ERAWATCH COUNTRY REPORTS 2010:

Iceland

ERAWATCH Network – NIFU

Lisa Scordato

Acknowledgements and further information:

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The report is currently only published in electronic format and available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

Executive Summary

Iceland is a small country with a population of about 320,000 inhabitants, of which over half are based in the Reykjavik capital area. In 1994, Iceland became fully integrated into the European single market, joining the European Economic Area Agreement (EEA) at the same time as Norway and Lichtenstein.

The Parliament of Iceland passed a resolution on 16th July 2009 instructing the government to apply for EU membership. Iceland's accession negotiations with the European Union were formally opened on July 27th 2010.

Two years after the collapse of the Icelandic banking and financial sector, which began in October 2008 as a direct result of the worldwide financial crisis, the Icelandic economy is still in a situation characterised by instability and profound political and economic insecurity. This instability is also impacting on science and technology policy, which has been undergoing a period of reorientation since 2008.

Iceland's total investment in research and development (R&D) as share of Gross Domestic Product (GDP) was 2.65% in 2008, a relatively high level compared to the EU27 average of 1.77%. The business sector accounts for 55% of R&D expenditure while the public sector, including higher education institutions, accounts for about 43%.

Iceland had only two universities until relatively recently. During the economic boom of the 1990s universities expanded dramatically to include four state-owned and three private higher education institutions (HEIs), a considerable number of HEIs relative to population size. The leading public HEI, the University of Iceland, is the only university offering a complete range of disciplines; it is also the most substantial public R&D performer.

In terms of private investment, a single biopharmaceutical company, deCODE Genetics, is responsible for a large share of all business R&D.

Knowledge Triangle

The following table provides a short assessment of the interaction between different policies relevant for the Icelandic knowledge triangle.

Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	• New target for R&D spending: 4% of GDP for R&D by 2020, with 70% of spending to come from companies and 30% from public funds.	• - The severe economic and financial crisis which hit the country in October 2008 continues to negatively affect public research spending. The envisaged target to increase public expenditure for competitive funding could not be maintained in 2011. The 2011 budget included a 9% overall cut to the state budget (compared to 2010) with a 7.5% cut for universities and 5% cut for competitive funds. Public expenditure on competitive funds remained stable in 2010. Continued budget cuts are expected in the coming years.

	Recent policy changes	Assessment of strengths and weaknesses
Innovation policy	• New act on tax incentives for R&D • Merging of the Research Fund and the Technology Development Fund	• + Tax incentives for R&D have been discussed for some years as a way to strengthen the competitiveness of innovative companies. The first effective tax year was 2010. • + The merging of the research and industrial funds, under the umbrella of RANNÍS is being recognised by the government as both timely and important. A broad consensus has been reached on a policy to ensure research and development is conducted through competitive funds and the strategic research programmes of the Science and Technology Policy Council.
Education policy	• Recommendations on merging public universities and tertiary institutions	• + The economic crisis has brought policymakers to think in terms of effectiveness and pooling of existing resources. University mergers are seen as an important step in this direction. • - Attempts to merge universities during 2010 have met resistance from university administrations and have been suspended.
Other policies	• EU accession process	• + Since July 2010 Iceland has held formal EU Candidate Country status. It remains to be seen if there is political will to set a date for an EU membership referendum in a near future.

European Research Area

Iceland's national science and technology policy is regularly updated and takes into account European developments. The Icelandic Science and Technology Policy Council has responsibility for preparing actions on how to follow and integrate ERA policies into this process. The government policy paper from January 2011, 'Iceland 2020 – Action plan for industry and society; knowledge, sustainability and welfare', takes the objectives of the ERA into account.

The following table gives a short summary of the national policies or measures that support the strategic ERA objectives.

