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Executive Summary

The ministry responsible for the research policy is the Ministry of Education and Research. The Ministry of Enterprise, Energy and Communication has a complementary responsibility for innovation policy. Under the ministries, there are national agencies, which can be rather large and in practice carry out and monitor much of the policies. Most national agencies in the research sector sort under the Ministry of Education and Research. The other ministries, with sector interests in research, communicate and interact with the Ministry of Education and Research in order to push their own priorities through.

Swedish research policy has traditionally been characterised by a balance between basic research, at universities, and sectoral research of a more applied kind, at private and public institutes. Over the years, the balance has shifted back and forth, but not dramatically.

In 2009, the total R&D expenditure amounted to 3.62% of GDP compared to an average of 2.01% for all Member States. However, in contrast to many other countries, the volume of R&D investment has decreased in recent years from a peak in 2001 of 4.18%. It is first and foremost the private sector that has decreased its investment in R&D, the BERD as % of GDP was in 2005 2.81% and in 2009 2.55%. The higher education institutions expenditure as % of GDP for 2009 was 0.91%. The government sector expenditure as % of GDP for 2009 was 0.16%, as compared to 0.27% for the Member States.

The general perception among both policy makers and the general public is that R&D&I activities is of great importance for Sweden to stay or become more competitive. This area will therefore most likely continue to be prioritised in terms of policy mixes. The role of research and innovation in the overall national policy can thus clearly be conceived of as part of a fairly strategic, coherent and integrated policy framework, oriented towards addressing major societal challenges which also reflect EU priorities. The research and innovation policy in Sweden did not change much in the past three years. In line with this, the set of policy instruments in place as well as main governing mechanisms remained unchanged with few exemptions. Focus continued to be on initiatives that link academic research and private enterprises. Organisations like VINNOVA and the Knowledge Foundation have a mix of support measures, targeting individual researchers and small firms as well as institutional grants to large consortia, established R&D companies or universities as a whole. The funding is primarily distributed in the form of project grants. Co-funding is often required.

In earlier assessments, some imbalances and corresponding policy instruments were highlighted. There has been a perceived focus on “knowledge creation” rather than “value creation”. Therefore the government has proposed a number of policy changes to help restoring the imbalances and to increase private R&D investment. Among these, instruments promoting the establishment of new indigenous R&D performing firms include increased provision of venture capital, especially in the early stages of the innovation processes, the strengthening of Intellectual Property Rights (IPR) and the initiative to establish ‘innovation offices’ at the major universities. They are expected to support commercialisation, patenting and licensing, etc, and the government allocated app. €8m (SEK75m) for these efforts.

The 2009 country report presented a set of challenges within the four policy domains Resource mobilisation, Knowledge demand, Knowledge production, and Knowledge circulation. A total of twelve challenges were identified. On the one hand, as there have been few changes in the innovation policy, these challenges are essentially still relevant.

On the other hand, with reference to Sweden's position in the Innovation Union Competitiveness Report, included in the group of "very high knowledge-intensity countries" together with Denmark, Finland and Switzerland, the challenges should be seen in some perspective. In international comparison, some of the challenges are more critical than others.

When looking at the measure *Scientific publications within the 10% most cited publications worldwide as % of total scientific publications of the country*, the performance of Sweden is less prominent; the group average is higher than Sweden's score. National statistics of highly cited papers have shown a slightly declining trend for some years. Consequently, the challenge identified in the country report from 2009, labelled *Ensuring quality and excellence of knowledge production*, remains critical for Sweden.

Another challenge which remains critical is *Ensuring exploitability of knowledge*. It is well known that the significant Swedish investment in R&D is not resulting in corresponding and proportional economic growth. Sweden has for a long time had problems transforming the R&D investments into commercial products and services. This is for instance reflected in the Innovation Union Competitiveness Report measure *Contribution of high-tech and medium-high-tech manufactured goods to the trade balance*, where Sweden is under-performing compared to the reference group average. Both these challenges refer to the policy domain Knowledge production.

The 2009 country report also identified three challenges related to Knowledge circulation: *Facilitating circulation between university, PRO and business sectors*; *Profiting from international knowledge*; and *Enhancing absorptive capacity of knowledge users*. The assessment of these challenges depends among other things on the functionality of university-industry collaboration, and how attractive Swedish research environments are for international researchers, with respect to e.g. tax incentives and social benefits. When revisiting the challenges from the SWOR analysis in the 2009 country report, and when reviewing the challenges in the light of the latest results in the Innovation Union Competitiveness Report, the most critical challenges would be sorted as follows:

- Ensuring quality and excellence of knowledge production
- Ensuring exploitability of knowledge
- Profiting from international knowledge
- Enhancing absorptive capacity of knowledge users

The 'Innovation Union' flagship initiative has defined a number of priority areas, in particular the commercialisation of research (getting ideas to the market), social innovation, public sector innovation, design and creativity, and services innovation. Commercialising research results is increasingly a priority in Sweden, but few new initiatives have been presented since 2009. The forthcoming governmental research and innovation bill in 2012 is likely to include specific proposals targeting commercialisation and the utilisation of scientific results. Furthermore, a national innovation strategy is foreseen during 2012.

One new type of measure stands out as perhaps the sole change in the innovation policy mix: VINNOVA's initiative to focus on 'Challenge-driven Innovation'. Relatively large funding has been committed by the agency to projects, which will develop challenge-driven innovation ideas in consortia of academics and private enterprises, and later on implementing them. A first call was closed in September 2011.

There is a reasonable match between the challenges and the initiatives that the government has proposed the last years. Reforms towards a competitive distribution of

governmental funding to HEIs as well as increased autonomy for HEIs should be understood as quality driven reforms. The innovation liaison offices is one attempt to meet the challenge of exploiting and commercialising knowledge, while the tax deductions for foreign experts is a step towards increased in-coming mobility and utilisation of foreign knowledge. Various programmes that link HEIs and industry aim at better absorptive capacity among participating companies.

Swedish policies for research and innovation are generally well at terms with the ERA pillars and objectives. In many ERA dimensions Swedish policies meet the goals, and the process from goal-setting to implementation often appears relatively efficient.

In a short and medium long term, the development of research and innovation policy in Sweden include the creation and development of support measures which even better target the 'Grand Challenges', which are as valid in Sweden as elsewhere in the European Union. Public procurement and user-driven innovation procurement of various kinds are likely to be strengthened, but finding effective instruments for this may prove to be a challenge as well. The Government has made strong investments in R&D funding the last years, and there is currently pressure from the industry and the surrounding society to put more focus on investments in utilisation and commercialisation of scientific results, than has been the case. Increased governmental spending on VINNOVA and the institute sector, in order to better bridge the academic and industrial spheres, is asked for. Voices are raised for the creation of 'Strategic Innovation Areas', corresponding to the past bill's 'Strategic Research Areas'. Against this perspective stand those who want to protect curiosity-driven research at the universities. Voices have been raised in support for individual research funding, in contrast to institutional funding. Insofar, the national debate is relatively polarised.

Much expectation is put on the forthcoming governmental research and innovation bill, expected in the autumn of 2012. The national innovation strategy is expected to be presented at about the same time.

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1 Introduction

The Swedish population amounted to 9 340 682 in 2010, which amounts to about 1.9% of the total EU-27 population. The GDP in 2010 (€ per inhabitant) was €37 000 which is higher than the average for the 27 member states of €24 400, with a GDP growth over the last three years of 2.4%. The estimated GDP for 2011 is €386 212m, a 4.2% increase on the previous year. Sweden is the EU country that invests most in R&D relative to its GDP. In 2009, the total R&D expenditure amounted to 3.62% of GDP compared to an average of 2.01% for all Member States. However, in contrast to many other countries, the volume of R&D investment has decreased in recent years from a peak in 2001 of 4.18%. It is first and foremost the private sector that has decreased its investment in R&D, the BERD as % of GDP was in 2005 2.81% and in 2009 2.55%. The higher education institutions expenditure as % of GDP for 2009 was 0.91%. The government sector expenditure as % of GDP for 2009 was 0.16%, as compared to 0.27% for the Member States.

The system for allocation of research funding outlined in the Research and Innovation Bill "A boost to research and innovation" (2008/2009:50) defines that the distribution of funding between higher education institutions (HEI) is determined by quality, measured by two criteria: publications/references to publications and external research funds. The National Reform Programme 2008 concludes that Sweden needs to prioritise and improve management of intellectual property rights, and some measures which will make it easier and less costly for firms to protect their inventions, e.g. in relation to patents applied for through the European Patent Office, have been taken.

Sweden is among the most knowledge-intensive countries in the world, included in the group of "very high knowledge-intensity countries" together with Denmark, Finland and Switzerland in the Innovation Union Competitiveness Report. More than 42 % of the Swedish work force is employed in knowledge-intensive activities. Sweden has among the highest R&D intensities, high shares of researchers and skilled human resources in the economy, low unemployment rates for researchers and high levels of new academic-oriented tertiary education degrees.

The scientific production is high, with a ratio of 14 % of the Swedish scientific publications being among the 10 % most cited in the world (although this is lower than the 16 % for the reference group of countries in the Innovation Union Competitiveness Report). Sweden scores above the reference group on PCT patent applications per billion GDP (11.01 to 9.67), almost equals the reference group when it comes to PCT patent applications in societal challenges per billion GDP but below the reference group (2.01 to 2.06), but scores below the reference group of countries in the Innovation Union Competitiveness Report on Licence and patent revenues from abroad as % of GDP (1.18 to 1.32). On all these indicators, however, Sweden scores well above the EU-27 average. In its most recent publication (July 2010) The Government's Research Advisory Committee lists a number of challenges that Swedish research faces. Most industrialised countries are currently making large investments in R&D, and Sweden should clearly keep up with this increasing movement of the research front. The Committee proposes a general expansion of R&D in Sweden, that distinct driving forces for quality are developed, that the innovation force in Swedish research is strengthened, and that the role of research institutes as a link between academic research and the corporate needs of research results is enforced. The Committee recommends a clear strategy for investments in research infrastructure, further development of the innovation procurement system, increase wild card-ventures in research, improve conditions for

graduate students, create transparent career paths and establish a national elite programme for young, talented researchers.

Research priorities in Sweden coincide to a high degree with the business sector's demand. It is mainly the multi-national companies (MNC) that have been in demand of R&D, rather than the small and medium-sized enterprises (SME), even though the picture is changing. The MNCs are mainly found in sectors such as engineering (accounting for 50% of the production), forestry, ICT, biotechnology and life sciences, environmental industries, and renewable energy.

