the CREST policy mix report, which argued for a more ambitious target setting in terms of output and excellence. A very recent assessment (Wissenschaftsrat, 2010) concludes that the first performance contracts did not generate new impulses due to a lack of formative will both on the side of the universities and the BMWF. Regarding the running performance contract period the situation improved, but the Wissenschaftsrat still identifies – among other issues - deficits in aligning the development plan of some universities with the performance contracts and a lack of critical reflection and accountability.

Another trend encouraging excellence through joint knowledge production initiatives reaches back to the 1990's: The COMET programme is one of these. It was launched in autumn 2006 as a follow-up to the previous 'competence centre programmes'. COMET is designed to fund larger and more (internationally) visible centres of competence for up to ten years. At the time being, five K2-Centres, which is the most advanced COMET level with a duration of up to 10 years, 16 K1-Centres with a duration of 7 years and 25 K-Projects with a duration of 3 to 5 years are operative[11]. The budget consolidation planning for the years 2011 until 2014, however, shows considerable cuts in the allocations for the COMET programme. The 'clusters for excellence' is another example of excellence and joint knowledge production-oriented policy. Other initiatives, like the 'Laura Bassi Excellence Centres' or 'Josef Ressel Laboratories', are following a similar trend.

As a final example, in 2006 the IST Austria (Institute of Science and Technology Austria) was set-up as a post-graduate academic institution. The institution aims to perform basic research at a world-leading standard which aims to open up and to develop new areas of research. The first heads of departments were selected and the institute became operative in 2008 (Hofer, 2009).

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences, e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or MS acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section will provide an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

Austria has a long tradition in stimulating interaction between different actors of the 'knowledge triangle' especially with respect to enhance science-industry relations.

[11] FFG: http://www.ffg.at/content.php?cid=531, accessed on 8 November 2010.

This has resulted in a rich portfolio of R&D programmes which are targeted at inter-sectoral R&D co-operation between the business sector on one hand and universities and non-university public and private research organisations on the other. The most important examples are already featured in the ERAWATCH Country Report Austria 2009 by Reinhold Hofer. These comprise low-key initiatives such as 'innovation cheques' or the 'research premium' as well as more demanding institutional arrangements such as COIN or COMET.

To foster a human resource based knowledge circulation between academia and SMEs as well as large enterprises which do not have an own research unit, the 'young experts'-programme has been launched, under whose framework master thesis and PhD thesis, which are firmly embedded in the R&D work of a company, can be supported. The programme has been recently extended towards the co-financing of post-doc positions employed at companies. The subsidy provides 80% coverage of personnel costs and, thus, is very attractive.

Another societal challenge related to the structural economic change in Austria is the stimulation of technology- and/or knowledge-intense start-ups in Austria. FFG supports innovative start-ups with up to 70% financial subsidy for technologically risky but economically promising R&D projects. In this field also cooperation with the federal states exists. In 2009, 114 start-up projects were subsidised with €33.0m, out of which 41 projects belonged to the high-tech sector (FFG, 2010).

To support young enterprises in the identification of potential partners and investors, FFG organises venture-capital-fora in which young entrepreneurs are matched with potential investors.

The creation of academic spin-off companies is assessed as a proper mechanism for circulating new educated R&D personnel from the universities into industry. The AplusB programme with a budget of more than €77m supports the establishment of centres owned by at least one academic institution and one institution with professional knowledge in business start-up support. 37% are financed by the federal state's budget, 33% by regional funding from the Austrian provinces and the rest by own means of the participating institutions. Until mid April 2008, the AplusB centres generated 236 technology projects, out of which 171 start-ups of technology enterprises emerged, out of which 144 are still operating on markets (BMWF, BMVIT, BMWFJ, 2009).

2.5.2 Cross-border knowledge circulation

Within the current governmental programme (Austrian Government, 2008), scientific and technological cooperation within the European Research Area and an extension of S&T cooperation towards global "frontrunners" and scientifically and economically dynamic regions has been emphasised. The Austrian Council affirmed in its strategy 2020 the importance of the European dimension and its usage for internationalisation towards third countries, for example by participating in international ERA-NETs based on a set of pre-defined criteria. Moreover, the Council emphasised an active scientific and technological neighbourhood policy towards Central, Eastern and Southeast European countries and a selected multi-instrumental approach towards BRIC countries and emerging regions.

In terms of cross-border knowledge circulation, the Austrian participation in the European Framework Programme for RTD (FP) is of particular importance. Firstly, the Austrian participation in FP has continuously been rising since Austria's accession to the EU and has been financially successful as of FP5 in terms of juste retour. Recent analysis confirmed that geographical proximity and language are important factors for the selection of cooperation partners (BMWF, BMVIT and BMWFJ, 2010; Berger, Gassler and Meyer, 2010). Austrian participants cooperate above average with partners from Germany and with partners from their own country. Slightly above average is also cooperation with the other neighbouring countries Switzerland, Slovenia, the Czech Republic, Slovakia and Hungary. The only exception in this respect is Italy. Moreover, cooperation with geographical closer countries such as Poland, the Western Balkan Countries and Romania is above average too (BMWF, BMVIT and BMWFJ, 2010; Paier and Roediger-Schluga, 2006).

Austria also makes extensive use of ERA instruments, especially ERA-NETs, to advance the cross-border knowledge circulation. Also international ERA-NETs and INCO-NETs are employed for this in a wider geographical dimension. Examples are the Southeast European ERA-NET PLUS and the Western Balkan INCO-NET, which are strongly supported by the BMWF as well as the international ERA-NET with Russia and the Eastern European and Central Asian INCO-NET.

This strong neighbourhood orientation was fostered through a multitude of unilateral and bilateral instruments employed by Austria during the last 20 years (Schuch, 2008). Many of these instruments are, however, rather low-key (e.g. mobility oriented measures or financial contributions for conferences etc. provided by the Austrian Science and Research Liaison Network in Central and Southeast Europe). An exception in size and scope is the CIR-CE programme, which has been incorporated into the COIN programme in 2008. This dedicated internationalisation scheme is unilaterally funded by the BMWFJ and targets on innovation oriented networking measures and technological development between Austrian companies (mostly SMEs) and companies from Central, East and Southeast Europe. The geographical orientation within this programme shifted during the last three years from the neighbouring countries towards a more inclusive approach of more East and Southeast European countries (e.g. Croatia, Russia, Serbia, Ukraine).

International R&D cooperation at the regional level of Austria’s provinces is rather an exception. The CENTROPE region (a cross-border regional network including the cities of Vienna, Bratislava, Brno and Gyor) includes some R&D elements and also Styria explicitly supports R&D cooperation towards Slovenia, as well as Croatia and other Western Balkan countries. Many of the regionally supported projects make use of the new Transnational Territorial Cooperation Programmes.

A result of the manifold connections towards Austria’s neighbouring countries has been also a noticeable influx of researchers and students from Central and Southeast Europe to Austrian HEI and research organisations during the last two decades.

Austria is also engaged in political agenda setting together with many Central European countries in the “Salzburg Gruppe” and has an active role in the ‘Steering Platform on Research with the Western Balkan Countries’.

Nevertheless, many of the recommendations in the 2020 Strategy of the Austrian Council for Research and Technological Development (2009) are far from being realised. This is also due to the aftermath of the financial crisis. The initially planned establishment of offices for science and technology or at least scientific attaché positions in Russia, China and India had to be cancelled. The network of Austrian Science and Research Liaison Offices in Central and Southeast Europe has been stepwise downsized during the last three years.

2.5.3 Main societal challenges

The main societal challenges are funded through mission-oriented thematic programmes in Austria and encompass first of all the fields of energy and transport. Additional priorities are established in security research, sustainable production and climate research. Another focus is on generic technologies, which include different priority fields such as genome research, the Austrian electronic network, nano-technologies and ICT research. Among the later, a specific thematic focus on ICT based approaches for elderly people has been established (including ambient assisted living). The budget appropriations in these thematic priorities increased significantly since 2007. In 2009 more than €138m have been funded in these thematic areas by the Austrian Research Promotion Agency, which is an increase of slightly more than 25% compared to 2008 and a quadruplication of the budget spent in 2007. A further, smaller priority has been recently established by the Austrian Science Funds in the field of academic clinical research with a budget of €3m for this year’s call for proposals.

2.6 Overall assessment

After a period of constant upswing of R&D financing from the corporate and public sector, the economic crisis put an immediate halt to a further increase of R&D financing from domestic companies and caused reductions of foreign R&D appropriations. At the overall level, these could be counterbalanced by an anti-cyclical public R&D spending policy. In the last three months of 2010, position of points regarding the budget consolidation, which also affects the field of R&D, became public and cause public debates. Structural weaknesses, for instance in terms of excellence, which were at least partially hidden by the spirit of constant R&D upswing during the last 10 years became apparent again. Austria invests 1.3% of GDP in tertiary education, which is below other R&D intense countries, such as Finland (1.7%), Sweden (1.6%) or Switzerland (1.4%). In a long-term perspective this allocation gap is considered as a threat for the supply of qualified human capital and the creation of useful basic knowledge and of adequate absorption capacities. Effects of budget cuts will be traceable mostly as of 2011.

Table 3: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	• Safeguarding a 2/3 share of the corporate sector by further promoting targeted science-industry programmes and indirect measures; • Common political understanding to safeguard the objective to increase the GERD/GDP ratio to 3.76 % in 2020; • Further facilitation of immigration and integration of non-national researchers (‘Austria Card’).	• Too much focus on leveraging industrial R&D financing and R&D performance could lead to shortcomings in basic research, structural excellence initiatives etc.; • A further stagnation or reduction of inflow of foreign R&D funding would require additional public funds to counterbalance this situation by further incentives; • Continuous shortage of private risk capital.

Domain	Main policy opportunities	Main policy-related risks
Knowledge demand	• Structural change of business knowledge demand towards the service sector could be more comprehensively addressed; • Grand challenges could be more explicitly funded; • Excellence of research and of public RI must be accelerated to meet the demand of high-tech service and manufacturing companies.	• Structural change towards high-tech economy with a knowledge-based radical innovation orientation is slow and neither decisively influenced nor supported by public sector financing of R&D; • Social scientific structures and capacities must be enhanced to contribute to grand challenges adequately in terms of quality and quantity.
Knowledge production	• Continuation of most of the programmes which serve the science-industry interface; • Establishment of a long-term university financing roadmap; • Focus on more excellence to safeguard absorption capacities.	• Forwarding the necessary reform of doctoral education is costly; • Basic sciences could be further hollowed-out if a critical minimum size cannot not be secured due to public budget crisis in the future; • Innovative top-end companies require increasingly qualified HRST, whose provision must be secured both in terms of quantity and quality; • Reduction of internationalisation efforts due to budget consolidation crisis.
Knowledge circulation	• Fortifying the strengths of the existing system and securing the existing funding portfolio; • Fostering HRD programmes to increase the permeability between private and public research; • Further modernisation of the education system.	• Clear-off of the private non-profit sector could create deficits in the science-society and science-industry nexus; • Permeability between the private and the public research sector for researchers is still very low; • Ideological arguments still dominate facts in the debate on education.

The Austrian research system has experienced a successful catching-up phase during the last 20 years, characterised by a remarkable increase of R&D funding both from private and public sources. Overall, the research system is both adequate and relevant to support the catching-up. The aspired advancement from an innovation follower to an innovation leader, however, will depend heavily on strategic system's adaptations. These must be based on an orientation towards excellence and openness, the consequent exploitation of already accumulated knowledge, and sound policy measures to address emerging challenges (Hofer, 2009). The research system, however, has several shortcomings, which need to be addressed. Foremost the provision of high-qualified human resources, especially in science, engineering and technology fields is insufficient. Doctoral education is not enough quality assured. Women are still significantly underrepresented in R&D and the school system needs to be fundamentally reformed to generate an adequate supply of young professionals. In 2010, several promising attempts continued to resolving this unfavourable situation. However, the issue of human resources can only be solved in the long-term.