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

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• All universities have signed the European charter for researchers and their code of conduct. • RANNIS participates actively in the EURAXESS service network that provides practical assistance to mobile researchers and their families. • New programme dedicated to researchers' mobility under the Research Fund to offer incoming, outgoing and reintegration grants irrespective of the applicant's nationality.	• - The supply for science & engineering considered to be inadequate, no formal channel for the education system to systematically identify the need in this respect. • - The weak Icelandic currency may be a considerable barrier for researchers with Icelandic salaries to go abroad.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
2	Increase public support for research	• New target for R&D spending to reach 4% of GDP by 2020, with 70% of spending to come from companies and 30% from public funds.	• - The envisaged increase of competitive funding was not met in 2010; the budget for 2011 foresees cuts in competitive spending.
3	Increase European coordination and integration of research funding	• In 2010 the government appointed a number of working groups to assess the status of, and future possibilities for enhanced Icelandic participation in European and international research.	• + Access to EU research funding has increased in importance and the number of applications for both national and EU framework programmes are rising.
4	Enhance research capacity across Europe	• No policy changes	
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• A new working group on research infrastructure has been set up with the mandate to make recommendations on how Iceland can better link up with Nordic RI. • The STPC strategy 2010-2012 emphasises the importance of eScience for Icelandic researchers.	• + Iceland has participated actively in five ESFRI groups. • - Due to budgetary constraints it is unclear if Iceland will be able to continue its engagement in the implementation phase.
6	Strengthen research institutions, including notably universities	• Recommendations on merging public universities and tertiary institutions.	• - Attempts to merge universities in 2010 have failed.
7	Improve framework conditions for private investment in R&D	• New act on tax incentives for R&D.	• + The policy measure has been discussed for some years as a way to strengthen the competitiveness of innovative companies. The first effective tax year was 2010.
8	Promote public-private cooperation and knowledge transfer	• The “Centres of Excellence” programme, launched in 2009, includes a key objective about fostering knowledge circulation between university, Public Research Organisations (PRO) and business sectors.	• + The issue of knowledge circulation and the need to capitalise on public investments in research have become prominent policy issues as a result of the economic downturn. • It is too early to assess the effectiveness of the measure, but it is of interest and should be followed up closely in terms of the development and nature of the cooperation established by the centres.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
9	Enhance knowledge circulation across Europe and beyond	• Introduction of the first programme dedicated to researchers' mobility with co-funding from the FP7 People programme to offer incoming, outgoing and reintegration grants, irrespective of the applicant's nationality.	• + Like all previous S&T policy strategies, the latest strategy from the STPC for the period 2010-2012 emphasises the vital importance of international cooperation for the development of research and innovation in Iceland. +Icelandic research establishments and funding rules are traditionally open to researchers' mobility, although financial resources have been scarce.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• No policy changes.	
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• A process aiming at improving the coordination of strategic programmes under the ministries is underway. The process is headed by the Ministry of Education, Research and Culture.	• - Lack of coordination of research programmes is perceived as a problem in Icelandic research policy governance. There are particular tensions regarding coordination and alignment of programmes under the auspices of Ministry of Agriculture and Fisheries (notably the AVS fund).
12	Develop and sustain excellence and overall quality of European research	• The Centre of Excellence programme has been in place since 2009.	• + The setting up of centres of excellence under the scheme is in line with the recent process of prioritisation in Icelandic research. • - The lack of prioritisation between research policies has been under criticism for some time.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
13	Promote structural change and specialisation towards a more knowledge-intensive economy	• In January 2011, the government issued a policy paper called 'Iceland 2020 – Action plan for industry and society; knowledge, sustainability and welfare'. One of its main goals is: to reduce the percentage of Icelanders aged between 20 and 66 who have not received any formal secondary education, from 30% to 10%, by 2020.	• + The economic crisis has led Icelandic policymakers to re-orient science policy and prioritise areas with Icelandic strength. • - A particular concern is the high dropout rate from secondary school. The number of people of working age who have only completed primary education is a further source of concern. • + The Iceland 2020 strategy points at particularly strong opportunities for innovation in the production of agriculture and marine products and eco-innovations.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• The Iceland 2020 strategy emphasised the importance of eco-innovations for the Icelandic economy. The aim is to make eco-innovation and its products a main growth sector for this decade, with an annual growth in turnover of 20%, which will double between 2011 and 2015. Other policies emphasise ambitions to boost research, development and production of domestic, environmentally friendly fuels.	• Icelandic policy for research has not traditionally emphasised particular priority areas such as solving societal challenges or contributing to sustainable development. • + From recent policy strategies it is evident that a shift in this direction is taking place. There is a stronger policy focus on eco-innovations and sustainable fuels especially.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• The STPC strategy 2010-2012 emphasises the importance of strengthening policy intelligence and evidence-based policy making. It is recommended that RANNIS should be strengthened, as the main body involved in supporting and analysing research and innovation processes in the country.	• - Icelandic policy makers do not make extensive use of evaluation tools. A key criticism from independent expert assessments of the Icelandic research system is the lack of evidence-based policies, to a large extent due to the inadequate policy intelligence preparation of the advisory bodies.