Sweden has a scattered governance system and, while policy formulation is carried out largely at a ministerial level, different agencies are responsible for the design and implementation of individual policy instruments. The government ensures policy coordination at ministry level. At agency level, policy implementation is in principle dispersed and coordination is carried out informally and on an ad hoc basis. No formal and obligatory arena for coordination exists in the area of research and innovation policy and operations, and the lack of comprehensive coordination at this level is a recognised weakness (SOU 2008:30). Regional authorities play a minor role but in specific initiatives, they can be important funding bodies. Their activities primarily target private-public collaboration in key areas such as health or energy.

The main agency supporting R&D is the Swedish Research Council (VR), funded by the Ministry of Education and Research. Its main responsibilities include funding of research across fields of natural and social sciences, medicine and education. The Swedish Council for Working Life and Social Science (FAS), supported by the Ministry of Health and Social Affairs, is responsible for funding research on welfare, labour market, health and social services. The Swedish Council for Environment, Agricultural Sciences and Spatial Planning (Formas) supports research on ecological, conservation, natural resources-related and construction issues. The funding is provided by the Ministry of Sustainable Development and the Ministry of Agriculture, Food and Consumer Affairs (Mattsson and Åström, 2009).

In addition to these agencies there are six major national semi-public foundations. The Swedish Foundation for Strategic Research (SSF) supports research in science and engineering, and the Knowledge Foundation (KKS) promotes research carried out at newly established universities. Riksbankens Jubileumsfond (RJ) is an independent foundation with the goal of promoting and supporting research in the Humanities and Social Sciences, while the mandate of the Swedish Foundation for International Cooperation in Research and Higher Education (STINT) is to internationalise Swedish higher education and research. The Foundation for Strategic Environmental Research (MISTRA) supports research of strategic importance for a good living environment and the Swedish Foundation for Health Care Sciences and Allergy Research (Vårdal Foundation) stimulates innovative, interdisciplinary Swedish health care science and allergy research (Mattsson and Åström, 2009).

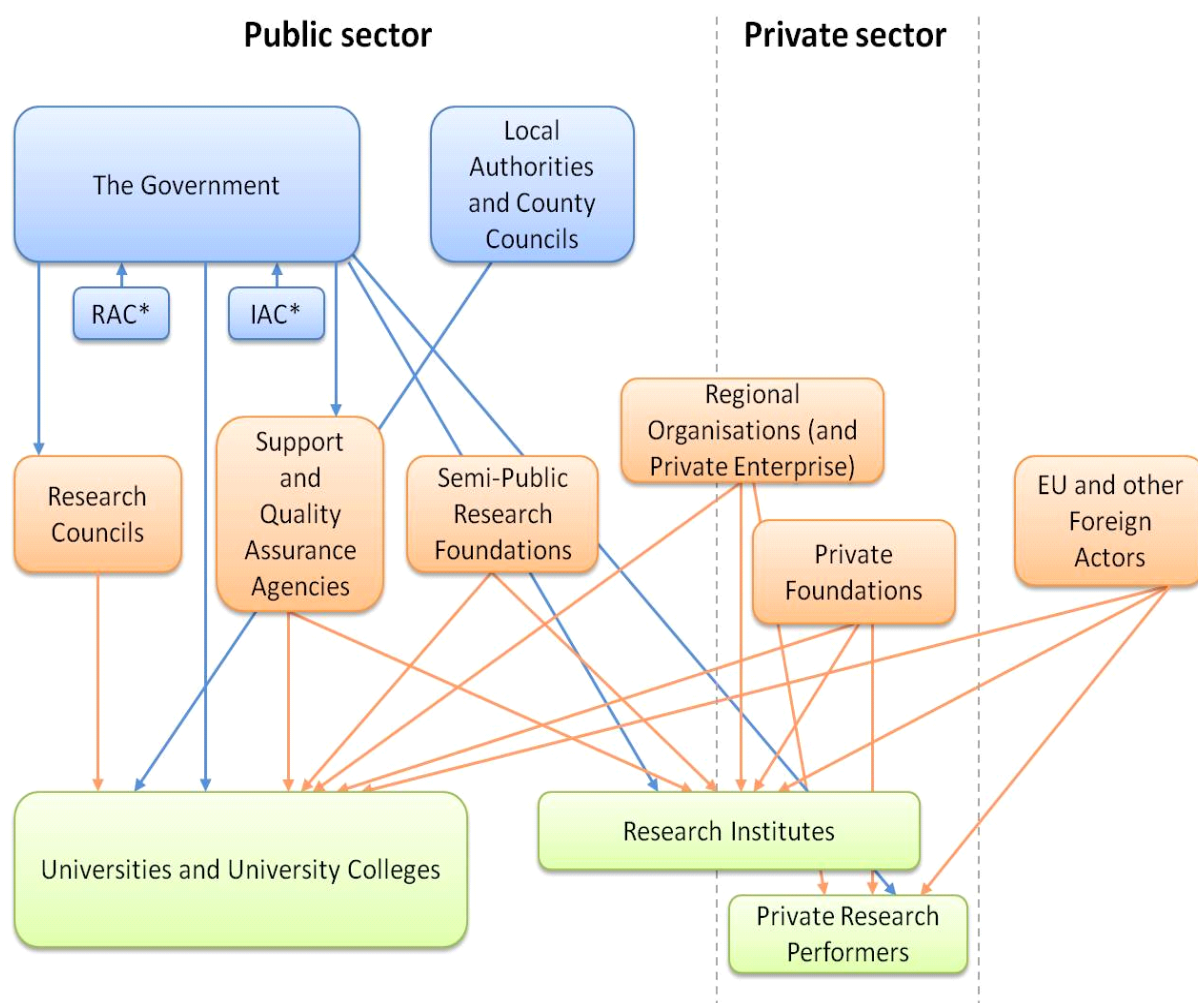
Innovation and research of an applied nature is supported by the Swedish Governmental Agency for Innovation Systems (VINNOVA). It was established in 2001 and receives its funding from the Ministry of Enterprise, Energy and Communication, although it also interacts with the Ministry of Education and Research on research related issues. VINNOVA's remit includes funding of problem-oriented R&D and innovation-oriented activities linked to R&D. Other major R&D actors include the Swedish National Space Board, the Swedish Energy Agency, and the Swedish Defence Material Administration (Mattsson and Åström, 2009). There are some quite large public-industry jointly funded research, development, technology and innovation programmes being launched (e.g. FFI at VINNOVA). Public Private Partnership programmes that target the knowledge

demand from both universities and industry have been established. Along with ideas in the latest research and innovation bill, innovation offices have been opened at the universities.

Design and implementation of research and innovation policies is handled through a well-established system of recurring government bills and implementation at higher education institutions as well as through funding agencies, which all have a part of the role of formulating and implementing policy.

The national research and innovation system is completed by private research performers, such as companies and sectoral organisations.

Figure 1: Overview of the Swedish research system governance structure



* RAC: Research Advisory Committee; IAC: Innovation Advisory Committee

2 Structural challenges faced by the national system

The research and innovation policy in Sweden in 2011 is to a large extent dependent on the various propositions and initiatives laid out in the latest governmental Research and Innovation Bill (Ett lyft för forskning och innovation, 'A Boost to Research and Innovation', Regeringens proposition (Government bill) 2008/09:50), which came in 2008. The Ministry of Education and Research and the Ministry of Enterprise, Energy

and Communication, and concerned national agencies, have since been busy turning the bill's words into action. Since 2010 when the latest ERAWATCH country report was presented, there has not been much change at all.

The 2009 country report presented a set of challenges within the four policy domains Resource mobilisation, Knowledge demand, Knowledge production, and Knowledge circulation. A total of twelve challenges were identified. On the one hand, as there have been few changes in the innovation policy, these challenges are essentially still relevant. On the other hand, with reference to Sweden's position in the Innovation Union Competitiveness Report, included in the group of "very high knowledge-intensity countries" together with Denmark, Finland and Switzerland, the challenges should be seen in some perspective. In international comparison, some of the challenges are more critical than others.

Behind these challenges lies a perception of inadequate return on public investments in R&D. This situation can be explained by several possible factors related to the industrial structure, the entrepreneurial climate and traditions in public R&D expenditure. Much of the research is conducted in the larger firms, which is partly related to limited resources among SMEs and a lack of venture capital sources resulting in limited growth opportunities. Moreover, the entrepreneurial climate in Sweden is poor in comparison with many other European countries. There are few incentives to start a firm in Sweden, which is related to the reliance of the welfare-system on the status of being an employee. Finally, there is a tradition in Swedish research policy to fund basic research. Concurrently, there is a growing expectation that research results should be economically exploited.

A comparison within this reference group of countries in the Innovation Union Competitiveness Report reveals that Sweden scores better than the reference group average when it comes to *R&D Intensity (Gross domestic expenditure on R&D (GERD) as % of GDP)*, *Business expenditure on R&D (BERD)*, and *Public expenditure on R&D*. Sweden furthermore scores better than the group average when it comes to *New doctoral graduates per thousand population aged 25-34*, and *Researchers (FTE) per thousand labour force*. Given this, challenges related to the policy domain Resource mobilisation cannot be assessed as critical.

When looking at the measure *scientific publications within the 10% most cited publications worldwide as % of total scientific publications of the country*, the performance of Sweden is less prominent; the group average is higher than Sweden's score. National statistics of highly cited papers have shown a slightly declining trend for some years. Consequently, the challenge identified in the country report from 2009, labelled *Ensuring quality and excellence of knowledge production*, remains critical for Sweden.

Another challenge which remains critical is *Ensuring exploitability of knowledge*. It is well known that the significant Swedish investment in R&D is not resulting in corresponding and proportional economic growth.¹ Sweden has for a long time had problems transforming the R&D investments into commercial products and services. This is for instance reflected in the Innovation Union Competitiveness Report measure *Contribution of high-tech and medium-high-tech manufactured goods to the trade balance*, where Sweden is under-performing compared to the reference group average. Both these challenges refer to the policy domain Knowledge production.