Another weakness of R&D in Austria is its overwhelmingly incremental character, especially in the business-enterprise sector, which seldom produces radical product innovations. This is also consolidated by sub-critical funding programmes which generate also deadweight effects. While indirect funding for corporate R&D is comparatively high in Austria, competitive funding, especially in the field of basic research, must be extended. Especially research in the HES should be increasingly based on competition to generate and shape R&D specialisation and priority-setting. Therefore, the budgets for competitive programmes, especially those of the FWF, have to be increased and based on real cost principles. On the other hand, enough structural funding needs to be secured for non-university research organisations to implement quality assurance and strategies oriented towards excellence. Access to and provision of research infrastructures require increased attention.

In general, Austria has a well differentiated policy mix in place. For the promotion of private investments in R&D a sufficiently high number of R&D programmes which support cooperation between the corporate and the public sector is available in the R&D funding portfolio. However, instead of adding more programmes, the scope of existing ones should be more inclusive to avoid clientelism and endowed with larger budgets. In addition, direct and indirect measures are available to stimulate greater R&D investment in R&D performing firms. The increase of the research premium as of 1 January 2011 to 10% should give a further stimulus. The challenge will be to stimulate more radical R&D and innovation endeavours, which can neither be steered no controlled by indirect funding. Another challenge is to stimulate firms that do not perform R&D yet. These firms are addressed by a large number of technology transfer and innovation support structures and especially the 'innovation cheques' instrument, which was greatly demanded by companies during the last few years. In order to safeguard the advantageous position of Austria in terms of foreign direct R&D investment, which is essential for sustaining a high R&D quota and securing openness towards international R&D developments, a number of support programmes are in place. However, to attract and keep foreign R&D headquarters sustainably in Austria, the entire R&D system in general needs to be continuously upgraded to provide optimal framework conditions for R&D intensive businesses. Finally, the establishment of new R&D performing companies is a necessary route to give not only more dynamic to the business enterprise sector per se, but to exploit academic knowledge in promising businesses ('gazelles'). Like the other policy mix routes, also this one is well addressed in Austria (Hofer, 2009).

Table 4: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
The economic crisis put the R&D performance of the domestic corporate sector on a hold. However, there are signs of overall economic recovery, while structural economic change towards high-tech sectors is progressing at medium pace.	R&D financing of the corporate sector was under pressure in 2009. Public support programmes were anti-cyclical funded to partially counterbalance the downward trends. In 2011, the research premium for companies will be increased to stimulate more private R&D expenditures. Coordination between the state and the regional level should be further strengthened for an optimal use of structural funds.
Foreign financing of R&D for the corporate sector declined sharply during the crisis. Whether 2009 was a point of break or not cannot be assessed. In fact, the relative increase of foreign financed corporate R&D during the years before the crisis occurred already at a lower level relative to other funding sources.	Single measures can hardly counterbalance this trend. Most decisive for foreign R&D inflow is a well performing and functional national and regional innovation system without severe systemic shortcomings and an open R&D environment. In general this is given in Austria. Further stimulus for domestic business (see above) will also benefit foreign R&D appropriations. A certain risk is associated with the level of R&D excellence in terms of human resources, infrastructures, research performing organisations etc. Company taxes in Austria are comparatively low and indirect funding for R&D in Austria is well developed and might even increase as of 2011.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Public funding for R&D was anti-cyclical in 2009 and 2010. The budget consolidation crisis will become effective as of 2011 and will affect the coming years most probably until 2014. This is true for both state and regional level.	The government decided to secure public funding for core areas like the HES, the FWF, the Austrian Academy of Science, the Austrian Research Fund, and the Ludwig Boltzmann Institutes, although partly without appropriate valorisation. Funding for universities as of 2013 (after the termination of the actual performance contract) is not secured. The funding portfolio in general should be sustained too, but there are several cuts described in this report which unevenly put hardship on certain research communities. Since also Austrian regions have to contribute to the reduction of public budgets, additional pressure from this level is to be expected, which will most probably affect organisations established/funded through regional means.
The private non-profit research sector, although very small in Austria, will most probably be one of the main losers of the current budget consolidation crisis. Budget appropriations from foundations or charities have been traditionally very small and public appropriations will be severely reduced.	Enhanced incentives for foundations to invest in R&D for public benefit could be used to counterbalance the budget cuts of the private non-profit sector, but for the time being there is no serious political backup for such attempts. The clear-cut of this sector could cause negative impact on the science-society interface and in the field of social sciences and humanities. There is a political wish to integrate some of the institutes of this sector into universities, but there is little fresh money available for this endeavour. Moreover, some of the institutes show entrepreneurial flexibility which can hardly be secured in rigid hierarchical structures.

3 Interactions between national policies and the European Research Area

3.1 *Towards a European labour market for researchers*

The Communication Better careers and more mobility: A European Partnership for Researchers proposed by EC in May 2008 aims to accelerate progress in four key areas: Open recruitment and portability of grants; Meeting the social security and supplementary pension needs of mobile researchers; Providing attractive employment and working conditions; Enhancing the training, skills and experience of researchers.

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped under the name of EURAXESS – Researchers in Motion. Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced 'brain circulation', with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the 'brain drain' rather than brain circulation.

3.1.1 Stocks and mobility flows of researchers

The share of human resources in S&T (HRST) in % of the working population aging between 25 and 64 years, defined as population either with a tertiary education *or* employed in a scientific or technical occupation, in Austria is 39.0% in 2009 and corresponds to the EU-27 average of 40.1%. Evidently, only a small share of this population is engaged in R&D. If a more narrow core definition is applied, namely to consider only a population with tertiary education who is also actually working in a scientific or technical occupation, than this share in Austria is 11.5% (2007), which is considerably lower than the EU average of 17.1% (BMWF, BMVIT, BMWFJ, 2010).

According to the last complete R&D census in Austria (2007), 89,458 persons (headcount) were employed in R&D. 53,590 were scientific personnel, 25,623 were higher-qualified non-scientific personnel and another 10,245 were supporting personnel. In full-time equivalents, 53,252.2 FTEs were employed in R&D in Austria in 2007, out of which 31,675.6 were scientific personnel, 16,277.9 higher-qualified non-scientific personnel and another 5,298.8 were supporting personnel. In terms of FTEs, 69.46% were employed in the corporate sector, 25.56% in the higher education sector, 4.67% in the public research sector and only below one percent in the private non-profit sector. The share of women in terms of FTE amounts only to 23.7% across all sectors. It is particularly low in the corporate sector (15.8%).

The distribution of R&D personnel is quite concentrated. Almost three quarters are located in three federal states only: 38.4% are located in the capital city Vienna, 18.8% in Styria and 15.1% in the Austrian province of Upper Austria.

Most negatively impacted by the financial and economic crisis in Austria were persons with low qualifications. The impact on R&D personnel is yet hardly traceable. Vocational leave ("Bildungskarenz") was granted to a limited number of R&D personnel whose further return to the job and uptake is not yet investigated. Also the impact on the labour market for R&D personnel, due to the subsequent crisis to consolidate the public budget can only be assessed as of 2011 when the public budget cuts will become effective. In general the sectoral mobility of HRST in Austria is comparatively lower than that of human resources in other fields. This indicates a higher level of job security, which is due to a general larger demand for higher qualified labour. Consequently, also the transitions of HRST from unemployment or inactivity to employment status occur less frequently. An Austrian specific compared to the EU is that male HRST are less mobile than female HRST (BMWF, BMVIT, BMWFJ, 2010).

Austria disposes a high share of foreigners among its HRST. Each year between 0.4% and 0.7% of all employed HRST in Austria are immigrating to Austria, which is above the European average (BMWF, BMVIT, BMWFJ, 2010). While in the EU on an average 0.3% of HRST (in the core definition) in 2007 worked one year before abroad, this share in Austria is almost twice as high (0.59%). This is mainly due to a considerably above EU average immigration of people with tertiary education to Austria. Austria partially balances its low share of population with tertiary education in this respect.

Even more significant is that in Austria 15.9% of all HRST (in its core definition) were born abroad, while the EU average is 9.0%. Thus, in terms of foreign born population in HRST, Austria ranks on the 4th place in the EU after Luxembourg, Cyprus and Spain (BMWF, BMVIT, BMWFJ, 2010). But this does not mean that Austria is pursuing a selective immigration policy. On contrary, the share of foreign born HRST (according to the core definition) measured against all foreign born working population in Austria is with 10.3% rather low if compared to the EU average (13.8% in 2007). Foreign born HRST stay also considerably shorter in Austria if compared to the EU average. While 61.5% of foreign born HRST in Austria are remaining 10 or more years in the country, the EU average share is 68.9%. A fifth of the foreign born HRST in Austria comes from the New Member States, which is significantly higher than the average EU share. This reflects not only the short history of high-qualified migration to Austria, which changes the traditionally rather low qualification structure pattern of migrants, but highlights also the structural importance of the integration of the former communist countries located in immediate Austrian neighbourhood for Austria.

However, like in most small European countries, also a remarkable share of Austrian born HRST lives abroad. According to the European working force census (2007), 0.8% of all Austrians are working in other EU countries.

According to data from the 2nd 'Careers of Doctorate Holders Statistics', in which Austria participated for the first time, around 25,800 doctorate holders according to ISCED level 6 are living in Austria (data from 2006). A seventh of these were not born in Austria. Among the foreign born doctorate holders two fifth are from Germany. Comparatively low 8% of the doctorate holders living in Austria received their doctorate abroad. Around 10% of the doctorate holders living in Austria do not have Austrian citizenship. 36.5% of the doctorate holders living in Austria received their doctorate in social sciences, followed by natural sciences (30.7%), technical and engineering sciences (14.3%), humanities (12.2%), agriculture and forestry (4.6%) and medical sciences (1.7%). The share of non-Austrian doctorate holders from natural sciences who live in Austria is particularly high and balances a little bit the comparatively lower share of Austrian-born doctorate holders in this domain BMWF, BMVIT, BMWA, 2008).

93% of the doctorate holders were employed, while only 2% were unemployed, which is considerably below the average Austrian unemployment rate. Among the doctorate holders with social scientific background, a fourth works as attorney, each seventh in a social scientific position and 1,173 work in the tertiary education sector. Among the doctorate holders with a natural science background most work as physicists and chemists (BMWF, BMVIT, BMWA, 2008).

The international mobility among doctorate holders is comparatively high, although around 70% were living in Austria since 10 or more years without breaks. Germany is by far the most important destination of mobility. The most important factors for migration or return back to Austria are of personal, economic and political nature.

In its aspiration to become a 'frontrunner' in R&D, Austria suffers from a low share of graduates in science and technology, making human capital one of the most pressing challenges for the Austrian system (Tiefenthaler, 2009). Thus, measures were launched in recent years to attract foreign researchers and expatriates, as well as supporting the mobility of Austrian scientists. Special measures have also been taken to address the problem of female researchers.

The most important information sources for mobility support are the Austrian Researcher's Mobility Portal and the database, http://www.grants.at. Different kind of grants, managed by a variety of organisations, support mobility. Main contact points are the OeAD and FFG.

3.1.2 Providing attractive employment and working conditions

Austria was among the first European Countries to both adopt the EC directive on researchers' visas and install a Researchers' Mobility Portal. The Austrian Federal Ministry of Science and Research (BMWF), the former Austrian rector's conference, the Austrian Agency for International Cooperation in Education and Research (OeAD), the Austrian Science Fund (FWF), the platform "Forschung Austria" and 18 public research organisations have already signed the charter for researchers.[12]

The development of the Austrian HES has generated different kinds of employment. In the 'old' regime, most academic staff at universities received, following temporary employment contracts and a kind of tenure status, the status of civil servants with life-long employment ('Beamtenstatus'). Others received public contracts based on law ('Vertragsbedienstete'). Both were paid in accordance with the law on civil service ('Gehaltsgesetz'), i.e. they received wages based upon a pre-defined scheme and not upon individual merits. Following the University Act in 2002 the 'civil service route' was no longer open to new academics (beginning in 2004) (Hofer, 2009). Based on the University Act in 2002, the new regular tenure track starts with a temporary contract of a former master student as assistant in training ("AssistentInnen in Ausbildung"; §5). After the achievement of the PhD one can eventually become an assistant professor who is evaluated after five years according to a performance agreement in order to advance to an associate professor. Earliest after five more years and following a positive evaluation a full professorship can be achieved. For the promotion, bibliometric analysis is increasingly applied (ERAWATCH Network, 2010). Universities are now free to contract researchers based on private law, which led to a stronger increase of temporary contracts compared to tenure track positions[13]. Personnel employed on basis of third-party funded projects are usually working with temporary contracts. The same applies for most lecturers and student assistants. The first collective agreement ("Kollektivvertrag") for universities corresponding to the new autonomous character of universities came into force in October 2009. Its impact on career development cannot be assessed yet, but it doubtlessly enhances transparency, regulates minimum salaries, increases the period of cancellation of employment contracts and most likely will facilitate the mobility between different universities. Still, in November 2010 the labour union officially complained in a letter sent to the Austrian government about the very limited opportunities of scientific personnel to obtain permanent contracts (GÖD, 2010).