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1 Introduction

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

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

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

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

The aim of this chapter is to assess the performance of the national research system, the **'interlinkages'** between research and innovation systems, in terms of the broad range of relevant governance and policy. It also aims to assess the changes that have occurred in 2009 and 2010 in national policy mixes, from a perspective that is focused on the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and then goes on to describe and assess the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

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

This section gives the main characteristics of the structure of the national research and innovation systems and describes of their broader governance.

Iceland is a small country with a population of about 320,000 inhabitants, more than half of whom live in the Reykjavik capital area. In 1994, Iceland became fully integrated into the European single market, joining the European Economic Area

Agreement (EEA) at the same time as Norway and Lichtenstein. Iceland is also part of the group of European Free Trade Agreement (EFTA) states, together with Norway, Lichtenstein and Switzerland.

Through the EEA Agreement, Iceland has taken on much of the EU´s single market legislation. Icelandic legislation now incorporates 22 of the 35 chapters of all EU legislation, and Iceland participates in various EU programmes, including the EU Framework Programmes for Research and Technology.

Iceland is also involved in the Standing Committee for Agricultural Research, as an observer, and is involved in the governance of the ERA through its observer role in the Scientific and Technological Advisory Committee of the EU (CREST) and other ERA governance bodies.

The Parliament of Iceland passed a resolution on 16th July 2009 instructing the government to apply for EU membership. Iceland's accession negotiations with the European Union were formally opened on July 27th 2010. While EU membership would not have any direct consequences for Icelandic applicants, it would have an impact on policymaking, as Icelandic policymakers would have voting rights in the programme committees where EFTA states are currently only observers. The biggest change envisaged regards achieving full participation in structural funds, only relevant for EU Member States. For these reasons it is perceived to be necessary for Icelandic policymakers to formulate strategies to tackle the future changes and opportunities that an eventual EU membership would imply.

As part of the Nordic cooperation under the auspices of the Nordic Council and the Nordic Council of Ministers, Iceland also benefits from Nordic level research and innovation initiatives[1]. There are two main bodies set up on the Nordic level for research and innovation: NordForsk and the Nordic Innovation Centre (NICe). Nordic cooperation is also present through numerous informal bi-lateral and multi-lateral initiatives, established between research councils and agencies in the Nordic countries. The Nordic budget available for this cooperation is a common pot with no expectation of a 'fair return' and contributions are calculated according to a sliding scale based on national GDP (Rieker et al., 2010).

Two years after the complete collapse of the Icelandic banking and financial sector in October 2008, as a direct result of the worldwide financial crisis, the Icelandic economy is still in a situation of instability and profound political and economic insecurity. Economic growth in 2009 was -6.8% of GDP. Unemployment has traditionally very low in Iceland, has risen sharply; it stood at 8.7% in the 2nd quarter of 2010, compared to just 3% in 2008[2]. This economic and political instability is also impacting on science and technology policy, which has been undergoing a phase of reorientation since 2008.

Iceland's total investment in research and development (R&D) as share of Gross Domestic Product (GDP) was 2.65% in 2008, a relatively high level compared to the EU27 average of 1.77%. The business sector accounts for 55% of R&D expenditure while the public sector, including higher education institutions, accounts for 43%.

This share of investment is equivalent to an annual spend of €383m (ISK35b). Spending is fairly evenly divided between private and public sources: the private

[1] The Nordic countries comprise Denmark, Sweden, Norway, Finland, Iceland, the Faroe Islands, Greenland and Åland.
[2] Statistics Iceland.

sector spent about €208m (ISK19b) on R&D in 2008, about 54.6% of Iceland's gross expenditure on R&D (GERD).

Table 1: Key figures for Iceland

Population head count (2009)	319,368
GDP per capita (2009)	€27,200
R&D intensity (GERD/GDP) (2008)	2.65% of GDP
Share of private sector R&D (2008)	54.6% of GERD
Share of public sector R&D (2008)	43% of GERD

Main actors and institutions involved in research governance

Figure 1 below depicts the main actors and institutions, as well as funding flows, within the Icelandic research system.

On the policy design level, the Science and Technology Policy Council (STPC) is the key strategic body that sits at the core of the R&D policy system in Iceland. It includes 20 members and is headed by the prime minister. The role of this body is to define the country's strategic orientation for science and technology policy.