¹ BORTOM KRISEN, Om ett framgångsrikt Sverige i den nya globala ekonomin [BEYOND THE CRISIS, A successful Sweden in the new global economy], Globalisation Council's final report, Ds 2009:21 (in Swedish)

The 2009 country report also identified three challenges related to Knowledge circulation: *Facilitating circulation between university, PRO and business sectors*; *Profiting from international knowledge*; and *Enhancing absorptive capacity of knowledge users*. The assessment of these challenges depends among other things on the functionality of university-industry collaboration, and how attractive Swedish research environments are for international researchers, with respect to e.g. tax incentives and social benefits.

In 2010, the Research Policy Council identified this challenge as well, and wrote:

“Today’s relatively high level of investment in R&D in the business sector is no guarantee that it will be maintained in the future. The chances of attracting the R&D of businesses depend on how attractive a country is in terms of research investment compared to other countries. Once other countries have built up strong knowledge clusters in areas of relevance to Swedish enterprises, they will become increasingly more attractive as an R&D location. It is therefore important that Swedish state investment in research continues to increase, that the infrastructure is built up and that this takes place in areas that are important both for research-intensive businesses and for those that have limited R&D of their own.”²

The Innovation Union Competitiveness Report contains comparisons of *Licence and patent revenues from abroad as % of GDP*, and compared to the reference group of countries, Sweden is below the group average. This can be seen as one indication of existing room for improvements, especially related to the two latter challenges above. When revisiting the challenges from the SWOR analysis in the 2009 country report, and when reviewing the challenges in the light of the latest results in the Innovation Union Competitiveness Report, the most critical challenges would be sorted as follows:

Table 1: Challenges f

<u>Domain</u>	<u>Challenge</u>
Knowledge production	<i>Ensuring quality and excellence of knowledge production</i> <i>Ensuring exploitability of knowledge</i>
Knowledge circulation	<i>Profiting from international knowledge</i> <i>Enhancing absorptive capacity of knowledge users</i>

Since 2009, the Swedish Government has taken steps in order to meet some of the identified challenges. Several initiatives can be understood as targeting challenges in the domains of Knowledge production and Knowledge circulation.

The above-mentioned governmental bill presented among other things an initiative to set up ‘innovation liaison offices’ at eight universities. The purpose is that these offices should help the university at hand as well as other surrounding universities and colleges to better utilise the academic research results. These offices have only recently come into place and it is still too early to judge on their performance.

Late in 2009, the Innovation Inquiry was commissioned by the Swedish Government to investigate the conditions for public innovation procurement in Sweden and put forward proposals for measures to increase the application of innovation procurement. The Inquiry put forth its conclusions in a report from August 2010 (Innovationsupphandling (SOU, 2010:56)).³ The Inquiry proposed that Sweden

² Research shapes the future. Research Advisory Committee, ARTICLE NO. U10.026, p20

³ <http://www.regeringen.se/content/1/c6/15/09/90/08ef1a0a.pdf>

should introduce pre-commercial procurement of R&D services, and a new law. In the EU procurement directives there is an exemption for research and development services. However the opportunities for public authorities and entities to collaborate with private innovative companies are limited due to EU state aid rules. In the European Commission's Communication "Driving innovation to ensure public services of high quality in Europe" (COM, (2007) 799) the Commission shows that if an authority or entity contract R&D services that are tendered in competition, it is possible to actively seek innovations, while abiding state aid rules.

Other initiatives are also proposed by the Inquiry, for instance regarding public procurement in the health care sector and environment. The Government has not yet acted upon the Inquiry's proposals.

In the summer of 2010, the Ministry of Enterprise, Energy and Communication published a strategy for increased innovative services, "En strategi för ökad tjänsteinnovation". The strategy is regarded as the beginning of a work towards increased innovative services in Sweden. The aim is that private enterprise, the public sector and other organisations will cooperate and insofar contribute to a strengthened climate for innovative services.

Within the Swedish Government work is currently ongoing regarding a national innovation strategy. Its specific details are still unknown, but the underlying perspective is a broadened view on innovation, beyond the academia-industry link and technological development. The innovation strategy is foreseen to be finalised and made public in the autumn 2012. In general, an increased focus on innovation can be noted within the Government, not limited to the Ministry of Enterprise, Energy and Communication and the Ministry of Education and Research. Essentially all ministries are active and participating, not the least the Ministry of Social Affairs and the Ministry of Culture.

3 Assessment of the national innovation strategy

3.1 National research and innovation priorities

The liberal government that took office in 2006 initiated an agenda which so far have given strong additional funds to the universities themselves as well as to basic research. The innovation agency VINNOVA has also seen its funds increase these past years.

As noted elsewhere in this report, there have been almost no changes in the policy mix during the last three years; the direction and the policy features that were lined up in 2008 remain. The Ministry of Education and Research and the Ministry of Enterprise, Energy and Communication and concerned national agencies, have since 2008 been busy turning the bill's words into action.

In the bill of 2008, twenty strategic areas were pointed out and €200m (SEK 1.8 billion) was allocated for the period 2009–2012. The funding are to be distributed through the research funding agencies, and ten of those areas are managed by the Swedish Research Council, the remaining ten by other agencies. Such a significant redirection of funding, in part additional funding on top of what has previously been the case in governmental R&D bills, signals which fields are prioritised and emerging. These strategic areas are:

- Energy
- Sustainable exploitation of natural resources
- Effects on natural resources, ecosystems and biological diversity

- Climate models
- Sea environmental research
- Cancer
- Diabetes
- Epidemiology
- Molecular biology
- Neuroscience, incl. brain- and nerve system diseases
- Stem cells and regenerative medicine
- Health
- Nanoscience and nanotechnology
- E-science
- Material science, incl. functional materials
- IT and mobile communication, incl. future solutions for communication and monitoring systems
- Production technology
- Transport research
- Security and crisis management
- Politically important geographical regions

Even though these strategic areas are specifically pointed out by the government, calls are to a large extent open and follow the regular procedure where proposals are submitted by the research community.

While increasing the financial support to essentially all areas and thus maintaining the balance, the government has strongly emphasised utilisation of the scientific results. This can be interpreted as a slight shift back from what was the previous policy. Innovation offices have been created at the major universities, and the universities' holding companies have got additional funds. University staff is now obliged to report to the employer any outcome of their research that potentially could lead to commercialisation. The employer (a university, most often) can then choose to drop the case or carry on with further evaluation and patenting etc.

There has also been a strong trend towards a quality-driven agenda through all parts of the academic sector. A research-performance based system for distribution of the direct funds to universities has been launched, and a system for quality based distribution of funds for teaching is also decided upon. The research institutes have been re-organised. As of 1 January 2011 the Swedish HEIs have a new legislation which allows for far reaching university autonomy, again with the purpose to increase the quality. Essentially all HEIs are in a process of developing plans for how to use it and take position on their own in the increasingly competitive climate.

The forthcoming national innovation strategy is likely to picture a broadened view on innovation, beyond the academia-industry link and technological development. The driving factor behind the intensified attention to innovation is the notion that the comparatively large Swedish investments in R&D do not result in a corresponding level of innovation and economic growth. Sweden has reached the one percent goal regarding

volume of state funding of R&D, and has for a long time been well above the three percent goal of total investments in R&D, even close to four percent of GDP. Still, economic growth has not been on par with these investments. Already the above-mentioned Research and Innovation Bill from 2008 targeted better utilisation of the scientific results, for instance through the establishment of innovation liaison offices at eight universities, and a changed legislation regarding researchers' obligation to report on commercialisation potential of their results.

At the same time it must be noted that Sweden was not severely hit by the financial crisis in 2008 compared to many other countries. The crisis as such has not been a cause to intensified focus on innovation; there has existed a notion of under-performance in this respect during at least the past decade. The crisis may however have contributed with a sense of urgency.

The deregulations that have been launched in the past years - for instance in the health sector and the elderly care sector - have increased the market for services and should be regarded as relatively successful drivers for innovation reform. Public procurement has thus increased in these areas.

Late in 2009, the Innovation Inquiry was commissioned by the Swedish Government to investigate the conditions for public innovation procurement in Sweden and put forward proposals for measures to increase the application of innovation procurement. The Inquiry published its conclusions in a report from August 2010 (Innovationsupphandling (SOU, 2010:56)). Other initiatives are also proposed by the Inquiry, for instance regarding public procurement in the health care sector, infrastructure and environment. The Government has not yet acted upon the Inquiry's proposals.

Four societal challenges have been identified by VINNOVA, where Sweden is considered well placed for internationally leading innovation:

- Information Society 3.0
- Sustainable Attractive Cities
- Future Healthcare
- Competitive Production

Initiatives to produce initiatives for each challenge in dialogue with key actors and stakeholders have been taken by internal, interdisciplinary working groups at VINNOVA. The work includes partnerships with other organisations and stakeholders.

In the summer of 2010, the Ministry of Enterprise published a strategy for increased innovative services, "En strategi för ökad tjänsteinnovation". The strategy is regarded as the beginning of a work towards increased innovative services in Sweden. The aim is that private enterprises, the public sector and other organisations will cooperate and insofar contribute to a strengthened climate for innovative services.

There are several world-class clusters in Sweden. The Swedish biotechnology industry is Europe's fourth largest and home to distinguished biotech clusters, six medical universities and a number of groundbreaking innovations. Sweden is also one of the most advanced nations in ICT, with the presence of names like Sony Ericsson and TeliaSonera. Another strong cluster is the energy cluster around ABB.

The VINNVÄXT programme was the first great effort from VINNOVA to introduce a new innovation-driven growth policy. Work with the programme began as soon as the VINNOVA was established 2001. The purpose of the programme is to promote sustainable growth in the regions through the development of international competitive research and innovation environments in specific growth areas. The program assumes

an active involvement of actors in the business, research as well as policy and public activities. The current investments in VINNVÄXT cover a total of 730 million kronor (2003-2013).

In 2011, nine of the twelve current initiatives were evaluated by international evaluators, noting that the VINNVÄXT programme is still among the leading in the world of its kind. Most of the initiatives develop well or very well according to the evaluators. The latest follow-up data from reveal that more than 1000 for-profit companies are involved in the project, with 55 new products, 122 new prototypes, 47 new processes and contribution to 33 patents reported. The follow-up also shows that the initiatives helped to 24 companies make start-ups or expansion investments. Several initiatives have also taken steps towards becoming nodes to drive the national agenda within their areas, in many cases also increasingly establishing arrangements for different types of international activities for the initiative.

3.2 Trends in R&D funding

In 2009 the gross domestic expenditure on R&D (GERD) was 3.6% (1.06% public and 2.54% private) of GDP in Sweden, well above the average of the EU-27 of 1.9%. This implies that Sweden already fulfils the Lisbon goal.