The non-university research sector depends considerably more on third party funded projects than the universities. As a consequence, temporary contracts are more frequent, although their repeated application is suppressed by labour law. In general, however, even regular ('permanent') contracts can be easily terminated in Austria. Therefore, the main problem for many researchers working outside the limited number of regulated tenure track positions is rather to procure new research funding to secure employment. The impact of the budget consolidation crisis on the employment situation of researchers might be assessed as of 2011.

Issues pertaining to female researchers are particularly challenging. Although more than half of all university graduates and nearly 42% of all PhDs are women, their level of participation in research careers is among the lowest in the EU. This is especially the case in the business sector. Also the representation of women in leading positions is very low. This 'leaky pipeline' phenomenon is blatantly visible in Austria. Austria has one of the thickest 'glass ceilings' in the EU, although a look into other economic or societal sectors reveals that this is not limited to careers in R&D.

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[12] http://ec.europa.eu/euraxess/index.cfm/rights/charterAndCode, accessed on 8 November 2010.
[13] Interview with Professor Ulrike Felt in "Der Standard" on "Der Umgang mit dem Nachwuchs ist nicht ehrlich" (‚The handling of the offspring lacks honesty'), 23 February 2011, p. 14

According to more recent figures (University Report, 2008), the share of women among students in Austria is 53%, but only 25% in the scientific university personnel and only little above 15% among the professors (Gutiérrez-Lobos, 2009). In 2008 no female rector was leading one of the Austrian universities (which changed in 2009).

Although maternity leave is by law not a discriminating factor in Austria, statistics also reveal that children are a risk for careers. The share of female professors without children is around 45% in Austria, while it is only around 25% in Poland, 18% in Sweden and slightly above 10% in France or Spain (Lind and Banavas, 2008). Only Germany has a higher share of female professors without children. The long grace period for maternity leave and the lacking supply of nursery schools and kindergartens in Austria lead to a gradual retreat of women with young children from the labour market. A voluntarily long maternity leave is also supposed to lead to de-qualification; anyway to lower scientific output. The law stipulates that women have the right to restore to an equal (not necessarily the same) position as before their maternity leave. There are some other precautions deemed advantageously for the family-job balance (but not necessarily for career advancement) such as that women are for instance legally entitled to have a part time position when the end their maternity leave. Pregnancies also automatically freeze temporary contracts in Austria unless there are legal reasons or duly justified.

Austria has put in place various measures to increase the rate of women in science and industry. In the University Act a women quota in university committees of 40% is stipulated, which went into force on October, 1st, 2009. Activities encompass a variety of measures, such as human resource development measures, recruiting of female scientific personnel and implementation of gender monitoring and gender budgeting. Also a number of instruments have been launched under the umbrella of an inter-ministerial action programme ‘fforte' ('Women in Research and Technology') to counteract the low rate of women in R&D. Given the modest budget for these measures and the cross-cutting nature of the problem, it is unlikely that the condition for women in research will improve significantly unless gender mainstreaming becomes standard in all R&D policy measures – and beyond (Tiefenthaler, 2009).

3.1.3 Open recruitment and portability of grants

Overall, both the mobility of researchers and support for internationalisation through the opening up of the labour market for researchers are well developed in Austria. Non-Austrians are eligible in competing for permanent research and academic positions. Depending on the funding programme, research grants are also partly portable and can be transferred by the grantee to another national or foreign institution. This is especially the case for grants provided on individual merit base, where the applicant is an individual researcher and not a research organisation (like in the case of most FWF-grants). If this is not the case, agreements have to be negotiated with the research organisation.

For the recognition of academic diplomas and certificates, Austria has since long established a National Academic Recognition Information Centre which provides support. Due to the long-lasting experience of the Austrian ENIC-NARIC centre, most cases can be treated in an efficient manner.

With regard to the mobility of researchers, Austria was among the first European Countries to adopt both the EC directive concerning researchers' visas and to install a Mobility Portal. Moreover, Austria is actively supporting the Bologna process. A national contact point has been established in the BMWF, which is responsible for universities and tertiary education. A wide range of measures aim to provide support for the international mobility of researchers. In recent years, special emphasis has been placed on attracting expatriate researchers back to Austria (Hofer, 2009).

FFG and OeAD are partners in the European EURAXESS networks and inform about fellowships and research grants, immigration and residential regulations, work permits, housing, health and medical care, language courses, diploma recognition and more. Research organisations can advertise their research positions free of charge there. Moreover, a 'Guide to Residence and Employment of Foreign Researchers in Austria' has been published which is regularly updated.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

The Austrian system has fully opened itself up to foreign researchers concerning residence and work permits, but does not distinguish between researchers and other employees when it comes to social security. This means, that there is no special treatment of foreign researchers in terms of social security, pensions or health insurance. Eligibility for social security benefits depends on the employment contract. In a regular employment contract all researchers, irrespectively of their origin, are subject to social and health security contributions and to labour tax, unless there are individual special delegation provisions by a foreign employer. Length of stay and the type of contract held determine the type of social security applied in each case. All kinds of information relating to these matters can be found via EURAXESS. Tax incentives to facilitate the participation in supplementary private pension schemes apply to the entire population.

It goes without saying, that for EU/EEA citizens no right of entry or residence is required. However, due to a negotiated transition period, the Austrian labour market for citizens from the new EU member states is still restricted until 30 April 2011.[14] Researchers from third countries who wish to work at a research institution or a researching company in Austria for more than 6 months may choose from three modes of residence, depending on the intended period of stay and activity.

- "Residence Permit – Researcher" (quota-free);
- "Residence Permit – Special Cases of Paid Employment" (quota-free);
- "Settlement Permit – Key Worker" (subject to quotas) (Federal Ministry of the Interior, 2008).

The 'Residence Permit – Researcher' is intended for third-country nationals who can provide proof of a hosting agreement with a certified research institution or a research institution that does not require certification. The 'Residence Permit – Researcher' is issued for a period of up to 12 months and may be extended within Austria (Federal Ministry of the Interior, 2008).

The 'Residence Permit – Special Cases of Paid Employment' is for internationally recognised researchers and other researchers who do not have a Hosting Agreement with a research institution. Internationally recognised researchers whose intended employment in Austria serves the development or extension of sustainable economic relationships or the creation or protection of qualified jobs, and who receive

[14] For citizens from Bulgaria and Romania the Austrian labour market will most probably not be fully open before 2013.

a monthly gross payment of at least €4,932 (2009) for this are exempted from the scope of application of the Aliens Employment Act *[AusIBG]* and permitted to work without an employment permit. The "Residence Permit – Special Cases of Paid Employment" is issued for a period of up to 12 months and may be extended within Austria (Federal Ministry of the Interior, 2008).

The 'Settlement Permit – Key Worker' applies for researchers who meet the requirements for key workers with regard to their qualifications and the payment offered to them. If researchers together with their family wish to live and work in Austria permanently, they may obtain a settlement permit within the scope of the quota for key workers. There are, however, criteria for key workers, such as a particular qualification demanded on the Austrian labour market or special expertise and a monthly payment of €2,466 gross/month (2009). The key worker researcher receives a "Settlement Permit – Key Worker" out of the quota for key workers for a period of maximum 18 months, and is permitted to work with this without any further permit related to labour market law. After 18 months, the key worker researcher receives a "Settlement Permit – Unrestricted" for 12 months, if the key worker researcher was employed as key worker for twelve months during this period of time (inspection by the employment services office) (Federal Ministry of the Interior, 2008).

Except the last of the three modes, also the family migration conditions are favourable. The last mode, however, falls under a quota regulation.

Late 2010 a new immigration regime to become effective mid of 2011 was announced in Austria, the "rot-weiß-rot"-card, which should simplify the immigration for qualified personnel, including HRST, and facilitate and increase the inflow of qualified migrants to Austria.

3.1.5 Enhancing the training, skills and experience of European researchers

The share of completed doctorate studies in Austria is high compared to OECD and EU average, which would indicate a relatively high potential for R&D activities. Though, the traditional Austrian doctorate study does not equal a full-fledged research oriented PhD study and does not in each and every case lead to competency for conducting independent research, due to the sometimes weak supervisory role of the 'doctor father', the remote integration of the PhD student into the faculty and the yet insufficient supply of top-end courses to increase the methodological research competency of the PhD student[15]. Not surprisingly, the official 'research maturity' in Austria is attained only with the "Habilitation" (post-doctoral lecture qualification) (BMWF, BMVIT, BMWFJ, 2010). The FWF concludes that Austria is educating an above average share of doctorate students, of whom many do not strive for a scientific education, who also do not receive a professional scientific education and training and who are not adequately integrated into the science system (FWF, 2010).

In front of this background, doctoral education is undergoing reform. In the past, doctoral education in Austria has been dominated by individual monitoring, rather than by systemic and structured training. The University Act 2002 provides a new

[15] To improve the situation in the field of social sciences for instance, the BMWF supported the SOQUA-programme, which aims to upgrade the methodological and practical research skills of postgraduate social scientists in Austria (www.soqua.net).

legal basis for the reform of doctoral education in Austria. This shift is also made in response to the Bologna Process. Accordingly, the FWF has provided funding for graduate schools since six years, which can be considered as good practices in Austria. In total, 67 doctorate studies have been implemented at the Austrian universities in the winter semester 2008/2009. 27 of those were based on the new 3 years Bologna design. Still, the larger share was offered as two years studies.

In order to increase the quality of the doctorate education, more than half of the universities have committed themselves in their performance contracts to establish additional new ones (FWF, 2010). Admittedly, the implemented design approaches for the doctorate study programmes show a high variety and often do not meet criteria of professional, structured doctoral education programmes (FWF, 2010). The financing and social security of doctorate students remains one of the most central problems. The number of fellowships or employment contracts granted under doctorate studies is still low compared to the overall number of doctorate students and the net of graduate schools at the Austrian universities is far from being close-meshed. The majority of the granted fellowships are quite marginally endowed too. Foreign doctorate students can also participate in the doctorate programmes and/or schools if they are rightfully enrolled in a domestic university. English classes are still only exceptionally offered, but their enlargement is foreseen in some of the performance contracts of the universities.

Based on a study from 2008 (Pechar, Brechelmacher, Campbell, 2008) only 15% of the doctorate students (around 2,800 persons) were enrolled in a doctorate programme. The yearly average cost for each doctorate student was around €48,000. To secure a structured doctorate education for all doctorate candidates who aim at a scientific career would cost around €640m per year.

To counteract the low absorptive attraction capacity of the HES was one of the motivations to establish the Institute of Science and Technology Austria (IST Austria). It is a new institute dedicated to basic research and graduate education in natural sciences, located in the Vienna Woods. The graduate school of IST Austria is open to PhD applicants in biology, computer sciences and neuroscience as well as interdisciplinary areas from all over the world holding either am MS or BS degree (or equivalent). All participants are selected in an annual, institute-wide admissions procedure according to their research potential. PhD students are employed by the institute and will take advanced courses and contribute to the research of one or more scientific groups. The language of research and instruction at IST Austria is English.

3.2 Research infrastructures

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in the so called National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RI have already been created in Europe. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section will assess the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

The Austrian Council mentioned in its 2020 strategy a number of structural problems concerning the planning and management of research infrastructures (RI), such as

a) an insufficient coordination of research infrastructures and RI needs among the potential operators, funding agencies and ministries;

b) a lack of structured, long-term oriented top-down approaches and priorities;

c) a lack of adequate financial tools, since, apart from the structural programmes of the FFG and the University infrastructure programme, many research infrastructures have to be procured under project based funding arrangements which – very often – have shorter durations than the economic life-time of RIs; which leads among other things to

d) a sub-critical and insufficient endowment of RI in terms of basic infrastructures (Austrian Council, 2009).