The Council is organised in two committees, the Science Committee and the Technology Committee, which prepare the decisions of the Council. There is an overlap between members of these two committees in order to foster synergies.

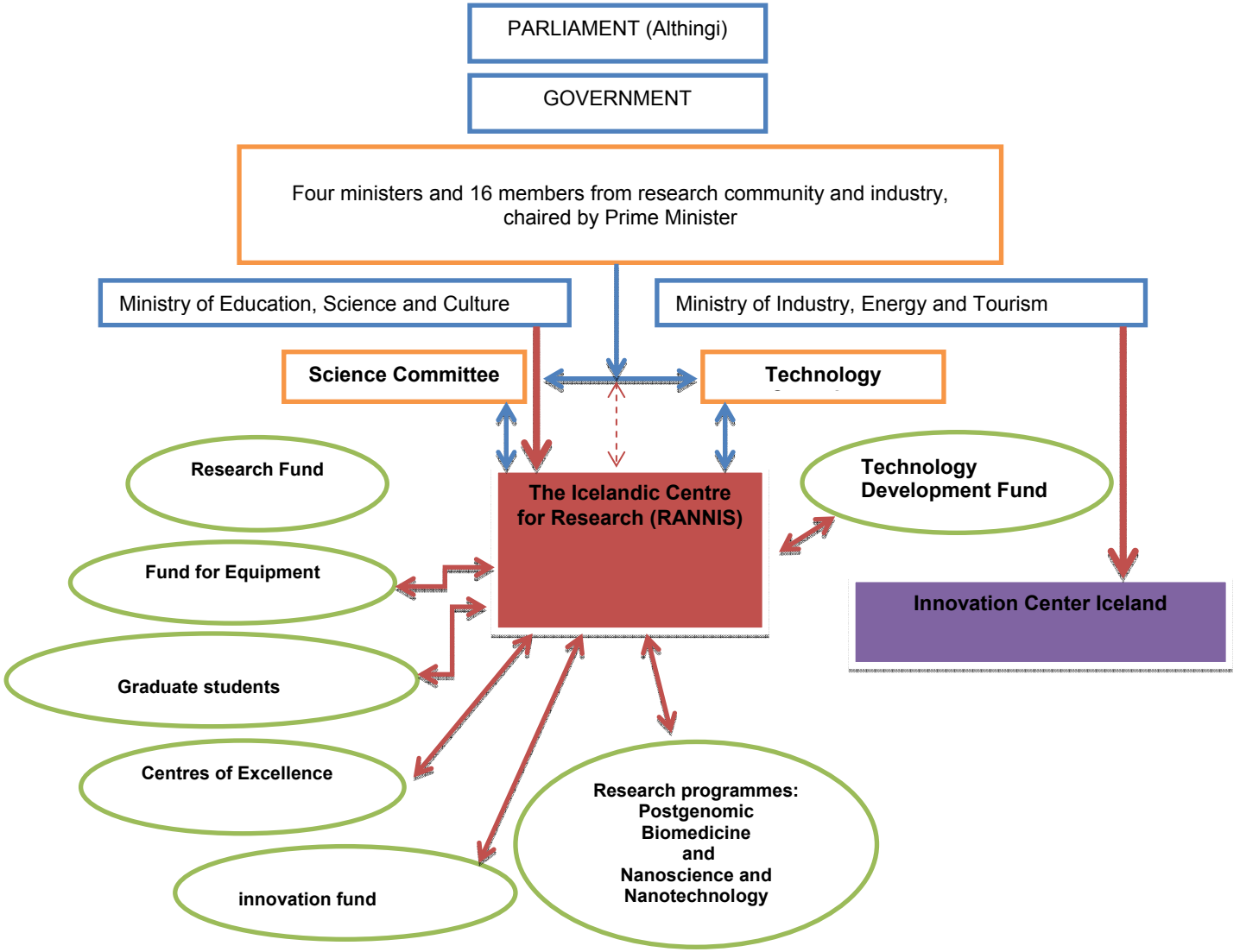
Each Minister with responsibilities for R&D activities takes decisions with respect to R&D institutions and funds under their own department's control.

On the operational level, the Icelandic Centre for Research, RANNIS (reporting to the Ministry of Education, Science and Culture) is an important agent for the implementation of the policy: it provides technical support to the council, its committees and to funding bodies, and also manages and follows up the implementation of most research programmes.