This is still below its probable⁴ peak level of 2001 (4.18% of GDP). The downward trend is mainly due to changes in private sector R&D investments. In its most recent Research and Innovation Bill, for the period 2009–2012, the government substantially increased its R&D expenditures, despite the financial crisis at the time.

Table 2 Basic indicators for R&D investments in Sweden

	2008	2009	2010	EU average 201-
GDP growth rate	-0.6	-5.2	5.6	2.0
GERD as % of GDP	3.7	3.62		2.0
GERD per capita	1,341	1,138.7		490.2
GBAORD (€ million)	2,661.8	2,661.8		92,729.05
GBAORD as % of GDP	0.8	0.91	0.92	0.76
BERD (€ million)	9,118.999	7,429.255	8,422.727	151,125.56
BERD as % of GDP	2.74	2.55	2.33	1.23
GERD financed by abroad as % of total GERD	0.33 (2007)	0.38	:	N/A ⁵
R&D performed by HEIs (% of GERD)	:	25	:	24.2
R&D performed by PROs (% of GERD)	:	4	:	13.2
R&D performed by Business Enterprise sector (as % of GERD)	:	70	:	61.5

Since 2009, the rough balance of funding allocated to different types of measures has only shifted slightly. There are no specific national investment targets set. In the governmental Research and Innovation Bill from 2008, additional funding was allocated to the research councils, to VINNOVA, to specified 'Strategic Research Areas', and to

⁴ There is a break in series of data over the period 2000–2009.

⁵ 8.4 (2009), 9.04 (2005)

other organisations involved in funding of research and innovation. The additional funding will reach about €550m in 2012 compared to 2008. The implementation of this decision has been done step by step since 2008, and continues through 2012. Not much has occurred between 2009 and 2011 and there has not been any significant change in the share provided by different funding sources, nor in the balance of support provided through different forms of funding (grants, venture capital, subsidised loans, tax incentives, guarantees, etc.). It should however be noted that since the implementation of the Research and Innovation Bill's initiatives started, the twenty Strategic Research Areas have been significantly strengthened. Much of this funding is distributed to strong centres of excellence or research consortia, indicating a shift towards institutional grants rather than individual grants. An evaluation of the innovative capacity of the Strategic Research Areas shows that they need to improve in this respect.⁶

VINNOVA has furthermore identified four broad 'societal challenges', areas where Sweden is assumed to have good preconditions to be leading in innovation. The ambition is to invest more strategically. This is somewhat of a new direction; previous measures had a broader sectoral application. The Research and Innovation Bill from 2008 has resulted in large investments in areas deemed strategically important to Swedish society and the business sector. VINNOVA states that this investment up until now has not led to increased innovation through strengthening coordination and collaboration between HEIs and the private sector. VINNOVA has recommended the government to further invest in strategic innovation programmes in order to fully utilise the potential of the research that is taking place.

The EU structural funds are now established as a prime part of the regional support for research and innovation. The EU structural funds make up for between 40-50% of the total public contribution depending on the region. Roughly 40% of the Regional Operational Programme is devoted to innovation and renewal. The total public contribution to the Regional Operation Programme for the period of 2007-2013 amounts to almost €1.7b. The Swedish Agency for Economic and Regional Growth manages the programme.

VINNOVA has established formal collaboration with every major public or semi-public actor in the field of innovation and growth in order to maintain the position as the central hub and the Government's most important tool for realising its innovation policy. Usually VINNOVA demands co-funding from the private sector at least 50%. In 2010 the average level of co-funding amounted to 57%. It is not rare for other funding agencies or foundations to make the same demands. The additional funding from the private sector thus leverages the public investments significantly. It is therefore crucial for organisations applying for a specific measure to have a well-established partnership with the private sector.

This has to do with the notion of the knowledge triangle. VINNOVA has an important task of implementing and strengthening the knowledge triangle. It does so by supporting cluster building and strong R&D milieus. In 2010 a total of €20m were earmarked specifically for the knowledge triangle, and especially the integration of research and innovation. About 50% of VINNOVA's total funding can be categorised as measures targeted at different types of PPP-collaborations aimed at achieving innovation. The Knowledge Foundation continues their investment in cluster building by providing support measures to different HEIs that can show proof of relevance to the private sector by providing co-funding with at least as much, a similar financing model to that of VINNOVA.

⁶ <http://www.vinnova.se/PageFiles/79140918/110615%20SFO-rapport%20Slutversion.pdf>

Transnational funding and inter-regional funding play a minor role to the Swedish system. Programmes open between the Nordic or Baltic countries play some role, but should often be regarded as super-national rather than transnational. With this in mind, the following Nordic collaboration programmes in research and innovation are relevant anyhow:

Top-level Research Initiative – Nordic focus on climate, environment and energy

NORIA-net Citizens Services – Research about e-citizens

NORIA-net Living Labs – Nordic-Baltic cooperation in IT

NORDITE – Nordic research in ICT

The Top-level Research Initiative is the largest joint Nordic research and innovation initiative to date⁷.

Similarly, Sweden participates in the COST and EUREKA programmes, but these are rather to be labelled as supranational.

3.3 Evolution and analysis of the policy mixes

Since Sweden has what could be understood as a multi annual RDI strategy, built on the content of the research and innovation bill “A boost to research and innovation” (2008/2009:50) which will be effective through 2012, the last three years did not see any substantial changes in the policy mix. The next bill will be outlined during 2012. Still, the general trend among both policy makers and the general public is that R&D activities as well as innovation activities are of great importance for Sweden to stay or become more competitive. This area will therefore most likely continue to be prioritised in terms of policy mixes. The role of research and innovation in the overall national policy can thus clearly be conceived of as part of a fairly strategic, coherent and integrated policy framework, oriented (as will be touched upon below) towards addressing major societal challenges which also reflect EU priorities.

This is also to say that research and innovation policies are governed quite effectively and near the centre of government structure. The outlining of the new research and innovation bill will surely follow from thorough review of earlier efforts, building on the views of the different stakeholders as well as the monitoring and evaluations conducted by the different responsible funding bodies.

It is mostly among the large companies affected by the global financial crises where reorganisation and downscaling of R&D can be seen. Among SMEs, long term activities, including R&D, have not been the major priority during the period, for the same reasons. Some people argue, though, that the best way to stay competitive is to continue investing in R&D activities to be able to stay innovative.

In earlier assessments,⁸ some imbalances and corresponding policy instruments were highlighted. There has been a perceived focus on “knowledge creation” rather than “value creation”. Therefore the research and innovation bill proposed a number of policy changes to help restoring the imbalances and to increase private R&D investment.

Among these, instruments promoting the establishment of new indigenous R&D performing firms include increased provision of venture capital, especially in the early stages of the innovation processes, the strengthening of Intellectual Property Rights (IPR) and the initiative to establish ‘innovation offices’ at the major universities. They are expected to support commercialisation, patenting and licensing, etc., and the government allocated app. €8m (SEK75m) for these efforts.

⁷ <http://www.toppforskningssinitiativet.org/en>

⁸ Such as The Swedish Reform Programme for Growth and Jobs 2008-2010, as well as the INNO-Policy TrendChart 2008.

The 2008 Research and Innovation Bill thus targets improved commercialisation and knowledge transfer around universities in relation to the universities' "third task". This is to encourage universities to commercialise to a greater degree the outcomes of their research. A change in the Higher Education Act, with a clearer statement of the responsibilities of universities to promote commercialisation of research results, is hopefully instrumental to achieve that.

Policy instruments still focus on keeping a strong performance in terms of knowledge and innovation creation, where some of the main policy instruments are the centre of excellence programmes and the support of strong regional innovation milieus. During the latter half of the last decade we saw an implementation of a number of centres of excellence, e.g. the "VINN Excellence" programme, "Berzelii Centres", "Institute Excellence Centres" programme and "Industry Excellence Centre" programme. These programmes have the common aim to build bridges between academia and industry by creating excellent academic research environments in which industrial companies actively participate. The "Linnaeus Grant", jointly announced by the Swedish Research Council and Formas in 2005, is supporting strong basic-research environments at universities.

This implies quite a broad scope of innovation, which includes innovation in services, improvements of processes and organisational change, business models and so on. It also shows that primacy is given to the pursuit of excellence (also indicated by the names of the programmes) in research and innovation policies. Funding is exclusively allocated on a competitive basis, with clear rules and rationales for balancing institutional and project funding. Evaluation is conducted along internationally recognised criteria, projects are subject to external review and selected on the basis of quality and expected results, and the results of publically funded research are to some extent exploited by companies. The higher education and research institutions are going through a development towards greater autonomy, and conditions are continually levelled between men and women. There are some tax incentives in the Swedish system to attract leading international talent.

One of the most significant recent policy changes is the government launching and funding R&D within strategic research areas at the universities. The properties of this R&D include, among other things, to address social challenges such as improved health and quality of life. More specifically research related to an ageing population, climate change, structural changes following from globalisation etc. are funded. Regarding poverty issues, Sweden continue to fund research focusing on developing countries mainly through the Swedish International Development Cooperation Agency (SIDA). The establishment of the strategic areas is understood as a way forward in supporting excellence research in Sweden, to stay competitive in areas where Sweden has competitive advantage and where there is an industrial presence. It is also important to give some space and funding opportunities for "new" science that might have a potential to grow strong. This is also a way to utilise public funding to create leverage effects on private investment. European Structural Funds are the means in a similar manner to build equivalent relationships on the regional level.

The focus on funding strong research centres has received increasing attention in the major funding agencies to the extent that many traditional research grants have been limited. Several researchers have criticised this increasing focus upholding that the large universities are more likely to receive these grants. It is regarded important to keep a good mix of funding instruments, at the same time as innovation and excellence should be encouraged to a higher degree than before it is also important to provide funding to smaller research groups.

There is a considerable interest from the government to stimulate innovation in the public sector and the delivery of public services. The interest also extends to innovative services as a whole, regardless of sector. A government strategy is published, and VINNOVA has the assignment, together with special funding, to develop these areas. Partnerships between research and innovation stakeholders are promoted. Also outside the different forms of centres of excellence described above, there are policies and instruments, managed by actors like VINNOVA and Innovationsbron, to support the commercialisation of innovative ideas. Programmes with these aims have been launched in different sectors, sometimes as assignments from the government. Ownership of IPR is mostly regulated through contracts between participants in such programmes. Setting up partnerships must be described as relatively easy. There is still however, in general, a quite low degree of mobility of researchers and innovators between public and private institutions.