In front of this critical assessment, the Austrian Council recommended to connect Austrian R&D closer with international infrastructures, to plan research infrastructures in a more integrative manner through the implementation of a national research infrastructures platform, which should prepare a national research infrastructure roadmap embedded in a long-term master plan; and to secure adequate financial resources sustainably.

On the 27 February 2009, the Austrian Parliament ratified the Austrian membership to ESO, but further endeavours to systematically tackle the issue of RI in Austria are at least interrupted due to the financial and economic crisis and the need to consolidate the public budget as of 2010. Latest available data from 2007 show that investments for technical equipment (without expenditures for buildings and procurement of premises) in the HES amounted to €110.543m, which represents 6.75% of the total expenditures in the higher education sector. Expenditures for buildings and procurement of premises accounted for another 1.8% in 2007. According to the latest available ESFRI implementation report (2009), a national Austrian road map is in preparation but has not yet been published.

3.2.2 National participation in the *ESFRI roadmap*. Updates 2009-2010

Austria participates (cut-off date March 2010) in three ESFRI projects, namely ESRF Upgrade and ILL20/20 in the field of materials and analytical facilities and BBMRI in the field of biological and medical sciences. The decision concerning E-ELT (the European extremely large telescope for optical astronomy) is still pending. The participation concerning CLARIN, CESSDA and SHARE (all in the field of social sciences and humanities) is planed, while the participation concerning FAIR in the field of physical sciences and engineering has been suspended due to budgetary reasons (BMWF, BMVIT, BMWFJ, 2010).

3.3 Strengthening research institutions

The ERA green paper highlights the importance of excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. The Universities/ research institutions should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system, assessing its research performance, the level of academic autonomy achieved so far, dominant governing and funding models

3.3.1 Quality of National Higher Education System

In Austria 22 public universities, 21 universities of applied sciences and 13 rather small private universities operate in November 2010. The public universities are the backbone of basic research in Austria. Their traditional missions are teaching and research, but they have been increasingly expected to cooperate with companies and other partners from practice. Universities of Applied Sciences ('Fachhochschulen') have been established in Austria in order to diversify tertiary education and to meet the demands of the labour market. Their main task is tertiary, practice-related education (ERAWATCH Network, 2010).

The Austrian university sector is characterised by comparatively small to medium-sized universities (with exception of the University of Vienna) with a high degree of specialisation and at average a good students-professor relation (Steiner, Ploder, Niederl, 2009), although the university of Vienna, for instance, is the university with one of the worst student-professor ration among the best 200 universities in the world (www.topuniversities.com)[16]. The HES performed 23.8% of R&D in Austria in 2007. The public universities consumed 91% of the higher education sector's R&D budget in 2007; another 4.98% went to the Austrian Academy of Sciences, and 2.99% to the universities of applied sciences. The rest was allocated to private universities and pedagogical higher schools. The overall financial share of the business sector for the higher education sector was 5.74% in 2007. The overwhelming part of finances was provided through the public (88.3%). The EU contribution was 3.32%. The rest came from private non-profit sources (1.03%) and from abroad (without EU).

At the cut-off date 28 February 2010, 273,542 students were enrolled in Austria's public universities, out of which 53.4% are women. The share of foreign students is 22.59%. 36,085 students are additionally enrolled in the universities of applied sciences (cut-off date: 15 November 2009) and 5,829 are enrolled in private universities in the winter term 2009/2010. The number of students enrolled in HEI is less than 4% of the Austrian population.

From the 27,232 university graduates in the winter term 2008/2009, 36% are from the field of social and economic sciences (incl. law), 14% from humanities and 10% from pedagogic studies. 15% graduated in the natural sciences, 12% in engineering studies and 6% in medicine and health studies. The rest graduated primarily in agricultural studies, veterinary medicine and other service oriented studies. The share of women is especially high in pedagogic studies (79.3%). Out of the 27,232 graduates, around 8% (2,261) obtained a doctorate. Here the distribution between men and women is almost balanced. Only in engineering studies and in natural

[16] Times THE-QS World University Rankings

sciences (including mathematics and informatics) a considerably higher share of men can be observed (75.0% resp. 63.1%).

11.1% of all university graduates in the winter term 2008/2009 were non-Austrian EU citizens. 4.7% were from third countries.[17]

The access conditions to universities are politically highly disputed. Currently, a very liberal regime is applied; everyone with a "Matura" (official certificate after a successful secondary education) is entitled to enrol at an Austrian university. No student fees are charged. Contrary to the numerus clausus system in Germany, this situation leads to a strong inflow of German freshmen at Austrian universities.

Publication intensity (measured by the average number of publications per scientific university employee) is slightly below the European average (Steiner, Ploder, Niederl, 2009). In international rankings Austrian universities are scoring rather disappointing. In the QS World University Rankings of 2010, the best positioned Austrian university is at rank 143 (University of Vienna), the second ranks 240 (Vienna University of Technology). Usually in the QS World University Rankings Austrian universities score better in the scientific criteria than the non-scientific ones. No Austrian university ranked among the top 100 in the Shanghai rating during the last 7 years. Best rated here is again the University of Vienna at the bottom of the top 200 universities. Among the top 300 of the Shanghai rating is also the Medical University of Vienna.

To support quality assurance in the HES in Austria, the Austrian Agency for Quality Assurance (AQA) was established as an autonomous institution in 2004 as a joint initiative of the former Austrian Rectors' Conference, the Austrian Conference of Universities of Applied Sciences, the Austrian Union of Private Universities, the Austrian National Union of Students and the former Federal Ministry for Education, Science and Culture. AQA is a full member of international networks for quality assurance (ENQA, CEE network and INQAAHE) and registered in the European Quality Assurance Register for Higher Education. As one of the first European agencies AQA has undergone an external evaluation co-ordinated by ENQA in 2007.

AQA develops and conducts external quality assurance procedures in accordance with European standards, in compliance with legal requirements and includes international experiences and expertise. The results serve as a basis for HEI internal control.

An external accreditation of university courses is not required in Austria.

3.3.2 Academic autonomy

Austrian universities are to a very high degree autonomous. The development towards autonomy started already with the University Act 1993 with a separation between decision and control functions and the introduction of global budgets. Comprehensive personnel responsibility for universities was attained in 2001 with the service law for university personnel ("Universitätslehrerdienstrecht"), including the abolishment of public servants status for new employees. The rector became supervisor for the entire university personnel. With the University Act 2002 finally, all universities became autonomous legal entities of their own ("Vollrechtsfähigkeit"), guaranteed by the constitution (Art. 81c B-VG). The control of legality is still a matter of state, but universities conclude under their own behalf and right business and

[17] http://eportal.bmbwk.gv.at/

contracts. Highest institutions within the university fabric became the university council, the rector and the senate. The universities are free to decide on further committees or boards. The rectorate became the most central position in terms of decision-making. The university council has a control and supervisory function. It consists of five members external to the university. Two are appointed by the senate and two by the BMWF and one in unanimity between both. The members appointed by the ministry must not belong to the ministry itself. Also members of national and regional governments, MPs or members of any other public representation body as well as functionaries of political parties are not allowed to be nominated. The senate is mainly decisive in terms of academic matters, including decision-making concerning curricula. In this committee, the professors do have the majority. 25% of the members are student representatives. The senate has no direct decision-making power regarding organisational and resource issues.

The universities have also financial autonomy in terms of global budgets based on performance contracts with three years duration. In return, cost accounting and planning as well as intellectual capital reports became compulsory.

Still disputed are the limitations of universities to decide about the admittance of students and to influence the number of study places. The open access to universities led to several mass subjects with several hundreds of freshman which overburden the given capacities in terms of teaching infrastructure and personnel resources. Thus, as of 2005 qualifications tests have been introduced in the beginning phase of study enrolment for a couple of highly demanded studies such as sport, dentistry, veterinary medicine, psychology or journalism and communication sciences. On the other hand, several SET studies with more elastic absorption capacities are considerably less demanded.

Universities of applied sciences are from inception mainly organised under private law. They have financial autonomy, but the state is responsible for the financing of the study places according to the norm cost model. Contrary to universities, universities of applied sciences can autonomously regulate the admittance of students.

Although the Austrian Science Council ascertained that the new leading structures of the universities proved of value, a few profound and unpleasant conflicts occurred. These were caused by thematically irrelevant factors, such as politically suspect nomination of university council members. The participation of non-full-professor faculty members in inner-university decision-making or at least decision-preparation is another still disputed issue (Wissenschaftsrat, 2009).

Impacts of academic autonomy on R&D are hardly traceable yet. Only few universities have already systematically started to prioritise (and de-prioritise) fields of R&D in a structural manner. Much is still dominated by previous bottom-up activity and follow-up of given trajectories (Wissenschaftsrat, 2010).

3.3.3 Academic funding

The National Assembly has agreed to increase the private and public investments in the higher education sector from actually 1.2% of GDP to 2% until 2020. However, due to public budget consolidation requirements, the universities are confronted with reductions after 2013, when the current performance contracting period ends. Public funding is by far the highest source of income of the higher education sector in Austria. Public expenditures for higher education were €3.045b in 2008, which is

1.08% of GDP and 3.79% of public budget spending (BWWF, 2009). The highest share of this public expenditure falls under the category 'general university funds' (GUF), which was €2.396b in 2008 and which increased considerably in 2009 (€2.648b) and 2010 (€2.874b) (BMWF, BMVIT, BMWFJ, 2010). The R&D share of GUF has been constantly around 47% during the last five years. 80% of the block funding granted to universities is 'global funding' and 20% are formula based budget allocation. 14% of the university budget comes from competitive funding and contracted research. Tuition fees, which were around 5.6% of the university revenues in 2008, were abolished as of March 2009 (BMWF, 2009) and had to be substituted by public budgets.

Eleven criteria are considered in the calculation of the formula budget, which are subsumed under three overall blocks (1) education, (2) R&D and (3) social objectives.[18] There are currently discussions to put more emphasis on research parameters such as bibliometric indicators, which would lead to more competition among the universities in this field and eventually to excellence based priority-setting and concentration processes within a university and between competing universities.

The distribution of the money within the university is left to the universities themselves, which means that they could make decisions for allocating resources autonomously in line with their research priorities. The process of establishing R&D priorities, however, is still in its exploratory phase and rather the exception than the rule (Wissenschaftsrat, 2010).

In general, due to the relatively high earmarking of public budgets for institutional funding of R&D in universities (GUF), there is not enough public money allocated to competitive R&D funding, especially for basic science, to kick-off and support a paradigmatic change towards more accountability of R&D in the field of higher education and to substantially enhance scientific excellence, although the funding agencies and regulations would be in place.

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the ERA Green Paper in April 2007, the EC Communication "Improving knowledge transfer between research institutions and industry across Europe" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs.

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the transnational dimension of knowledge transfer. This section will assess the national policy efforts aimed to promote the national and trans-national public-private knowledge transfer.

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[18] Verordnung der Bundesministerin für Bildung, Wissenschaft und Kultur über das formelgebundene Budget der Universitäten in der Fassung vom 22.11.2010 (By-law of the minister of education, science and culture on the formula-based buget of universities in the edition of 22 November 2010)

3.4.1 Intellectual Property Policies

Austria's IP policy has been characterised by two major interventions during the last couple of years, which also respond to international and European trends and recommendations (Elias, 2008), namely a new legal basis of the university IP policy and the implementation of the uni:invent programme.

Based on the University Act from 2002, universities became entitled to drive the capitalisation of their intellectual property. Universities have the possibility to take-up and capitalise service inventions and results of scientific work of their personnel (§106 UG 2002). If a patent can be economically exploited than the inventors receive compensation which is relatively high in international comparison. If the university does not react within three months, then the inventor himself has the right to make use of his exploitation right.

"uni:invent" was a programme managed by the AWS by order of the BMWF and the BMWFJ between 2004 and 2009. The aim of the programme was to unlock and exploit the patenting and licensing potential of the Austrian universities and non-university research organisations and to capitalise the research outputs in economic terms.