As part of the on-going reorientation phase in science and technology policy, various working groups (composed of national and international experts) have been appointed by the Ministry of Education, Science and Culture with the task of assessing existing policy and making recommendations for future directions for science and technology (for more details, see Taxell et al. 2009 and ERAWATCH Country Report for Iceland 2009). The expert assessments pointed out a number of weaknesses in the S&T governance system in Iceland. It was recommended that increased autonomy should be given to the STPC, enabling more effective and transparent decisions. At the same time, it was stressed that professional policy preparation needs to be strengthened at all levels, not least in the internal policy preparation of RANNIS.

Private R&D performers receive limited government funding for research: they can access competitive funds (mainly Technology Development Fund, AVS and targeted programmes) but they do not benefit from dedicated funding sources. The government has invested in a venture capital fund, the *New Business Venture Fund*. The Icelandic Innovation Centre, under the control of the Ministry of Industry, Energy and Tourism, is in charge of technology development, technology transfer to companies and support to innovative businesses.

Figure 1: Iceland's research system governance structure



Source: ERAWATCH Research Inventory

The institutional role of regions in research governance

Iceland is a unitary state. Its eight regions are mainly used for statistical purposes: they are not defined by law and have no official standing or administrative function. Hence, regions play no role in Iceland's research and innovation governance.

Main research performer groups

Public research in Iceland is conducted in universities but also in a range of other public research organisations.

Until recent decades Iceland had only two universities, but during the economic boom of the 1990s university numbers expanded, up to today's range of four state-owned and three private institutions, a considerable number of HEIs relative to population size. The major public HEI, the **University of Iceland** is the only university offering a complete range of disciplines. It is also the leading R&D performer in the public sector. The University Hospital is also an important research actor, which has established extensive research co-operation with the medical faculty at the University of Iceland. The universities are financed and controlled by the Ministry of Education, Science and Culture. The *HERD intensity ratio* (HERD as percentage of GDP) was 0.67% in 2008, above the EU27 average of 0.43%.

Table 2: Universities in Iceland and number of students in 2009

Institutions	Total number of students
Public	
University of Iceland	12,765
University of Akureyri	1,496
Agricultural University of Iceland	230
Holar University College	47
Private	
Reykjavik University	2,488
Bifröst University	534
Iceland Academy of Arts	425

In the wake of the economic downturn an international panel of experts has recommended that the country merge its universities into just two institutions (Taxell, 2009).

For this reason, in 2010 the Icelandic government appointed a committee to look into merging the four state universities. State funding to Universities has been reduced as a consequence of the economic crisis, while the number of students has sharply increased. The number of students in 2009 was 15% higher than in 2008. Even more budget cuts are expected in 2011 and 2012.

Other important research performers are the specialised governmental **research institutes** that are owned by several Ministries, according to their domain of competence. The largest research institute is the Marine Research Institute, under the Ministry of Fisheries and Agriculture. Others are: Matis, a private food research company owned by the government; the National Energy Authority; Iceland Geosurvey; the Icelandic Meteorological Office; the Icelandic Institute of Natural History; and, the Institute of Earth Science.

In the private sector, a single company, **deCODE**, is responsible for a large share of all business R&D in Iceland. This biopharmaceutical company applies its discoveries in human genetics to the development of drugs for common diseases. The country hosts several other biotech companies, a few pharmaceutical companies and medtech companies, as well as marine biotech companies, most of which are clustered in Reykjavik around the University of Iceland and the national hospital. Other important private R&D spenders belong to the machinery and equipment sector (for food and medical industry) and software sector.

In 2007 the business sector accounted for about 55% of R&D expenditure whereas the public sector, including higher education institutions, accounted for about 43% (Source: Rannis).

2.2 Resource mobilisation

Since 2000, Europe has made clear progress towards the ERA goals. However, it is also clear that Europe's overall position in terms of global research performance has not improved, especially in terms of R&D intensity, which remains low. The low R&D spending in the EU is mainly a result of lower levels of private investment. Europe therefore needs to focus on the impact and composition of research spending and improve the conditions for private sector R&D investments.