The education system shows a tendency to produce a decreasing number of science and technology graduates, which would serve as the main workforce in the international companies' R&D efforts. This could result in these companies reallocating R&D resources to other countries, and/or to decreasing industry R&D investment. There is also a somewhat alarmingly low level of R&D activities in SMEs, which does not help up the quality of industry-university links.

There are however some programmes dedicated to the support of business research and innovation, also for SMEs. In the latter case, VINNOVA's Forska&Väx (Research&Grow) is a good example. There is a tradition to perform industrial sector research, where also participation in international programmes is an objective. As preparatory actions for the next research and innovation bill, several stakeholders are involved in the formulation of ideas on how the future cooperative programmes are best and most effectively composed.

There are several world-class clusters in Sweden. The Swedish biotechnology industry is Europe's fourth largest and home to distinguished biotech clusters, six medical universities and a number of groundbreaking innovations. Sweden is also one of the most advanced nations in ICT, with the presence of names like Sony Ericsson and TeliaSonera. Another strong cluster is the energy cluster around ABB.

The VINNVÄXT programme was the first great effort from VINNOVA to introduce a new innovation-driven growth policy. Work with the programme began as soon as the VINNOVA was established 2001. The purpose of the programme is to promote sustainable growth in the regions through the development of international competitive research and innovation environments in specific growth areas. The program assumes an active involvement of actors in the business, research as well as policy and public activities. The current investments in VINNVÄXT cover a total of 730 million kronor (2003-2013).

In 2011, nine of the twelve current initiatives were evaluated by international evaluators, noting that the VINNVÄXT programme is still among the leading in the world of its kind. Most of the initiatives develop well or very well according to the evaluators. The latest follow-up data from reveal that more than 1000 for-profit companies are involved in the project, with 55 new products, 122 new prototypes, 47 new processes and contribution to 33 patents reported. The follow-up also shows that the initiatives helped to 24 companies make start-ups or expansion investments. Several initiatives have also taken steps towards becoming nodes to drive the national agenda within their areas, in many cases also increasingly establishing arrangements for different types of international activities for the initiative.

3.4 Assessment of the policy mix

There is a specific reference to a number of structural challenges in several programmes and activities related to the Swedish policy mix in research and innovation. The government's launch of strategic research areas is thus made with such references, and so are a number of dedicated programmes by sector funding bodies.

Sweden has a long tradition of carrying out high quality research and education, and there is generally a high level of trust in research among Swedish citizens. There are however still a number of structural issues with which the innovation system has to deal. There is, for instance, a decreasing number of students enrolling in science and engineering programmes, as well as a decreasing number of PhD graduates. There are also still weak connections between academic research and industry.

The role of the Swedish universities is furthermore not entirely clear. It is complex and there are signs of mission overload. The latest model for distribution of resources puts more emphasis on performance and quality. The development has been disputed by representatives of academia, who are interested in more autonomy. Higher education institutions feel deregulated on the one hand, but at the same time micromanaged and monitored by the state.

The recent economic crises will most likely lead to further decrease in private investment in R&D. Companies are facing increasing globalisation, as well as increasing competition, which may result in the larger, transnational companies moving their R&D investments abroad. To this picture, the traditionally low investments in R&D among SMEs can be added.

In Sweden there is no formal or compulsory arena for co-ordination in the area of research and innovation policy and operations. A recognised weakness of the system is a lack of comprehensive co-operation between relevant actors at this level.

As distinct examples of elements in the policy mix to handle these structural challenges a post-doctoral employment scheme is worth highlighting, as well as investments carried out in quality of mathematics, engineering and science in primary and secondary school. Following from the latest research and innovation bill, the Swedish government has also launched strategic research areas, which, among other things, also serve as arenas for interaction and co-operation between higher education institutions and industry.

Furthermore there is an emphasis on the building, maintaining and operation of research infrastructure. The Swedish system also sees a development of a quality assurance system for evaluating research at universities that will hopefully result in increasing quality of research. At the same time, however, traditional indicators are used, that could limit the growth of new research and the interaction with society.

The policy mix for promoting private investments in R&D developed further in 2009 and 2010, as the strategic research areas amounting to nearly €200m (SEK 1.8b) on a yearly basis took effect. These strategic investments are made to build up a number of new world class research environments in research fields that have been specifically selected because of their strong strategic importance for society. A number of the strategic research areas are also appropriate for partnership programs with industry, where institutions of higher education, agencies, companies and research institutes make joint investments. The long term objective is to contribute to increasing quality of research, improving conditions for commercialisation, encouraging cross-disciplinary scientific approaches and increasing opportunities for the system to make use of EU funding. The approach outlined here is quite new, and there is yet little evidence to show its efficiency or effectiveness. There is, however, a quite well spread consensus among stakeholders on the merits and what to expect from it. Systematic evaluation studies need to be performed, though, before any clear cut conclusions can be made in that

respect. Nevertheless, the policy mix seems to be quite well articulated for addressing the challenges.

Table 3: Assessment of the policy mix

Challenges	Policy measures/actions ⁹	Assessment in terms of appropriateness, efficiency and effectiveness
<p>Decreasing number of students enrolling for science and engineering programmes.</p> <p>Decreasing number of PhD graduates.</p> <p>Weak connections between academic research and industry.</p> <p>Role of the Swedish universities not entirely clear. HEI feel deregulated on the one hand, but at the same time micromanaged and monitored by the state.</p> <p>Decrease in private investment in R&D following from economic crises. Companies are facing increasing globalisation and competition, which may result in the larger, transnational companies moving their R&D investments abroad.</p> <p>Traditionally low investments in R&D among SMEs.</p> <p>No formal or compulsory arena for co-ordination in the area of research and innovation policy and operations.</p> <p>A lack of comprehensive co-operation between relevant actors.</p>	<p>Post-doctoral employment scheme.</p> <p>Investment in quality of mathematics, engineering and science in primary and secondary school.</p> <p>Government launch of strategic research areas.</p> <p>Building, maintaining and operation of research infrastructure.</p> <p>Development of a quality assurance system for evaluating research at universities.</p> <p>Launch of public-industry joint funding of research, innovation and development (e.g. the likes of FFI at VINNOVA).</p> <p>Establishment of public private partnership (PPP) programmes that target the knowledge demand from both universities and industry.</p> <p>Establishment of innovation offices at universities.</p>	<p>Successfully implemented, not yet evaluated.</p>

4 National policy and the European perspective

Sweden has a strong mobilisation of resources for research. Most critically, Sweden enjoys high gross domestic expenditures in R&D. In comparison with other countries, Swedish investments in R&D are especially high in the business and enterprise sector, but the share is also high in publicly funded R&D. This has resulted in Sweden scoring high on researchers per thousand labour force and on doctoral graduates per thousand population aged 25-34. Sweden also has a relatively high standard of Research Infrastructure. Since the amount of future business and enterprise investments in R&D

⁹ Changes in the legislation and other initiatives not necessarily related with funding are also included.

most likely will depend on access to skilled employees and a good research infrastructure, it is important that the investments remain on a high level also in the years to come.

Swedish policies for R&D have focused increasingly on 'strategic research areas' of national relevance (listed above in the report). Most of those areas are relevant also in a European perspective. Most strategic areas are found in science and engineering and often identified based on demands from the business and enterprise sector. It is therefore a bit worrying that the number of doctoral graduates in engineering and medicine has decreased for two years in a row. Swedish policies should seek to prevent the number of graduates in those areas from falling further.

The standard of Swedish research is relatively high. Swedish researchers are in average well-cited and have high publication rates. However, the citation rates are low in several strategic research areas, and Sweden has comparably few researchers at the frontier in their respective fields. It would therefore be recommended that Swedish policies focus on enhancing research quality. Several steps have already been taken, for example to encourage competition between researchers and between HEIs/PROs as well as to encourage recurring evaluations.

Sweden has for a long time been comparably poor at translating research findings into commercial products and services. This is for example indicated in the relatively weak Swedish scores on licence and patent revenues from abroad in the Innovation Union's Competitiveness Report. Swedish policies have for years focused on relieving this bottleneck in the innovation system. One recent policy measure that has been realised is the 'Innovation liaison offices' at eight universities, aiming to reach critical mass and more professionalism in technology transfer activities. A second way has been to support cooperative research centres and other partnerships between HEIs/PROs and industry. A third way has been to consider ways in which public procurement can boost innovation. It is recommended that Swedish policies continue to stimulate those and related activities. It is also recommended to focus on quality ('good innovations') rather than on quantity ('a lot of innovations').

Swedish policies for research and innovation are currently being governed relatively effectively and near the centre of the Government structure. Policies are typically developed in dialogue with key stakeholders in different sectors and after monitoring and evaluations being carried out by e.g. funding bodies. That is positive and would be a good strategy also for the coming years.

Future challenges for funding of research and innovation policy in Sweden include the creation and development of support measures which target the 'Grand Challenges', which are as valid in Sweden as elsewhere in the European Union. Public procurement and user-driven innovation procurement of various kinds ought to be strengthened, but finding efficient instruments for this may prove to be a challenge as well. The Government has made strong investments in R&D funding the last years, and there is currently pressure from the industry and the surrounding society to put more focus on investments in utilisation and commercialisation of scientific results, than has been the case. Increased governmental spending on VINNOVA and the institute sector, in order to better bridge the academic and industrial spheres, is asked for. Voices are raised for the creation of 'Strategic Innovation Areas', corresponding to the past bill's 'Strategic Research Areas'. Against this perspective stand those who want to protect curiosity-driven research at the universities. Insofar, the national debate is relatively polarised. Much expectation is laid on the forthcoming governmental research and innovation bill, expected in the autumn of 2012. The national innovation strategy is expected to be presented about the same time. Shifting the balance in the governmental research and

innovation budget so that larger shares are distributed to institutes and agencies that support user-driven innovation projects, instead of the research councils, is a core challenge for the near future. Identifying potential strategic innovation areas will be another, if the Government decides to go in that way.

Swedish policies for research and innovation are generally well at terms with the ERA pillars and objectives. In many ERA dimensions Swedish policies meet the goals, and the process from goal-setting to implementation often appears relatively efficient. However, beside shortcomings mentioned in the above paragraphs, Sweden is still relatively far from the goal of a single European labour market for researchers, in particular to offer attractive permanent positions at HEIs.