More concretely, uni:invent supported partly the financing of patent applications from universities and the production of prototypes, provided professional consulting and assistance and financing of innovation scouts, who directly work in universities and who promoted an active patenting and licensing policy (Elias, 2008).

Between 2004 and 2009, 13 university transfer offices were established, 50 transfer managers were professionally trained along a dedicated job profile and more than 30 innovation scouts were established at 17 Austrian universities together with AWS, which increased the performance of the TT offices.

Moreover, under this programme 1,547 inventions were submitted to assess their commercialisation substance. AWS recommended to the universities to take up 40 to 60% of the assessed inventions (per year). Around a third of all registered inventions received financial support through uni:invent (AWS 2010). In terms of patenting the most active universities in Austria are the Technical Universities in Graz and Vienna, the University of Innsbruck and the Medical University Vienna (Elias 2008). In terms of commercialisation, AWS supported universities to conclude 29 – mostly licensing - contracts. Moreover, 40 more patent exploitation contracts could be concluded directly by technology transfer units of the universities. The yearly income from license agreements was more than €700,000 since 2008. In total, €8.5m were granted to the Austrian universities under the programme, out of which €2.7m were used for co-financing patent applications (AWS, 2010).

The elaboration of operational patent and exploitation strategies has been taken up in the performance contracts of the universities. A national IP contact point has been nominated in the BMWF and became operational in spring 2010 (BMWF, 2010). Although technology transfer offices became institutionalised elements of the university fabric in Austria and uni:invent supported many of the recommendations of the EC on the management of IP in knowledge transfer activities, it will remain a challenge in the future to enhance the initiated cultural change at universities with respect to IP and its exploitation.

Based on the findings of a survey carried out by AWS and FFG in 2010 (BWWF, 2010), around 60% of the Austrian universities and 30% of the public non-university research organisations answered that they have an IP policy in place. Questions on

IP strategy showed that there was no common picture of what an IP strategy actually is. Universities and public non-university research organisations felt well-trained in technology transfer issues, but felt a lack of skills in areas such as IP and licensing as well as in commercialisation and marketing. Staff in industry responsible for knowledge transfer felt even less well-trained. More than half of them responded that they have had no or only poor training on these issues. Despite the manifold activities implemented by now, the survey revealed that more than half of the responding enterprises and all universities felt a need for national guidelines and/or model contracts.

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

The highest representation of industry in Austria's RTD governance takes place in the Austrian Council for Research and Technological Development, which is actually chaired by a reputed Austrian industrialist. Three of the eight members of the Austrian Council are working in the private sector.

Moreover, the private sector is also perceptibly represented in the University Councils, because by law this committee should consist of members with responsible positions in society, especially from science, culture, and economy.

In general there are no hard factors that restrict mobility of researchers between the public and the private sector. Researchers employed in the public sector are allowed to work for industry on a part-time, consultancy or other basis, provided that their contracts do not include competition clauses which prohibit such arrangements. However, such clauses are valid in both directions. Through the gradual abolishment of civil servants status at universities and the introduction of private law-based labour contracts further mobility obstacles have been removed in the last years.

However, different soft factor still aggravate inter-sectoral mobility. For instance, the number and quality of publications becomes increasingly central to access an academic position as well as for career promotion, which is a systemic inter-sectoral mobility dilemma, because industry researchers are less stimulated or even not allowed to publish results of their work. The necessity of more permeability between the university sector, the non-university research sector and the corporate sector was repeatedly addressed during the Austrian research dialogue (BMWF, 2008). Most likely inter-sectoral researcher mobility is still low in Austria, and, thus, in line with the European mainstream. Unfortunately, there are no data available to falsify this guesswork. The Austrian participation in the 'Industry-Academia Partnerships and Pathways' (IAPP) topic under the 'people' sub-programme in FP7 can serve as a reference point for this average, ambiguous situation. Austria's participation in this topic is ranked 11th among the EU-27 Member States which more or less corresponds to Austria's overall country ranking position in FP7. Interestingly, in the field of IAPP Austria is most successful in mathematics and social sciences and humanities.

The problem of missing links between science and industry, which has been perceived as one of the most crucial systemic problems in Austria in the 1990s has been largely resolved through the introduction of a large number of instruments and interventions. The 'competence centres' programmes (now COMET) has been the most visible among the many programmes which operate at the interface of science and industry. However, more advanced programmes such as COMET are less accessible for SMEs. Thus, more SME adequate instruments, such as the 'innovation cheques', have been implemented to complement the existing portfolio.

Under the structural funds period 2007 until 2013, many research, technological development and innovation projects are funded at the science-industry interface. The main R&D related activities funded have had a focus on innovation and technology development under the title "innovative business". Examples are cluster-policies or the establishment of incubators. Most of them address explicitly SMEs. In some Federal States, e.g. Carinthia, Upper Austria and Styria, more research related projects were funded, especially in the context of the national COMET programme.

Since 2001 the publicly funded AplusB programme, which can be added to the numerous science-industry programmes, supports spin-offs from universities, universities of applied sciences and non-university research organisations. In 2010, nine AplusB centres operated in Austria and provided awareness raising and stimulation for academic entrepreneurship, consultancy, training and assistance for a duration of 1.5 years and support through cooperation with financiers and other support structures and programmes.

The AplusB centres include around 150 partners coming from different institutional background, such as foreign academic partners, domestic R&D partners, financial partners, media partners, intermediary partners such as incubators and business partners. The target for the next couple of years is to facilitate in total around 320 academic spin-offs. A recent evaluation confirmed the successful conception of the AplusB programme (Heydebreck and Petersen, 2008) but emphasises the need to pay increased attention towards more experienced researchers, further flexibility concerning the length of stay of business founders within the programme, increased international exchange of knowledge and an intensification of the AplusB platform among other issues.

3.5 Cooperation, coordination and opening up national research programmes within ERA

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of coordination, synergies, efficiency and simplification. The policy fragmentation at EU and national levels, and between EU and national policies can hinder the build of up critical masses of research excellence, leads to the duplication of efforts, sub-optimal impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section will assess the effectiveness of national policy efforts aiming to improve the coordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

Austrian research organisations from the university, non-university and corporate sector are actively engaged in the European Framework Programme for RTD (FP), COST and EUREKA. By May 2010, Austria is the 10th successful EU member state in FP7 in number of approved participations. The share of Austrian participations in % of all approved participations of the EU is 2.9%, which is considerably higher than the Austrian share (2.1%) of researchers, scientists and engineers (RSE) in % of all RSE in the EU-27. This clearly demonstrates the importance and acceptance of the FP for the Austrian research communities as well as their European competitiveness. The financial juste retour to Austria is 2.57%, which is more than €100m per year. Austria is net receiver in FP7 (Proviso, 2010).

In the FP7 sub-programme 'cooperation', Austrian organisations are above average successfully involved in the thematic areas 'social sciences and humanities', 'security research', 'ICT' (with the by far highest absolute budget allocations), 'space' and 'environment'. In the other thematic areas, the Austrian participation is below the average Austrian participation and especially humble in the fields of 'nano-sciences, nano-technologies, materials and production technologies', 'food, agriculture, fishery and biotechnology' and 'energy' (Proviso, 2010). In the sub-programme 'capacities' Austrian researchers are above average successfully involved in 'support for coherent research strategies', 'international cooperation', 'science in society' and 'regions of knowledge' (Proviso, 2010). The Austrian participation in the 'ideas' sub-programme is still rather inconclusive. It indicates a relative lag of Austria in the (future) high-end excellence spectrum. On the other hand, the share of advanced Austrian researchers in the two calls for 'advanced grants' was 2.67%, which is above the Austrian share (2.1%) of RSE in % of all RSE in the EU-27. In total, Austria is on the 9th rank among the EU-27 in the 'ideas' sub-programme.

Data available from mid 2009 also show a high acceptance of EUREKA in Austria, especially from industrial organisations. Companies account for 75% of all Austrian participants, out of which three quarters are SMEs. At this point of time, 74 Austrian organisations participated in 62 running EUREKA and Eurostars-projects. Therewith Austria participates in 8% of all projects running mid 2009. The financial volume of these projects is around €1.4b (FFG, 2009).[19] Thematic priorities of Austrian participation are in ICT, industrial production technologies, agriculture and food technologies and transport technologies. The EUREKA support structure in the FFG advices on possible funding instruments, supports partner search and assists the EUREKA projects during their implementation, for instance with marketing and PR activities.

Austrian researchers participate in almost 70% of the running COST actions. In total, Austria is ranked 14th among the 36 COST countries in terms of the country rate of participation in 2009 (COST, 2010). Most demanded by Austrian participants are the fields of agricultural research and biotechnology, medical research, social sciences, chemistry, material sciences, ICT, forestry research and meteorology. The institutional background of the Austrian participants depends on the thematic field, but in general is dominated by university participants. Universities of applied sciences do only rarely show up. Higher participation shares from non-university research organisations are found in the fields of environmental research, social sciences, ICT, meteorology and transport. SMEs are more apparent in civil engineering, transport, material research, ICT and biotechnology.[20]

Austria participates in several international large scale research infrastructures such as CERN, ESRF, EMBO, CISM, ILL, ELETTRA, IASA, ISTC/STCU, WMO. The yearly budget contributions to these inter-governmental research infrastructures as well as to international research relevant institutions such as OECD amount to

[19] http://www.ffg.at/content.php?cid=32&sid=309; accessed on 25 November 2011.

[20] http://www.bmvit.gv.at/innovation/internationales/cost/aktionen.html; accessed on 25 November 2011.

around €80m. The largest share of these contributions is financed by the BMVIT with around €40m. Thereof Austria's contributions to ESA and other additional ESA-programmes are most prominent. On second place are Austria's contributions to CERN paid by the BMWF. Other larger contributions of the BMWF affect the European cooperation in molecular biology and the European Centre for Medium-Range Weather Forecasts (Schuch, 2008).

The Austrian Federal Ministry for European and International Affairs contributes mostly to IAEO and UNESCO. Other ministries support international organisations which thematically belong to them. OECD is mainly sponsored by the Austrian Federal Chancellery.

The only international research organisation located in Austria is the 'International Institute for Applied Systems Analysis', which conducts inter-disciplinary studies on global change and its social, economic, technological and environmental impact on humans.

3.5.2 Bi- and multilateral agreements with other ERA countries

Austria has intergovernmental bilateral S&T agreements with China, Croatia, the Czech Republic, France, FYR of Macedonia, Hungary, India, Italy, Korea, Poland, the Russian Federation, Slovakia, Slovenia, Spain, UK and Ukraine. Between 1997 and 2006, 2,854 projects could be supported within these S&T agreements. The funding of the Austrian Federal Ministry of Science and Research was €5.5m to subsidise the mobility costs of the participating researchers. The intergovernmental bilateral S&T agreements are predominantly used by universities for additional mobility funding. The agreements are usually not or only very roughly thematically defined and encourage a bottom-up approach.

The policy focus has shifted from a bilateral cooperation perspective towards a multilateral perspective in two aspects. Firstly, it is recommended to use the projects for the preparation of proposal to be submitted under the FP. A recent study identified only a partial suitability of this approach (Schuch, 2010). Secondly, bilateral S&T programmes are increasingly included in international ERA-NETs. SEE-ERA.NET, for instance, was established to combine bilateral programmes of EU member states with Southeast European countries into a bundle.

Austria furthermore participates in the 'International Continental Scientific Drilling Program' and within its membership in the European Consortium for Ocean Research Drilling) in the 'Integrated Ocean Drilling Program'.

3.5.3 Other instruments of cooperation and coordination between national R&D programmes

With data status of May 2010, Austrian organisations participate in 58.3% of the 60 ERA-NET and ERANET-PLUS projects funded under FP7. Austrian funding organisations coordinate two ERA-NETs and one ERA-NET-PLUS. The Austrian ERA-NET participation is especially strong in 'international cooperation', 'actions of horizontal nature', 'food, agriculture, fishery and biotechnology', and 'nano-sciences, nano-technologies, materials and production technologies'. The two latter, interestingly, are thematic areas in which the Austrian participation in FP7 is below average. A rather low Austrian ERA-NET participation (compared with the overall number of ERA-NETs funded in the respective thematic area) can be found in the field of 'social sciences and humanities' and 'infrastructures'. This is not surprising, because Austria lacks national programmes in these fields.