This section assesses progress towards national R&D targets, with particular focus on action related to private R&D, recent policy measures or governance changes and the status of key existing measures, all in light of recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment also includes a section on the human resources for R&D in Iceland. The main assessment criteria applied throughout are the degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

As was thoroughly described in the ERAWATCH Country Report 2009, the financial crisis has led to challenges in public funding for research. The public research sector has seen revenues from university capital funds deteriorate. Public expenditure by universities has been decreasing, at the same time as many more students are enrolling at. It has become apparent that more students are 'sitting out' the economic crisis at university, while some students with master's degree have returned to study for a second master's qualification. Rising unemployment trends since the end of 2008 have pushed a high numbers back to university. This phenomenon, combined with budget cuts, places an extreme pressure on universities.

The public budgets for research and development reached a peak in 2009. Cuts to public R&D budgets from 2009 to 2011 have been around 18% (2010 prices). These decreases mean that the public contribution has returned to something close to 2005 levels (in real-terms/2010 prices). The policy for these cuts has been to maintain the competitive funding element as far as possible. Nevertheless cuts in competitive funds are being made in the 2011 budget. Compared to 2010, 2011 saw a 9% general cut in the state budget, which breaks down as a 7.5% cut to public spending on universities and 5% cut to competitive funds.

Until recently there have not been any quantitative targets along the lines of the Barcelona 3% objective for Iceland. However, in the policy strategy document '*Iceland 2020*' (published January 2011) a new set of research policy goals are set

out, including a quantitative target for R&D spending. According to the plan, 4% of GDP should go to R&D by 2020, with companies' contributing 70% of the total to competitive funds and research programmes while the other 30% is to come from the state.

Overall expenditure on R&D in Iceland, as a share of GDP, continues to compare well to EU27 countries and remained close to 3% in 2009.

The Science and Technology Policy Council (STPC) strategy for the period 2010-2012 emphasises the need for several specific actions to encourage increased participation of industry in financing research, such as tax incentives or strong competitive funds. A law on R&D incentives came into effect in December 2009.

A recurrent criticism of the Icelandic research funding system has been that insufficient public research and innovation allocations are made through competitive funds. The STPC responds to this criticism in its 2010-2012 strategy in a comprehensive way. The strategy sees the government argue the case for doubling the size of competitive funds over four years, from 2008 to 2011 (European Commission, 2010). However recent and expected upcoming cuts in competitive funds will make this goal difficult to reach.

The wording of the latest STPC strategy bears clear signs of the consequences of the economic crisis on research policy, reflected in the overriding need of the country to recover from over-expenditures in state finances. The STCP strategy stresses that there is an increased need to find a more effective balance for the financial allocations made to universities, institutions, competitive funds and other funds. It is also acknowledged that in times of severe cuts in state expenditure, it becomes even more important to make better use of existing resources, to safeguard the quality of research and to ensure that resources are allocated to projects that yield maximum results and benefits to society (STPC, 2009).

In sum, the Council recommends the following actions:

- to increase the proportion of public allocations to research and innovation through competitive funds;
- to collect and assess information to provide a comprehensive overview of all public funds for research and innovation, in order to provide recommendations to the Science and Technology Policy Council on whether there is a reason to merge or transfer the administration of funds;
- public funds shall adopt comparable cost assessment criteria for projects and take into account the real overall cost of research and innovation;
- when evaluating applications for funding from competitive funds, the role of the funds and the system as a whole needs to be taken into account. Apart from professional quality criteria, it is also necessary to account for potential capital value creation as well as cultural and social innovation; and
- to create a legislative framework for the Science and Technology Policy Council's new strategic funding programmes that stipulates procedures for professional evaluation and decision-making.

The following table shows Iceland's gross expenditure on R&D compared to the EU27 and the OECD over the period 1998-2008. The data indicate that the level of gross expenditure in R&D in Iceland has been substantially above the EU27 average since 1998 and above the OECD average since 2000.

Table 3: Iceland's Gross expenditure on R&D, 1998-2008

	1998	2000	2002	2004	2006	2008
OECD	2.13%	2.21%	2.22%	2.19%	2.26%	2.29%
EU27	1.67%	1.74%	1.76%	1.73%	1.76%	1.77%
GERD/GDP Iceland	2.0%	2.67%	2.95%	:	2.99%	2.65%

The main sources of funding of national R&D in 2008 were the private sector (54.6%) and the public sector (43%). Public and private R&D performers also access R&D funding from abroad (from the EU's Framework Programme (FP), Nordic funds, US funds and private sources). Funding from abroad amounted to 10% of total R&D funding in 2007.