Table 4: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	Labour Market for Researchers	Decreasing number of graduating PhDs in engineering and medicine Lack of tenure-track/permanent positions in HEIs/PROs Common that HEIs/ PROs recruit own alumni to permanent positions	Increased funding to research at HEIs/PROs Increased incentives for HEIs/PROs to focus on fields with high demand Increased incentives for HEIs/PROs to conduct and disseminate internationally competitive research Initiatives to increase young people's interest in S&E and the quality of S&E education
2	Cross-border cooperation	Participation in European programmes could be higher	Increased incentives for researchers to participate in European programmes Increased engagement in European research infrastructure
3	World class research infrastructures	Strategies for engagement in research infrastructure need to be clear and have broad support	The Swedish Research Council has developed its role as national coordinator for research infrastructure
4	Research institutions	Low competition between HEIs/PROs Inadequate quality of research in some areas of national importance General lack of elite researchers	Increased autonomy for HEIs/PROs to encourage HEI/PRO competitive strategies Increased incentives for HEIs/PROs to conduct and disseminate internationally competitive research Direct funding to areas of national importance
5	Public-private partnerships	Efficiency of technology transfer could be better Low intersectoral research mobility	Government-funded innovation liaison offices at eight universities New R&D programmes in which HEIs/PROs and industry cooperate HEIs/PROs allowed to call professors without traditional open competition Measures to keep up competition for positions at HEIs/ PROs
6	Knowledge circulation across Europe	Swedish participation in European programmes could be higher Much output from public-funded research not open access	Increased incentives for researchers to participate in European programmes Increased engagement in European research infrastructure Development of national program for open access Participation in European initiatives for open access

	ERA dimension	Main challenges at national level	Recent policy changes
7	International Cooperation	R&D cooperation with countries of strategic importance could be higher	New bilateral programmes targeted to increase R&D cooperation with countries of strategic importance Participation in European R&D programmes targeted towards countries of strategic importance

Annex: Alignment of national policies with ERA pillars / objectives

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*

1.1 Supply of human resources for research

In 2009 Sweden had 46,784 researchers (FTEs). Of these, 15,908 worked in the higher education sector, 29,328 in the business enterprise sector, 1,483 in the government sector, and 65 in the private non-profit sector (Eurostat, note: all except the government sector are provisional values).

In 2007 the female proportion of all researchers (FTEs) in Sweden was 29.5 per cent. The rate differs between sectors: in the higher education sector 44.1 per cent of the researchers were women, in the business enterprise sector there was 25.0 per cent women, and in the government sector 40.4 per cent were women (Eurostat).

The demand for researchers in Sweden is relatively high, which is indicated by the strong positions of research graduates on the labour market. Of the 7,400 graduating PhDs in 2000, 2003 or 2005, about 90 per cent were established on the labour market in 2008. Almost all of these, between 90 and 98 per cent depending on scientific field, were either managers or had an employment that demanded theoretical specialist competence. The highest levels of establishment were found in engineering, medicine and the social sciences. Graduates in those fields also established faster than others (HSV, 2010a).

With regard to supply of researchers, the number of graduating PhDs at Swedish universities was 2,590 in 2010. The largest scientific fields for research graduates in 2010 were medicine (850 graduating PhDs) followed by engineering sciences (500) and natural sciences (420). The number of research graduates steadily increased between 2005 and 2008, from 2,750 to 2,900. In 2009 that figure decreased to 2,720 and in 2010 it was further down to 2,590. The largest decreases between 2009 and 2010 were in engineering sciences (a decrease by 50 graduates), social sciences (30) and the humanities (20) and medicine (20). Between 2009 and 2010 no major field increased its number of research graduates (Statistics Sweden, 2011). The graduation rate for PhDs in Sweden was in 2009 3.0%, in comparison to the EU average where the graduation rate for PhDs in 2009 was 1.9% (OECD, 2011).

The high degree of rapid labour market establishment for research graduates in engineering, medicine and social sciences indicates that in those fields supply is lower than the demand. The decrease of research graduates in those fields is therefore a bit alarming. In the humanities and natural sciences demand and supply are more balanced, but supply is not overly high. However, there are most likely significant differences between disciplines within fields. Such detailed statistics is not available.

In 2010 about 25 per cent of the PhD students in Sweden were foreign citizens. The number of foreign citizens among PhD students increased rapidly from 2007. Between 2003 and 2007 the number oscillated around 3,500. Between 2007 and 2010 the number increased to 5,200 in 2010. The increase is likely to continue as the share of foreign citizens among first-year PhD students was 34 per cent in 2010. The share of foreign citizens among first-year PhD students is highest in engineering (47 per cent) and the natural sciences (45 per cent). About 50 per cent of the foreign citizens among first-year PhD students are from Asia. Another 30-40 per cent are from the European Union or the other Nordic countries. The three largest countries are China, Iran, and Germany (Statistics Sweden, 2011). In addition, about 800 PhD students enrolled at universities in other countries visited Swedish HEIs for periods of three months or more. About half of these came from another EU country. The number of visiting PhD students has since 2002 varied between 700 and 950 per year. Engineering received the largest number of incoming visiting PhD students in 2010 (HSV, 2010b).

During 2010 about 850 teachers and researchers employed at foreign HEIs/PROs visited Swedish HEIs for periods of one month or more, an increase by 50 from the year before. A significant share of these teachers and researchers came from EU countries, and the rest from most parts of the world. The reader should note that the statistics does not differ between teaching and research (HSV, 2010b).

PhD studies at Swedish HEIs are attractive to foreign citizens mainly because of a reputation of high-quality studies; because PhD students receive salaries that are high enough to cover normal costs of living; because

there is typically no requirement to know Swedish; and because Swedish HEIs generally offer access to good research infrastructure. About 50 per cent of the PhD students have studentships that include social benefits. Studentships make no difference between Swedish/EU citizens and citizens in other countries. The requirement that non-EU/EEA/Switzerland students pay tuition fees, introduced in 2010, does not cover PhD students. Most of those reasons also make Sweden attractive to researchers at post-doctoral levels. Most Swedish HEIs have during the last years increased their efforts to boost inward and outward flows of researchers.

During 2010 about 1,100 PhD students enrolled at Swedish HEIs visited a foreign HEI/PRO for a period of at least three months. That is the largest recorded number for any year. The PhD students were relatively evenly distributed across scientific fields. About half of them visited a university in another EU country and a significant number visited a university in the USA. About 570 teachers and researchers at Swedish HEIs visited foreign universities for one month more during 2010; a significant decrease from 670 in 2009. Note that there is no difference between teaching and research in the statistics (HSV, 2010b).

A number of national policy measures have been taken to increase transnational mobility. The government highlights transnational mobility as important. Most public research funders specifically target transnational mobility as positive criteria for research funding or have specific programs for incoming or outgoing researchers. Beside EU programmes, examples include programmes to increase and support the transnational mobility of post-docs and other skilled researchers between Sweden and other countries such as the VINNOVA – JSPS Joint Projects programme for two-year visiting research fellowships between Sweden and Japan, as well as a number of Nordic initiatives to increase mobility across the Nordic countries and between Nordic countries and neighbouring countries.

Initiatives stimulating the inward mobility of foreign researchers such as tax reductions are in place. Such tax incentives include the provision that foreign experts, executives, scientists and researchers only pay tax on 75 per cent of their income during the first three years in Sweden, a benefit that again applies to both EU and non-EU researchers.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed

When comparing average yearly salaries Swedish researchers are located in the middle band of EU15 countries. Researchers working in the higher education sector have slightly higher salaries than researchers in the business enterprise sector and significantly higher salaries than researchers in the government sector (European Commission, 2007).

The salaries of researchers at Swedish HEIs are formally determined on an individual basis. However, in practice they are often decided centrally on faculty or research-council level. In addition, labour unions have, especially for PhD students, worked to keep salaries relatively standardised. Researchers in equivalent positions therefore tend to have more or less the same salaries. Most HEIs have tight budgets. In combination with relatively inflexible labour market regulations and a good supply of researchers this has resulted in HEIs employing researchers on short term contracts and preferring researchers that are able to attract external funding. Another consequence is that salaries are a bit lower in the large and more research-intensive universities than in smaller, less research-intensive regional university colleges.

The Association of Swedish Higher Education (SUHF), which organises the 42 Swedish universities and university colleges, signed “The European Charter for Researchers” and “The Code of Conduct for the Recruitment of Researchers” in 2007. The charter is thereby signed by all HEIs. Most of the issues covered in these initiatives had been implemented already by the time the charter was signed.

Since 2006 EU/EEA citizens do not need any work permit to stay in Sweden. If their stay is longer than three months researchers need to register with the Swedish Migration Board. Citizens of a Nordic country (Norway, Finland, Iceland, and Denmark) do not need a residence permit. As for third country citizens a new legislation came into force on first of July 2008, which is based on the EUs Researchers Visa Directive.

According to these rules no work permit is needed, if the purpose is to teach or lecture during a period of time shorter than three months. If the purpose is to be hired as a researcher for any period of time a work permit is required before arrival. One of the main problems is that foreign researchers can only be affiliated with HEIs for two years. This might be changed to four years.

The lack of tenure-track positions at Swedish HEIs might discourage non-national applicants from making a long-distance international move, especially if they have families. It is also common that Swedish HEIs recruit

their own alumni to permanent positions. This indicates that recruitment and competition procedures are often not tailored to maximise competition, which is particularly negative to potential applicants from other countries. Recruitment issues are discussed at length in for example the extensive evaluations RED10 at University of Gothenburg and KoF11 at Uppsala University. PhD graduates with a foreign background have a lower rate of establishment on the labour market than others, which might be a sign of informal structures that give them a disadvantage on the labour market (HSV, 2010a).

Research vacancies are not always internationally advertised. Advertisements for research positions are also not always available in English, although most HEIs have policies to advertise most positions also in English. Swedish HEIs/PROs and industry are relatively good at publishing research related positions on the EURAXESS Portal.

The Swedish National Agency for Higher Education (HSV) is the public agency responsible for recognising qualifications from abroad. As a member state of the EU Sweden follows the directive 2005/36/EC that stipulates the terms for the mutual recognition of diplomas, certificates and other evidence of formal qualifications. HSV evaluates most foreign higher education programmes. Undergraduate and postgraduate programmes from other countries are compared with those provided in Sweden. The comparison is expressed in terms of Swedish degree levels. The evaluation does not result in awarding a Swedish degree. In the case of getting a profession recognised in Sweden, an authority recognised with competence for the profession in question makes the decision. There is a clear system how to get a profession recognised with a list of documents that have to be submitted with the application. After the application has been submitted the authority has three to four months to assess the application and notify the applicant.