The FWF and the Austrian Academy of Sciences are members of the European Science Foundation (ESF). The FWF participates also in ¾ of the "European Collaborative Research Programmes" (EUROCORES), the thematic research programmes of the ESF[21].

For the time being, Austria participates in the Art. 185 initiatives 'Eurostars', 'Ambient assisted living', and the European metrology research and development programme (EMRP) and in the joint programming initiatives[22] 'Agriculture, food security and climate change', 'Cultural Heritage and Global Change: a new challenge for Europe' (with observer status), 'A healthy diet for a healthy life', 'Urban Europe', 'Climate Knowledge for Europe (CliK'EU)' and 'Water challenges' and shows interest in the joint programming initiative 'More years, better lives (formerly known as 'Health & Ageing')'

Austria is founding member of the public-private-partnership based JTI 'Artemis'[23] and engaged in ENIAC, which aims to ensure that Europe realises its potential in new markets for intelligent products, processes and services by achieving world leadership in nano-electronics. The FFG implements the national JTI project administration and the BMVIT contributes financially. The ministry also initiated the Austrian Artemis platform which brings together industrial partners and relevant research organisations. A strong Austrian emphasis in the Artemis strategic research agenda is to support automotive industries and suppliers, aviation and space, rail traffic, communication technology, automatisation and productive industries. Similarly, an ENIAC Austria platform has been established for Austrian micro- and nano-electronics together with the Austrian Chamber of Commerce.

The dominant policy approach towards the ERA instruments is acceptive (Herlitschka, 2010). Due to the fragmented governance structure in Austria, the lack of a formal overall S&T strategy and the strong bottom-up tradition in R&D, different stakeholders make pro-actively use of the opportunities provided by the new ERA instruments. This enables division of labour, resources and competences, which could be hardly provided by a single organisation alone. A synopsis and monitoring of these initiatives is done by the national ERA governance unit in the BMWF. Due to the actual budget consolidation crisis, national co-financing requirements, however, may dilute this accepting attitude towards these instruments in the near future.

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[21] FWF participates in the following EUROCORES programmes: Consciousness in a Natural and Cultural Context (CNCC), the European Collaborative Research Projects (ECRP) in social sciences, EuroBABEL, EuroCORECODE: European Comparisons in Regional Cohesion, Dynamics and Expressions, EuroDIVERSITY, Ecological and evolutionary functional genomics (EuroEEFG), EuroGENESIS, Maximizing the Impact of Graphene Research in Science and Innovation (EuroGRAPHENE), Higher Education and Social Change (EuroHESC), Membrane Architecture and Dynamics (EuroMEMBRANE), Cold Quantum Matter (EuroQUAM), EuroQUASAR, Synthetic Biology: Engineering Complex Biological Systems (EuroSYNBIO), Fundamentals of NanoElectronics (FoNE), Cross-National and Multi-level Analysis of Human Values, Institutions and Behaviour (HumVIB), Modelling intelligent interaction - Logic in the Humanities, Social and Computational sciences (LogICCC), Quality Control of Gene Expression - RNA Surveillance (RNAQuality), Self-Organised NanoStructures (SONS 2), Smart Structural Systems Technologies (S3T), The Evolution of Cooperation and Trading (TECT), 4-D Topography Evolution in Europe: Uplift, Subsidence and Sea level Change.

[22] http://www.era.gv.at/space/11442/directory/11767.html; accessed on 25 November 2010.

[23] 'Advanced Research and Technology for Embedded Intelligence and Systems'

3.5.4 Opening up of national R&D programmes

The opening up of national R&D programmes depends on the programme 'owner', but in general one can summarise that Austria has a rather laissez-faire approach in this respect. In Austria the territorial principle applies, but a full-fledged definite strategy to tackle the issue of 'opening-up' does not exist. The major corner stones of the territorial principle are an Austrian legal status (e.g. a branch of a foreign company with registered address in Austria) or a residence in Austria (e.g. of a foreign researcher). Regarding the opening-up of national R&D programmes also the principle of non-discrimination of foreigners on the Austrian territory applies. This already rather liberal approach can be further macerated, as long as an advantage for the national economy can be justified (Schuch, 2008). With such a justification, which is highly context dependant, also non-nationals working abroad or nationals working in another country can participate in nationally funded R&D programmes and even receive a share of the funding. It does not matter, if in such cases the partners reside in EU countries or not.

In general, situations where substantial outflow of research funding occurs are by far not the rule. The demand for a share of funding for non-nationals working abroad or nationals working in another country is usually in low one-digit % numbers.

Austrian funding organisations participated also in ERA-NETs which used a real common pot system, but in general a mixed approach or a fully juste-retour based funding scheme is still preferred by the majority of funding partners.

3.6 International science and technology cooperation

In 2008, the European Commission proposed the Strategic European Framework for International Science and Technology Cooperation to strengthen science and technology cooperation with non-EU countries. The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies worldwide. Having in view these aspects, the following section will analyse how national policy measures reflect the need to strengthen the international cooperation in S&T.

3.6.1 International cooperation

The fragmentation of the Austrian science, technology and innovation system does not stop in front of international R&D cooperation. By now, no shared internationalisation strategy exists. Most advanced and comprehensive is the internationalisation strategy of the BMWF, which was submitted to the Council of Ministers in 2008. It comprises a European dimension, a neighbourhood dimension, selected bilateral cooperation priorities, the insight to make use of multilateral cooperation with third countries and a notion on international responsibility towards global goals.

An effective international cooperation strategy would require a long-term commitment, reduced ad-hocery and a new strategic and institutionalised approach in terms of partnering, instruments and funding (Schuch, 2008). At present, however, the internationalisation portfolio in Austria, which is broad in number of instruments[24], but highly under-critical in scale, scope and financial resource endowment, is confronted with downsizing rather than with a necessary enlargement. In front of the anticipated budget cuts, it seems that the attempts of the last years to bring internationalisation on the top of the political S&T agenda in Austria and to invest in strategy making and strategy implementation on many different levels come to a halt.

In order to make use of synergies, Austria participated also in a number of international oriented European R&D instruments. INCO-NETs for policy dialogue and mutual policy learning as well as international ERA-NETs for joint research funding have been actively approached and successfully implemented. Their sustainability, however, is not secured. For the time being, Austria coordinates the Southeast European ERA-NET PLUS, and the Austrian Federal Ministry of Science and Research is active in the international ERA-NETs with Russia, Korea, India and China. In these ERA-NETs strong elements, which are characteristic for joint programming endeavours, are employed between the European partners and also between them and their third country cooperation partners. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management participates in ERA-ARD, an ERA-NET to promote collaboration in European agricultural research for the World's poor.

3.6.2 Mobility schemes for researchers from third countries

Austria employs unilateral and bilateral mobility schemes for researchers from third countries and participates also in similar European initiatives. Among these programmes are (Schuch, 2008):

- the 'Salzburg Medical Seminars' which enable short research stays of medical doctors from Central and Southeast Europe as well as Central Asia in Austria;
- the 'translational brainpower' programme which aims to include foreign scientists into projects at the interface between basic and applied research;
- the intergovernmental S&T agreements, which support research mobility between Austria and its partner countries (see section 3.5.2) in both directions;
- the 'brainpower austria programme', which initially addressed Austrian researchers abroad, but more and more addresses also foreign researchers interested to work in Austria;
- the 'Lise-Meitner-Programm', which supports the stay of experienced researchers in Austria;
- the scientific exchange programme of the Austrian Academy of Sciences with its many partners around the globe;

[24] Austria makes use of manifold instruments, measures, programmes and initiatives to support international cooperation. These comprise research and research mobility funding, maintenance of a few Austrian liaison offices in third countries, engagement in political initiatives and support to substantial international networks with a high Austrian push factor as well as participation in relevant European networks to support the S&T dialogue with third countries. A dedicated focus of most of these instruments on grand challenges can not be ascertained.

- the CEEPUS-programme which supports students and faculty mobility in the region of Central and Southeast Europe.

In addition to these larger mobility schemes, a number of individual mobility opportunities exist, which can be accessed under Austria's central grants database www.grants.at. Furthermore, the study of Langthaler (2008) summarises the mobility programmes which enable students and researchers from developing countries a stay in Austria. An evaluation of the education and mobility programmes funded under the Austrian Development Cooperation (Feiler, Jäger, Reiter, 2007) concludes that a lot of budget has been previously earmarked in historically grown scholarship programmes implemented without a visible overall conceptual framework and policy guideline and with partly low system's impact (in terms of development policy).

In general, some of the existing mobility programmes need to be further enhanced based on institutionalised 'brain circulation' network models, which should not replace the dominant students and young scientist's programmes, but complement them. Evidently this calls for shared international division of labour between Austria and its partners who are ready to invest in such new models.

4 Conclusions

4.1 *Effectiveness of the knowledge triangle*

Based on the findings, one can conclude that more strategic governance, inter-sectoral alignment and an enhancement of links within the knowledge triangle would be of further advantage. Several important steps in this direction have already been implemented during the last decade. Most successful were the approaches for a stronger interlocking between the fields of research and innovation, which broadened the number of R&D active companies, including SMEs. An explicit, politically unambiguous strategic framework ("Überbau") with a long-term perspective and a vision and mission supported by all (or at least most) stakeholders, which provides guidance for a systemic further development of R&D&I is still missing. Although the necessity to consolidate the public budget due to the financial and economic crisis caused also cuts in financing R&D, both from corporate and public side, sufficient public investment in research and innovation is predictable, but budget cuts in R&D caused some hardship (especially in the private non-profit sector). Competitive research programmes, including the establishment of an integrated theme management for thematic programmes, need to be further extended and based on real cost principle. The evaluation culture in Austria is highly advanced at different evaluation levels with an emphasis on peer-review based project evaluations and on the evaluation of R&D programmes. In 2009, a comprehensive R&D system's evaluation, including a strong notion of governance aspects, has been carried out (Aiginger, K., Falk, R. and Reinstaller, A.) and in 2010 a sector evaluation of Austria's performance in European RTD programmes was conducted (Technopolis, 2010). In addition, institutional evaluations of R&D funding agencies are more or less regularly implemented, but shortcomings can be identified in full-fledged institutional evaluations of public research institutions.

Regarding investment related policies, one can conclude that Austria is comparatively generously funding the corporate sector with public money, especially through a number of science-industry programmes and by the research premium, while basic sciences are rather limited funded. The chronicle underinvestment in HES might lead also to continuing deficits in human resource provision, which could have a negative influence on future R&D investments and could lessen the attractiveness of Austria as a R&D location. The slow reform of doctoral education and the need for increasing the perspectives and, thus, the attraction of university careers (also for foreign academics) are examples for this.

In front of the need to consolidate the public budget, R&D funding has to refocus on investments in fields with high leverage effects to stimulate increased private R&D expenditures and to create as well the basic condition for a sustainable innovation based economic growth. The central bottleneck in a systemic perspective to advance from a catching-up country to a European frontrunner is a better integration of education policies into the knowledge-triangle. This calls for a reduced selectivity in earlier stages of school education, which currently reproduces a social segregation, and requires an improved steering capacity of HRD at the tertiary level, e.g. through a regulated study place based financing system and a study access management, which also takes into account the needs of companies operating in innovative top-end businesses.

Since Austria still follows the political goal to invest at least 3.76% of GDP in R&D until 2020, the financial perspectives to support the transformation from a catching-up country to a frontrunner are advantageous, even though this would mean GERD growth rates below those of the last decade. Thus, more efficiency and effectiveness in the way how funding is disbursed is required. More emphasis should be directed towards the management of themes, including grand challenges, for which higher public profit can be expected, like clean technologies and energy or ageing society. The absolute budget and share of competitive funding, based on real cost models (including real economic overheads), which would also facilitate the access of non-university research organisations to programmes which are by now pre-dominantly tailored towards HEI, should be increased to enhance competition and excellence. To close the gap between the Austrian universities towards the best performing ones in Europe, the performance contracts of the universities should be more instrumental to generate stronger steering effects and priority-setting (Wissenschaftsrat, 2010) and be more ambitious in terms of R&D and technology transfer. TT offices of universities should be benchmarked and eventually upgraded to deliver better services. In terms of R&D internationalisation, one can conclude that Austrian S&T policy managed successfully the integration of Austria's research communities into ERA, but more needs to be done to secure connectivity towards emerging overseas S&T developments.