The Swedish Research Council (VR) is currently working to make it easier for funded researchers to transfer the grants awarded to other countries in case of relocation. VR has therefore, on the initiative of the European Heads of Research Councils (EUROHORCs), signed the Money Follows Researcher (MFR) agreement. According to this agreement, a researcher moving to a country in which there is an organisation that has also signed the MFR agreement, can take along the remaining part of a grant. Project Research Grants and Research Equipment Grants (<SEK2m) are eligible for transfer. However, grants for Postdoctoral Positions cannot be transferred.

1.3 Improve young people's scientific education and increase interest in research careers

In recent years, there have been concerns regarding the low number of engineers and students studying natural sciences. Policies to ensure the medium and long-term supply of those skills are therefore prioritised. The Government decided in 2009 to invest €13.5m (SEK125m) to improve the quality of mathematics, natural science and engineering teaching at primary and secondary level, and provide a knowledge base that is of importance for high tech companies carrying out R&D (Mattsson P. and Åström T., 2009).

The curricula for higher education are legally required to focus on, amongst other, critical thinking, problem solving and ability to adapt to changes in work life. Creativity, teamwork and communication skills are usually viewed as key skills to achieve those goals. Entrepreneurship training is widely available at Swedish HEIs. It is usually organised in specific organisational arrangements and available to those students who are interested, instead of being integrated in ordinary curricula.

1.4 Promote equal treatment for women and men in research

Swedish governments have prioritised equal treatment for men and women in academic environments at least since the 1990s. During the last three years policies to promote the equal treatment for men and women have been relatively unchanged. The main differences have been that government in 2010 chose to abandon the quantitative goals of recruiting equal shares of male and female professors and lecturers and to abandon some of the demands on research funders and universities to report statistics on men and women in academic research (SOU, 2011:1).

The government has also commenced a series of investigations. Most notably, a delegation was appointed for 2009-2011 to investigate gender equality in higher education and research. The delegation produced their conclusions in a series of reports. One report concluded that the peer review processes in Swedish "Centres of Excellence" had discriminated female applicants, which led the government to initiate an investigation of gender equality in direct funding to universities in 2011. In 2011 the government also initiated an investigation of how the increased autonomy for universities and university colleges has affected gender equality. The reports and investigations have not yet resulted in policy changes.

Policy regulations that may hinder the progression of female researchers after career breaks, in comparison with male researchers, are generally not found on the national level. Swedish law guarantees that employers have to restore employees to the same positions after maternity or paternity leaves. It is usually possible to extend a fixed-term contract due to maternity or paternity leaves.

Regulations with regard to gender equality are found in appointment of Rectors. Rectors are formally appointed by the government after candidates have been nominated by the HEI board. The boards are obliged to nominate both female and male candidates insofar possible, and to inform the government how the aspect of gender equality has been treated in the nomination process. Gender equality has also to be considered in the processing of internal HEI employment matters. Also public bodies that fund research are obliged to consider gender equality both in their funding and in their advisory boards and other committees.

2. Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding¹⁰

Policy actions at national level support joint European programming and jointly funded activities.

Participation in such activities is a priority for all main research councils and agencies. The Swedish Governmental Agency for Innovation Systems (VINNOVA) is responsible for the Swedish participation in the FPs for R&D, EUREKA, and COST. VINNOVA is also responsible for the EU BSR Strategy. VINNOVA puts significant resources into encouraging and facilitating Swedish participation in these programs. Until March 2011 Sweden had contracted 4.0 per cent of the total funds for R&D in FP7. The 2,061 participants in 1,471 funded projects put Sweden in 8th place among countries in FP7. The Swedish success rate in FP7 is the fifth highest in EU-27, about 25 per cent.

Sweden is involved in eight ERA-NET. VINNOVA is involved in five ERA-NET that fall into Theme 2, "Technology for the Information Society" and one ERA-NET that belong to Theme 2, "Technology for the Information Society". VR is involved in three ERA-NET. Sweden also participates in the ESF through six member organisations that are all public research funding bodies or academic societies.

In addition, Sweden also engages in Nordic collaborations. This engagement largely takes place through the Nordic Council and Nordic Council of Ministers for Education and Research where Denmark, Finland, Iceland, Norway and Sweden participate. The Nordic Council participates in the Baltic Sea co-operation in the BSPC and has observer status in the permanent SCPAR. Strategies include to further develop the Nordic Research and Innovation Area (NORIA); to improve research and innovation through increased efforts in the joint Nordic research and innovation institutions as well as to intensify co-operation between the national research funding bodies; to improve NordForsk in the co-ordination of Nordic research activities; to identify the Nordic positions of strength in the area of research and innovation; and to promote co-operation around research infrastructure.

Funding in national programmes is rarely available to foreign entities or to non-Swedish researchers who are not based in Sweden. The main reason is that the community of Swedish researchers is reluctant to share its national funding resources with researchers in other European countries unless it receives equal opportunities to compete for funding in other countries. If such guarantees can be made the researchers are likely to be positive. That is indicated by the strong support from the Association of Swedish Higher Education (SUHF) for an extensive ERA framework. Also, the latest Research and Innovation Bill states that given the trend towards international collaborations, opening funding programmes to external collaborators and funding international actors may become a viable option. According to the bill such efforts will be carried out to a limited extent. The conditions on how to best implement such activities is still examined by the Government.

3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them

¹⁰ Promote more critical mass and more strategic, focussed, efficient and effective European research via improved cooperation and coordination between public research funding authorities across Europe, including joint programming, jointly funded activities and common foresight.

- Ensure the development of research systems and programmes across the Union in a more simple and coherent manner.
- Promote increased European-wide competition and access of cross-border projects to national projects funding

The Swedish Research Council (VR) is responsible for Sweden's participation in intergovernmental European infrastructures. A strategy document with a ten-year horizon is developed about every three years. A new strategy document will be published in December 2011. The previous document envisaged the following core strategies:

- Active participation in international infrastructures primarily by contributing to the 15 projects from the ESFRI Roadmap¹¹ for Research Infrastructures that were given highest priority by Swedish researchers. The Swedish Research Council participated in the planning of seven projects of particular interest: They are: ELIXIR, ESS, PRACE, FAIR, Infrafrontier, LifeWatch, and XFEL.
- National level coordination of Research Infrastructures to increase the quality of research and utilise resources more efficiently. Examples include systems for managing environmental and climate data and the coordination of biobanks.
- National nodes should be developed to collaborate with international infrastructures. Resources also needed to develop technology, expertise, and methods.
- Sweden should offer to host one or more international infrastructure, for example the European Spallation Source (ESS). Other possibilities would be the synchrotron generator MAX IV and the upgrading of EISCAT. (note: ESS and MAX IV are now under construction in Lund).
- E-Infrastructures for large-scale computing, communication, and storage of data should be strengthened to benefit all research fields.

The Swedish national RI landscape overall holds relatively high quality in international comparison. However, in several fields internationally competitive research cannot be conducted without access to infrastructure that is too expensive to be covered by national funding alone. Nationally funded research infrastructure is normally located at HEIs/PROs and accessible by foreign actors through research cooperations or in commissioned projects conducted by researchers at these institutions.

Sweden is also engaged in a number of European infrastructures. The responsibility for that work lies with the VR. The Swedish Research Council's Committee for Research Infrastructure represents Swedish interests in various national and international research infrastructures. Sweden participates in several international infrastructure initiatives and has been a long time member of CERN, EFDA, ESO, IceCube, JET, EMBL, ESRF, IARC, ILL, ISIS, PRACE, GBIF, IODP/ECORD, ESS, EUI, INCF and ITER. Furthermore, a number of Nordic initiatives exist such as NORDSIM, NDGF, NORDUnet, and NOT.

4. Strengthen research institutions, including notably universities

Swedish HEIs have three core missions: (i) to teach, (ii) to conduct research, and (iii) to interact with the surrounding society and inform about their activities as well as to ensure that benefit is derived from their research findings. These are legal obligations. The legal regulations changed 1 July 2009 on the third point above to include also the mission that HEIs ensure that benefit is derived from their research findings.

Swedish HEIs are either universities or university colleges. A majority of these are public authorities, subject to the same legislation and regulations as other public authorities in Sweden, as well as to the particular statutes, ordinances and regulations relevant to the higher education sector. A small number of universities and university colleges are self-governing and independent and operate on the basis of an agreement with the Government. Also these are obliged to follow the statutes, ordinances and regulations relevant to the higher education sector

Universities typically have degree awarding powers at first cycle (university diplomas and bachelors' degrees), second cycle (one-year and two-year masters' degrees) and third cycle (licentiate and doctoral degrees). They are also entitled to direct government funding for research.

University colleges typically have degree awarding powers at first cycle (university diplomas and bachelors' degrees) and second cycle (one-year masters' degrees). They can apply to the Swedish National Agency for Higher Education (HSV) for the entitlement to award two-year Masters' degrees and third cycle qualifications in specific domains.

The differences between universities and university colleges have decreased during the last three years. The government has declared that degree awarding powers should be determined by quality rather than the

¹¹ http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-roadmap

traditional categorisation into universities and university colleges. The quality will be determined in recurring evaluations conducted by HSV. Thus, the right to award for example third cycle degrees can be won by a university college or lost by a university. The government has encouraged universities and university colleges to merge with each other. One major merger has occurred since 2009.

According to the European University Association's (EUA) Autonomy Scorecard, presented in November 2011 and reflecting the level of university autonomy in European countries in 2010, Sweden takes a medium position when it comes to organisational autonomy and academic autonomy (Estermann, Nokkala, Steinel, 2011). These two dimensions capture among other things the capacity to autonomously design research agendas. Similarly, Sweden takes a medium position when regarding financial autonomy and the capacity to manage research budgets. Regarding staffing autonomy, Sweden scores higher and has one of the top positions, compared to other countries. Since 2010, an autonomy reform has been launched, resulting in significant change for Swedish universities. This reform took effect on 1 January 2011. The details are as follows.