Finally, the strengths of Austrian companies in niche markets have to be further supported. Austria is a good example that innovative top-end companies can be found in mid- and low-tech industries too. Such companies gained excellence and became market leaders with qualitatively high-rated goods and services. Support measures should take this individuality into account, instead of pursuing too simplistic one-size-fits all approaches towards pre-defined (high-tech) branches only. Thus, important generic locational elements such as the availability of qualified HRST, strong patent systems and locally available access to university and non-university R&D have to be further secured and developed. A real threat, however, is the lack of private risk capital to finance small, young enterprises with high growth potential. The creation of legal conditions for a crowding-in of private risk capital providers is recommended (Janger et al., 2010). This would also facilitate the emergence of 'gazelles', which could considerably contribute to employment and economic dynamics.

Table 5: Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	A new minister has been appointed early 2010 who basically follows previous tracks. End of October, budget cuts in the fields of science were announced with severe potential impact on scientific offspring, R&D internationalisation, the sector of private non-profit R&D institutions and also the further engagement of Austrian research organisations in FP7. Universities are confronted with budget cuts in the next performance contract period as of 2013 and the budget of the Academy of Sciences will be frozen. R&D funding in the corporate sector has stagnated and R&D inflow from abroad decreased substantially. New members for the Austrian Council for RTD have been nominated in the second half of 2010.	Austria has a robust research base. The inflow of foreign R&D funding is remarkable and Austrian R&D is very competitive within the ERA. The Austrian funding agencies work professionally and have been endowed with increasing resources. The development of universities is based on performance contracts which provide mid-term funding security. Nevertheless, the system still lacks excellence in many respects. Structurally problematic is the mostly unstructured doctoral education and the lack of larger cutting-edge R&D infrastructures. The political attempt to clear-cut the private non-profit R&D sector in Austria, with many institutes in the field of social sciences due to budgetary restrictions without any evaluation has caused discontent. Thematic programmes are increasingly introduced, but they are only partly responding to grand challenges. A conceptual 'theme management' incl. social sciences is still to come.
Innovation policy	No major policy changes in 2010. At programme level an initiative to support more innovation in the service sector was launched by FFG ("Dienstleistungsinitiative"). A decision was taken to increase the research premium for companies to 10% as of 1. January 2011, while the temporary increase of the de-minimis threshold, which was justified by the economic and financial crisis, will be terminated end of 2010. To counterbalance the stagnation in BERD, R&D development programmes for the automotive sector and a SME support package have been introduced and a further emphasis has been put on collaborative science-industry based RTDI programmes.	Although business expenditures for R&D have greatly expanded in the past two decades, a fundamental transformation of industry structures towards high-tech and new industries has happened only to a small degree (Friesenbichler and Hake, 2009). Productivity gains and technological capabilities have rather benefited traditional industries in Austria often operating in medium-high tech sectors, while the high-tech sector is still comparatively small. Knowledge transfer is actively supported by many R&D programmes operating at the science-industry interface. Measures range from low-key (e.g. innovation cheques) to challenging structural interventions (e.g competence centres). The relatively high public R&D budget appropriations in Austria for companies are also critically perceived as 'funding culture' instead of 'innovation culture' (CREST, 2008).

	Recent policy changes	Assessment of strengths and weaknesses
Education policy	Also in 2010 education policy remained one of the most disputed policy fields in Austria. Student protests calmed down at the beginning of 2010, but were re-emerging late 2010. Debate focussed on study access regulation, whether or not to introduce tuition fees and on a reduction of the years for obtaining family allowance. The MINT-initiative was launched to increase enrolment in engineering, technical and natural sciences. A political agreement to implement more joint secondary schools ("gemeinsame Mittelschule") to avoid too early separation of children into different school types and life perspectives could be achieved.	A remarkable number of persons with only secondary school attainment are engaged in R&D in Austria. This indicates a high level of technical and professional attainment at secondary schools in Austria. At the same time Austria ranks among those countries with the lowest share of university graduates in Europe. University education has been transformed along the Bologna principles, but structural doctoral education is still rather the exception than the rule. Quality assurance at the knowledge outcome level of students is insufficient. The average length of studying is still high as is the number of drop-outs. The number of graduates in science, engineering and technical (SET) fields remains very low, especially among women. Recently introduced programmes to motivate pupils to study SET fields are continuing.
Other policies	No major changes in the last year. To counterbalance economic demand slumps, economic stimulus packages were continued in 2010. A few R&D relevant thematic foci were supported such as on the energy-saving and energy-research sector. The financial sector remains restrained.	Alignment processes between R&D&I and industrial policy, structural policy and regional policy continue. Until recently R&D was not in the focus of labour market policy, but immigration procedures for foreign researchers were facilitated. Innovation oriented public procurement remains an issue, although not high on the agenda. The financial sector for R&D, especially risk capital appropriations and start-up funding, remains a structural weakness, which is counterbalanced through public initiatives (and money), which are under budgetary pressure and partly terminated (e.g. uni:invent programme). A private equity law is still missing in Austria. Generically, impact oriented new public management principles are stepwise introduced throughout different policy fields, including research and innovation policy.

4.2 *ERA 2020 objectives - a summary*

Table 6: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	**Main national policy changes**	**Assessment of national strengths and weaknesses with regard the specific ERA objective**
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• No major policy changes; • The MINT initiative to promote mathematics, natural studies and technical and engineering studies has been launched.	Strengths • Overall attractive working conditions for researchers (incl. high salaries); • Comparatively large number of doctoral students; high inflow of foreign students at all levels; comparatively high immigration of HRST; • Liberated immigration regime for researchers. Weaknesses • Lack of structured doctorate education; • Glass ceiling for women in S&T; • Low number of students graduating in SET.
2	Increase public support for research	• Anti-cyclical public R&D spending to compensate the declining investment of companies and to improve the financial basis of HES (partly to replace the cancellation of study fees); • Budgets for major public non-university R&D organisations frozen; • Announcement of drastic budget reductions for private non-profit R&D organisations (partly already effective in 2010); • Introduction of a rather low overhead allowance for FWF projects.	Strengths • Overall, high levels of R&D expenditure, slightly affected by the crisis; • Professional funding organisations in place. Weaknesses • Too limited funding for tertiary education; • Too limited funding for excellent research based on competitiveness.

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
3	Increase European coordination and integration of research funding	• No major policy changes; • Termination of the FP7 project preparation subsidy by end of 2010.	Strengths • Strong national ERA governance in place; • National funding organisations are experienced in ERA. Weaknesses • National/European integration of research funding partly still ad hoc and not fully mainstreamed; • National co-financing has to be secured; • Participatory approaches to include research communities in priority setting need to be improved.
4	Enhance research capacity across Europe	• No major policy changes	Strengths • Austria is well integrated into ERA; • Favourable environment for corporate R&D; • National programmes open for international cooperation. Weaknesses • HRST, especially in SET, are scarce and qualitatively uneven; • Social scientific research is under pressure due to funding cuts for non-university based research organisations.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• IST Austria fully operational.	Strengths • Sufficient basic RI. Weaknesses • High (financial) demand for RI not secured by budgets; • Lack of large RI; • RI roadmap prepared, but not finalised.

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
6	Strengthen research institutions, including notably universities	• Public R&D budgets for HES considerably increased; • Public support for private not-profit R&D organisations considerably reduced (incl. termination of the 'dynamic quality assurance' programme for social sciences).	Strengths • High number of public, private and cooperative research institutions. Weaknesses • Not enough budget to increase excellence through competitive funding programmes (esp. in the field of basic research); • Scientific offspring not sufficiently educated and sobering perspectives of young researchers.
7	Improve framework conditions for private investment in R&D	• Decision to increase research premium to 10% as of 1.1.2011 taken.	Strengths • Many science-industry programmes in place; • Attractive direct and indirect funding mechanisms. Weaknesses • Dependency on foreign R&D inflows.
8	Promote public-private cooperation and knowledge transfer	• Enhanced public support for R&D relevant PPP and knowledge transfer between universities of applied sciences and the corporate sector; • uni:invent programme terminated.	Strengths • Public-private cooperation and knowledge transfer is a systemic strength.
9	Enhance knowledge circulation (KC) across Europe and beyond	• Budget to secure financial room for manoeuvre to connect to promising European and international initiatives and trends to enhance knowledge circulation across Europe and beyond further downsized; • Implementation stop for initially planned new science liaison structures abroad and reduction of already existing ones.	Strengths • Austria is well integrated in the European KC. Weaknesses • Austria is only sub-critically integrated in overseas KC.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• New R&D cooperation with India and Korea consolidated and partly aligned with European programmes.	Strengths • Austria engaged in joint European initiatives; • Good take-up and domestic use of European instruments. Weaknesses • Severe budget constraints and under-critical programmes.

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• New members of the Austrian Council appointed; • Coordination between minister of research and minister of education enhanced.	Strengths • Council for R&D implemented by the government. Weaknesses • R&D&I agenda segmented across three ministries; • Ministry of finances has a stronger position in times of crisis; • Global challenges related 'theme management' across policy levels and policy areas not fully developed.
12	Develop and sustain excellence and overall quality of European research	• No major policy changes	Strengths • Developed R&D evaluation culture. Weaknesses • Austrian universities are placed at moderate positions in the Shanghai ranking.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	• No major policy changes	Strengths • Good knowledge base in high- and medium- tech industries and in knowledge-intense service sector; • Innovative companies are found in all sectors (even in traditional low-tech branches). Weaknesses • Industrial R&D mostly incremental.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• R&D relevant economic support programme for energy and energy-efficiency issues further developed.	Strengths • Societal challenges are also tackled in bottom-up research programmes. Weaknesses • Some societal challenges are not sufficiently tackled (e.g. aging society, poverty, migration/integration).
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• Budgets to commission external studies in sector ministries reduced. • Public debate about the ad-hoc decision of the minister of science and research to cut subsidies for private non-profit research organisations led to bottom-up establishment of the "Wissenschafts- konferenz" ('Science Conference').	Strengths • Advanced S&T evaluation culture; • Increasing media interest for R&D; • Instruments to reach out to the public are tested and available. Weaknesses • Top-down research policy decisions sometimes ad hoc.

References

Aiginger, K., Falk, R. and Reinstaller, A. (2009): Synthesis report: Evaluation of government funding in RTDI from a systems perspective in Austria. Based on nine special reports, Vienna, May 2009. http://www.bmvit.gv.at/innovation/publikationen/endbericht_syseval.html

Austin, Pock and Partners (2010): Erhebung österreichischer Forschungsinfrastruktur (inkl. Adaptierungen auf Basis der ergänzenden Erhebung im Frühjahr 2010), Endbericht, Juni 2010.

Austrian Council (2009): Strategie 2020.

Austrian Council (2007): Exzellenz Strategie.

Austrian Government (2008): Regierungsprogramm für die XXIV Gesetzgebungsperiode.

AWS (2010): uni:invent, Die Erfolgsstory, Die Erfolgsgeschichte von der Umsetzung universitärer Forschung in die wirtschaftliche Praxis 2004–2009.

Berger, M. (2010): Strukturen, Quoten und (falsche) Stereotypen – über den österreichischen Strukturwandel, seinen Beitrag zur F&E-Quote und warum high-tech nicht immer high-tech ist. Joanneum Research. POLICIES Working Paper Nr. 58-2010.

Berger, M., Gassler, H. und Meyer, S. (2010): Untersuchung der Kooperationspotentiale österreichischer Unternehmen im Bereich Forschung und Entwicklung außerhalb Europas. Joanneum Research, November 2010.

Buchinger, E. und Steindl, C. (2009): Innovationsfördernde öffentliche Beschaffung: Ein neues Instrument der Innovationspolitik? Austrian Institute of Technology. Wien.

BMWA (2007): procure_inno: Praxisorientierter Leitfaden für ein innovationsförderndes öffentliches Beschaffungs- und Vergabewesen. Wien.

BMWF (2010): Austrian Status Report on the implementation of the “Recommendation from the European Commission on the management of Intellectual Property in knowledge transfer activities and a Code of Practice for universities and other public research organisations”.

BMWF (2009): Statistisches Taschenbuch.

BMWF (2008): Österreichischer Forschungsdialog. Ergebnisdokumentation.

BMWF, BMVIT, BMWFJ (2010): Österreichischer Forschungs- und Technologiebericht 2010.

BMWF, BMVIT, BMWFJ (2009): Österreichischer Forschungs- und Technologiebericht 2009.

BMWF, BMVIT, BMWA (2008): Österreichischer Forschungs- und Technologiebericht 2008.

COST (2010): Annual Report 2009.

CREST (2008): Policy-Mix-Peer-Reviews: Länderbericht Österreich, September 2008.

Dall, E., Lampert, D. and Schuch, K. (2010): Evaluating Publicly Co-funded RTDI Programmes – Preliminary Benchmarks and Conclusions, fteval-newsletter, p. 34f.

EC (2009): Implementation of the Lisbon Strategy Structural Reforms in the context of the European Economic Recovery Plan – Annual country assessments: Recommendation for a Council Recommendation on the 2009 up-date of the broad guidelines for the economic policies of the Member States and the Community and on the implementation of Member States' employment policies.

EC (2008): Better careers and more mobility: A European Partnership for Researchers. European Commission. Brussels.

EC (2007): Guide on dealing with innovative solutions in public procurement: 10 elements of good practice. European Commission. Brussels.

EC (2007b): Remunerations of Researchers in the Public and Private Sector. Final Report, European Commission.
http://www.cipur.it/Varie/Forum%20DDL112/Study%20remuneration%20researchers.pdf

EC (2007c): Improving knowledge transfer between research institutions and industry across Europe. European Communities, Luxembourg.

EIS (2009): European Innovation Survey 2009.

Elias, B. (2008): Geistiges Eigentum. Geistige Eigentumsrechte und Intellectual-Property Politik. ZSI Discussion Paper, Nr. 11 (2008).

ERAWATCH Network (2010): Research Inventory Report Austria.

ESFRI (2009): ESFRI Roadmap Implementation Report 2009, European Communities, 2009, Luxembourg.

Eurostat (2008): Statistics in focus. 29/2008.

Federal Ministry of the Interior (2008): Guide to Residence and Employment of Foreign Researchers in Austria.

Feiler, L., Jäger, M and Reiter, W. (2007): Evaluation of the Education Sector of Austrian Development Cooperation and Cooperation with South-East Europe. Final report, April 2007.

FFG (2010): Zahlen, Daten, Fakten 2009. Wien, April 2010.

Friesenbichler, K. and Hake, M. (2009): INNO-Policy TrendChart. Innovation Policy Progress Report: Austria.

FWF (2010): Rollenmodelle des Doktoratsstudiums in Österreich. Ein Diskussionsbeitrag, Wien, August 2010.

FWF (2010b): Schlag auf Schlag. info 2/10. p. 6ff.

GÖD (2010): Brief des Vorsitzenden der GÖD an den Bundesminister für Finanzen. Betreff: Unterfinanzierung mit schwerwiegenden Folgen; Eheste Stärkung der Finanzkraft erforderlich, 15 November 2010.

Gutiérrez-Lobos, K. (2009): Umsetzung der 40 % Quote. Presentation given on 30 September 2010.

Herlitschka, S. (2010) (ed): Hinaus aus dem Schrebergarten. Die Europäisierung der österreichischen Forschung. StudienVerlag: Innsbruck.

Heydebreck, P. and Petersen, K. (2008): Zwischenevaluierung – AplusB Academia Business Spinn-off Gründerprogramm; inno, im Auftrag des bmvit, Karlsruhe.

Hörmann, R. (2010): Smarter Einkauf. Soziale Technik 3/2010.

Hofer, R. (2009): ERAWATCH Country Report 2009 Austria.

Janger, J. and Pechar, H. (2010): Organisatorische Rahmenbedingungen für die Entstehung und Nachhaltigkeit wissenschaftlicher Qualität an Österreichs Universitäten. Endbericht, Juli 2010.

Janger, J., Böheim, M., Falk, M., Falk, R., Hölzl, W., Peneder, M., Reinstaller, A., Unterlass, F. und Kletzan-Slamanig, D. (2010): Forschungs- und Innovationspolitik nach der Krise. WIFO-Positionspapier zur FTI-Strategie 2020.

KLIEN (2010): Jahresprogramm 2010 des Klima- und Energiefonds.

KLIEN (2009): Jahresprogramm 2009 des Klima- und Energiefonds.

Langthaler, M. (2008): Überblick über die Förderung von Studierenden und ForscherInnen aus Entwicklungsländern in Österreich. Report, Dezember 2008.

Lind, I and Banavas, T. (2008): Balancierung von Hochschulkarrieren und Elternschaft - Ein Überblick“ in: Dokumentation der Tagung des Deutschen Hochschullehrerinnenbundes ‚Hochschulkarriere und Familie - Wie geht das?', Mannheim, 2008.

Mayer, S., Fischl, I., Ruhland, S. and Sheikh, S. (2009): Das Angebot der direkten FTI-Förderung in Österreich. Teilbericht 5 der Systemevaluierung, Mai 2009.

OECD (2007): OECD Economic Survey Austria. July 2007.

Österreichischer Integrationsfonds (2009): Migration und Integration. Zahlen. Daten. Fakten 2009. Wien.

Paier, M. and Roediger-Schluga, T. (2006): Cooperation with Austrian enterprises and research organisations. In: Gesellschaft zur Förderung der Forschung (ed), Research and Development in South Eastern Europe. Vienna, Graz, 117-163.

Pechar H., Brechelmacher A., Campbell D. (2008): Doktoratsstudium in Österreich: Internationaler Vergleich und empirische Befragung von WissenschafterInnen und DoktorandInnen. Endbericht, Februar 2008.

Plattform FTI Österreich (2010): Arbeitsbericht 2010. Zusammenarbeit zwischen Bundesländern und Bundesagenturen zu „Forschung, Technologie und Innovation“.

Proviso (2010): 7. EU-Rahmenprogramm für Forschung, technologische Entwicklung und Demonstration (2007–2013), PROVISO-Überblicksbericht, Juni 2010.

Proviso (2010b): Monitoring der ERA-NET Joint Calls mit Beteiligung Österreichs. PROVISO, 22 November 2010.

Schibany, A. and Gassler, H. (2010): Costs and benefits of basic research. tip policy brief, 2010/06, October 2010.

Schuch, K. (2010): Transferpotential bilateraler wissenschaftlich-technischer Projekte für Einreichungen im Europäischen Forschungsrahmenprogramm, ZSI Discussion Paper, Nr. 12 (2010).

Schuch, K. (2008): Bestandsaufnahme und Positionierung der international ausgerichteten FTE Programme Österreichs. Endbericht im Auftrag des Rats für Forschung- und Technologieentwicklung, Wien, December 2008.

Schuch, K. und Scheck, H. (2007): Evaluierung von Jugend Innovation. Schlussbericht.

Statistik Austria (2008): Globalschätzung F&E.

Statistics Austria (2010): http://www.statistik.at/web_en/press/pressemitteilungen_laufendes_jahr/7/037203?year=2009&month=7

Steiner, M., Ploder, M. and Niederl, A. (2009): Die Struktur der österreichischen Universitätslandschaft im internationalen Vergleich anhand ausgewählter Indikatoren. Presentation given on 10 March 2009.

Technopolis (2010): Evaluation of Austrian Support Structures for FP7 & Eureka and Impact Analysis of EU Research Initiatives on the Austrian Research & Innovation System. Executive Summary.

Tichy, G. (2009): Was ist das “Österreichische” an der österreichischen FTI-Politik? In Leitner, K-H, Weber, M. und Fröhlich, J. (HG.): Innovationsforschung und Technologiepolitik in Österreich. StudienVerlag: Innsbruck.

Tiefenthaler, B. (2009): ERAWATCH Country Report 2008. An assessment of research system and policies: Austria.

Wissenschaftsrat (2010): Analyse der Leistungsvereinbarungen 2010-2012 und Stellungnahme, November 2010.

Wissenschaftsrat (2009): Universität Österreich 2025. Analysen und Empfehlungen zur Entwicklung des Österreichischen Hochschul- und Wissenschaftssystems. Wien, November 2009.

List of Abbreviations

AIT	Austrian Institute of Technology
AQA	Austrian Agency for Quality Assurance
ASCINA	Austrian scientists and scholars in North America
AUSTRIAN COUNCIL	Austrian Council for Research and Technological Development
AWS	Austrian Wirtschaftsservice GmbH
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
BERD	Business Expenditures for Research and Development
BMF	Federal Ministry of Finance
BMUKK	Federal Ministry of Education, Arts and Culture
BMVIT	Federal Ministry of Transport, Innovation and Technology
BMWF	Federal Ministry of Science and Research
BMWFJ	Federal Ministry of Economy, Family and Youth
CDG	Christian Doppler Research Society
CEE Network	Central and Eastern European Network of Quality Assurance
CENTROPE	Central European Region Platform
CERN	European Organisation for Nuclear Research
CESSDA	Council of European Social Science Data Archives
CISM	Centre International des Sciences Mécaniques
CLARIN	Common Language Resources and Technology Infrastructure
COMET	Competence Centers for excellent Technologies
COST	European Cooperation in Science and Technology
CREST	Comité de la Recherché scientifique et technique
EC	European Commission
E-ELT	the European extremely large telescope for optical astronomy
EIS	European Innovation Survey
ELETTRA	International multidisciplinary laboratory specialized in synchrotron radiation
EMBO	European Molecular Biology Organization
EMRP	European Metrology Research and development Programme
ENIC – NARIC	ENIC: European Network of Information Centres in the European Region NARIC: National Academic Recognition Information Centres in the European Union

ENQA	European Association for Quality Assurance in Higher Education
ERA	European Research Area
ERA-NET	European Research Area Network
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Science Foundation
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Organisation for Astronomical Research in the Southern Hemisphere
ESRF	European Synchrotron Radiation Facility
EU	European Union
EU-27	European Union including 27 Member States
EUROCORES	European Collaborative Research Programmes
FAIR	Facility for Antiproton and Ion Research
FFG	Austrian Research Promotion Agency
fforte	Women in Research and Technology/Frauen in Forschung und Technologie
FP	European Framework Programme for Research and Technology Development
FP7	7^{th} Framework Programme
FTE	Full Time Equivalents
FWF	Austrian Science Fund
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HRD	Human Resource Development
HRST	Human Resources in Science and Technology
IAEO (IAEA eng.)	International Atomic Energy Agency
IAPP	Industry-Academia Partnerships and Pathways
IIASA	International Institute for Applied Systems Analysis
ILL	Institut Laue-Langevin
ILL 20/20	Neutron for Science Science & Technology
ILO	International Labour Organisation
INQAAHE	International Network for Quality Assurance in Agencies
IPR	Intellectual Property Rights
ISCED	International Standard Classification of Education
IST Austria	Institute of Science and Technology Austria
ISTC/STCU	International Science and Technology Centre (ISTC) in Moscow and the Science and Technology Center in Ukraine

	(STCU) in Kiev
JTI	JTI Joint Technology Initiative
KC	Knowledge circulation
KLIEN	Climate Change and Energy Fund
MS	Member States of the European Union
OeAD	Austrian agency for international mobility and cooperation in education, science and research
OECD	Organisation for Economic Co-operation and Development
R&D&I	Research and development and innovation
RCA	Revealed comparative advantage
RI	Research Infrastructures
RSE	Researchers, Scientists and Engineers
RTDI	Research Technological Development and Innovation
S&T	Science and technology
SEE-ERA.NET	Southeast European ERA-NET
SET	Science, Engineering, Technology
SF	Structural Funds
SHARE	Survey of Health, Ageing and Retirement in Europe
SME	Small and Medium Sized Enterprise
TT	Technology transfer
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VC	Venture Capital
WMO	World Meteorological Organization