In June 2009 the Swedish government presented a bill on greater autonomy for HEIs (Govt. Bill, 2009/10:149). Following the bill HEIs will still have the status as state agencies, but faculty boards will no longer be mandatory and regulated by the Higher Education Ordinance. In brief, the main conclusions of the bill are:

- HEIs shall have a Board and a rector but are otherwise free to develop their own organisations
- Decisions requiring a particular, qualified assessment must be taken by people with scientific or artistic qualifications
- The students must have the right to be represented when decisions are taken when or preparations are made that significantly affect the education or the situation for students
- Staff in the categories Professor and Senior Lecturer will be regulated in the Higher Education Ordinance. Otherwise, HEIs can choose their own career structures and categories of staff. They can also recruit key individuals to a professorship without the traditional open competition
- Education is regulated at a less detailed level than before

The Government Bill A Reformed Constitution (Govt. Bill, 2009/10:80) also includes two amendments to the Instrument of Government that increase the freedom of higher education institutions. The amendments entered into force on 1 January 2011. Researchers will continue to be free to design their own research agendas and free to choose where to publish their results.

HEI boards include internal representatives, staff and students, and external members. It should be possible for a non-Swedish citizen to be a vice-chancellor or member of the board of a HEI. Rectors, deans and other HEI managers can either be recruited through an open tender process or elected among peers.

One of the main reasons to the increased autonomy is that HEIs to an increasing degree want to decide over funding sources. The mission to cooperate and inform society has put pressure on HEIs to interact with other actors. Increased autonomy will make it easier for HEIs to develop their own strategies and hopefully lead to increased funding. At the same time one of the hopes is that HEIs will further specialise in specific fields, which is hoped to result in increased international competitiveness as well as national competition between HEIs with the aim of increasing research quality. Since external funding plays an increasingly important role the debate also raised the issue on whether private HEIs should be allowed.

The government has declared that it intends to distribute a larger share of block funding for research on the basis of quality than is presently the case. Quality will be measured by two criteria: number of (high quality) publications/citations and the ability to attract external research funds. The government has also specified research areas of national interest and distributed specific funding to these. Research quality in those areas is specifically monitored. Swedish researchers perform well in some of those areas and not so well in other. The largest difference compared to relevant countries of reference is that Sweden has comparably few world-leading researchers (Swedish Research Council 2007, 2010). There is no broad national evaluation of block funded research. However, since 2007 several universities have conducted extensive evaluations of their research activities. Those evaluations have largely been conducted by panels with international experts. The Swedish Research Council (VR) has the national responsibility to monitor publication and citation patterns for Swedish research fields as well as for different HEIs/PROs. Depending on their profile, also most other public research funders keep track of the production of for example publications, citations and patents.

5. Facilitate partnerships and productive interactions between research institutions and the private sector

Knowledge circulation between academia, industry and the public sector has increasingly been stressed in Swedish research and innovation policy. This is particularly reflected in a number of programmes in which funding is conditioned by e.g. industry involvement. Such programs are especially launched by the Swedish Governmental Agency for Innovation Systems (VINNOVA). Ongoing programmes range from sector-specific programmes to programmes that facilitate regional innovation milieus. Specific programs intend to establish Centres of Excellence; those programs are particularly ambitious both with regard to scale and scope of funding and with regard to demands on research quality. Another common way to establish effective links between HEIs/PROs and industry is that a firm funds a PhD student who works on a problem relevant to the firm and is jointly supervised by a professor and the firm. Staff mobility between HEIs/PROs and firms sometimes result in fruitful personal networks. In order to strengthen technology transfer at HEIs, specific government-funded innovation liaison offices have been set up at eight HEIs. The offices provide advice on for instance patenting, licensing and contract research. Also most other HEIs have specific divisions that support such activities. According to research and evaluations, most initiatives (programmes, industry-funded PhD students, staff mobility, technology transfer offices) have resulted in improved mechanisms to make public research more useful in the private sector. However, the quality and effectiveness of such mechanisms differ significantly between different scientific and technological fields.

In the National Reform Programme 2008, it is stated that Sweden needs to prioritise and improve management of intellectual property rights. Some measures have been taken in this regard, which will make it easier and less costly for firms to protect their inventions, e.g. in relation to patents applied for through the European Patent Office. The government has also taken measures to facilitate the financing of academic spin-offs. In addition, the introduction of innovation offices and other infrastructure to support knowledge transfer has resulted in a growing professionalisation and standardisation of knowledge transfer activities. From 1 January 2010 most research generated by Swedish public funding must be made available to the public for free. This includes for example research funded by HEI/PRO base funding and all research funded by the Swedish Research Council and Swedish Research Council Formas. Local HEI/PRO policies differ, however.

The intersectoral mobility of researchers is widely regarded as low. This is particularly true of mobility from industry to HEIs/PROs. Policy-makers have identified intersectoral mobility as a prioritised area. One measure to increase the mobility is the extended rights for HEIs/PROs to call professors without traditional open competition. Another way is to ensure that the supply of research funding and academic positions continues to be considerably lower than the demand. However, policy measures that increase demands on HEI/PRO researchers to produce high-quality publications contradicts both the goal of increased intersectoral mobility and other goals to make HEI/PRO researchers more engaged in making research useful, as such policies strengthen incentives to focus on intra-academic research activities.

A HEI board must consist of 15 members of which at least eight must be external to the HEI. HEIs nominate board members to the government, which makes the formal decision. All HEIs have members from the business sector in their boards.

6. Enhance knowledge circulation across Europe and beyond

The importance of international cooperation in R&D is highlighted in the most recent government bill for research and innovation (Govt. Bill, 2008/2009:50). Swedish participation in FP7 and other European programs is highly prioritised. The bill also stresses the importance to cooperate with emerging economies in which the growth in R&D is relatively strong. See section seven below. The government also points at the links between on the one hand research and innovation policy and on the other hand other policy fields, such as industrial and foreign policies, which includes European interests. A recent large-scale VINNOVA program, "Challenge-driven innovation", strongly reflects EU2020 priorities and the international perspective. Overall, the international dimension is considered important in almost all R&D funding programmes and activities by Swedish public funders.

Another aspect of the promotion of knowledge circulation is the emphasis on Swedish participation in international research infrastructure, as mentioned particularly in section three above. Of particular note is the effort the Government and big parts of the scientific community put into hosting the ESS, which is under construction in Lund, Sweden.

A national program to enhance open access is currently being developed by the National Library of Sweden (KB). The program supports open access publishing and works with information and advice, infrastructure and service, and policy development. The program is a platform for collaboration between most of the largest research funders and all HEIs. The KB is also engaged in the development of a European scientific information system with open access, for example via the OpenAIREplus and COAR projects and in the work by IFLA on open access. In addition, most HEIs/PROs have local policies to publish as much research outputs as possible as open access. Since 1 January 2010 most large public research funders demand that research they fund will be freely available to the public.

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world

The government stresses the importance of international cooperation. In its current policy, the government also emphasises the need for strategies to cooperate with countries in other parts of the world, most notably emerging economies in which the growth in R&D is strong, for example China, India, Brazil, Singapore, South Africa, and Mexico. Also South Korea and Taiwan are identified as important partners. Cooperation with these countries either takes part via bilateral agreements or via European programmes. The government links research and innovation policy to other policy fields, such as industrial and foreign affairs policies, which includes European interests. In addition, Sweden participates in international collaborations through Nordic and European programmes. Those programmes typically involve the Nordic countries and often also neighbouring countries such as the Baltic states and sometimes also countries with interests in the Arctic region. The international dimension is considered important in most R&D funding programmes and activities by Swedish public funders.

There are no priorities of certain countries on national level. No national internationalisation strategy exists, thus no rules which regulate collaboration with other countries. Several public research funders participate in, or run, bilateral programmes with countries of strategic importance. VINNOVA organises bilateral programmes primarily within biotechnology and ICT. Examples of biotechnology programmes include cooperation with India on tuberculosis research, with Japan on multidisciplinary biotechnology, and with Canada and United Kingdom on structural genomics. Examples of ICT programmes include cooperation with China on materials science, with India on health and ICT, with China on wireless technology, and with Israel on mobile technologies and ICT security. Examples of other programmes include cooperation with Brazil on advanced technology and innovation, and with Japan on exchange of researchers. Nordic programmes include NORIA-net on e-citizens and NORDITE on ICT. It also includes the Nordic Top-level Research Initiative on climate, environment and energy. Several of the above-mentioned programmes address grand challenges, such as the programmes on tuberculosis, ICT security, and environment, climate and energy. The Swedish Energy Agency organises bilateral R&D agreements with Brazil on biofuels, United Arab Emirates on environmental and energy technologies for sustainable cities and climate changes, India on renewable energy with particular emphasis on biogas, China on bioenergy broadly, Russia on energy broadly, Ukraine on energy efficiency, and the United States on renewable energy with particular focus on biofuels in the transport sector. Bilateral agreements typically involve specific regulations from case to case.

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List of Abbreviations

BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
DT RTD	Directorate-General for Research & Innovation
EEA	European Economic Area
EFDA	European Fusion Development Agreement
EMBL	European Molecular Biology Laboratory
ERA	European Research Area
ERA-NET	European Research Area Network
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Southern Observatory
EU	European Union
EU-27	European Union including 27 Member States
EUA	European University Association's
FFI	Strategic Vehicle Research and Innovation
FP	European Framework Programme for Research and Technology Development
FDI	Foreign Direct Investments
FP	Framework Programme
FP7	7th Framework Programme
FTE	Full-time Equivalent
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
HSV	Swedish National Agency for Higher Education
ICT	Information and Communication Technology
IP	Intellectual Property
IPR	Intellectual Property Rights
IPTS	Institute for Prospective Technological Studies
JRC	European Commission's Joint Research Centre
JSPS	Japan Society for the Promotion of Science
MISTRA	Foundation for Strategic Environmental Research
MNC	Multi-national Companies
MFR	Money Follows Researcher
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
PPP	Public Private Partnerships
PRO	Public Research Organisations

R&D	Research and development
R&D&I	Research and Development and Innovation
RDI	Research Development and Innovation
RI	Research Infrastructures
RJ	Riksbankens Jubileumsfond
RTDI	Research Technological Development and Innovation
S&E	Science and Engineering
S&T	Science and technology
SEK	Swedish krona
SF	Structural Funds
SIDA	Swedish International Development Cooperation Agency
SME	Small and Medium Sized Enterprise
STINT	Swedish Foundation for International Cooperation in Research and Higher Education
SUHF	Swedish Higher Education
VC	Venture Capital
VR	Swedish Research Council

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Abstract

The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.