The major funders of R&D activities in Iceland are the Ministry of Education, Science and Culture and the Ministry of Industry, Energy and Tourism. Other ministries, such as the Ministry of Fisheries and Agriculture also fund research activities within their area.

The main instruments for funding research in Iceland are: *block grants* to universities and research institutions, and competitive funding programmes on the other hand.

Competitive funds for science are: the *Research Fund* closely linked to the *Research Equipment Fund* and the *Fund for Research and Graduate Education*. These are governed by a Board appointed by the Ministry of Education, Science and Culture. The competitive fund targeting technology is the *Technology Development Fund*, governed by a board appointed by the Ministry of Industry and Commerce.

Targeted research programmes of a limited duration are also launched, focusing on specific areas, such as currently programmes for nanotechnology and post-genomic biomedicine and a *Centre of Excellence programme*. The *Added Value for Seafood (AVS) Programme* is managed by the Ministry of Fisheries and Agriculture.

Compared to the situation in other countries, the share of state funding allocated through competitive funds is relatively low, at about 15% compared to 30-40% in the other Nordic countries. The low share of competitive funding is often criticised by the research community, which argues that this means that a large share of funding for research is decided at the political level and directed to research groups that are already strong or established.

For obvious reasons, the Icelandic S&T policy for the coming years is focused on rebuilding and strengthening strictly national capacities and knowledge needs. Societal challenges are perceived in a very "narrow" way, reflecting the urgent need to tackle the harsh consequences of the financial crisis on Icelandic society. The rhetoric of policymakers does not, therefore, reflect the focus on tackling global Grand Challenges that European level initiative feature. The three Centre of Excellence programmes selected at the beginning of 2009 may thus be understood as reflecting the recent sense of the themes that are Icelandic research priorities:

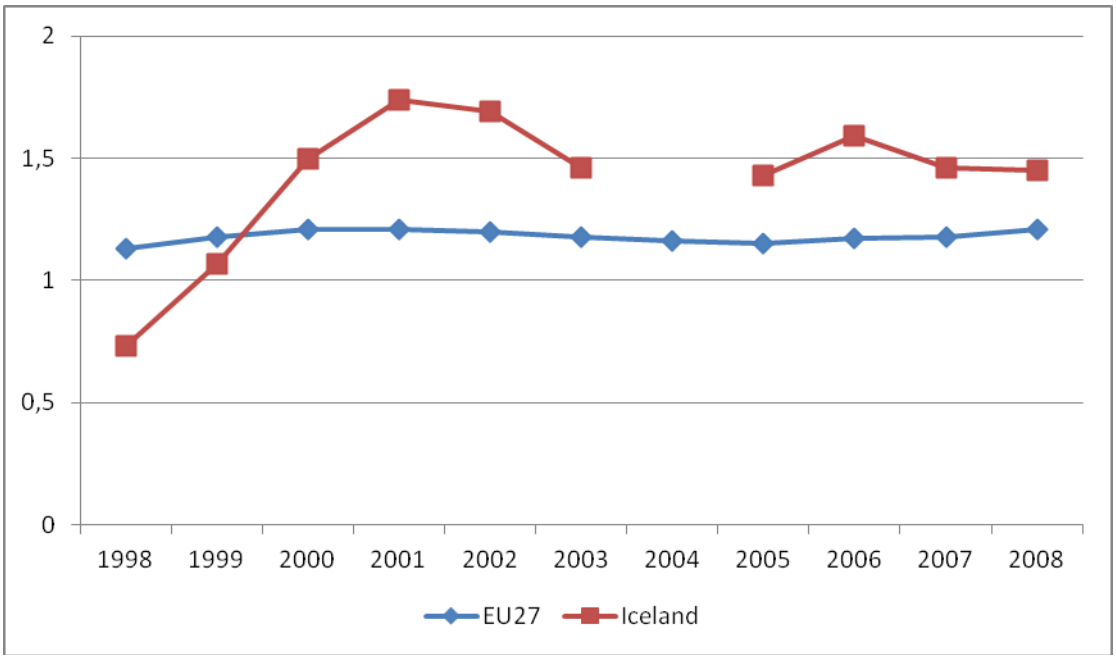
- artificial intelligence and simulation technologies;
- geothermal research; and
- gender, equality and diversity research.

The wording of Icelandic policymakers emphasises the need to prioritise research fields where Iceland already has a strong, competitive advantage and which can bring value and benefits for society. No particular fields are pointed out as future priorities in the STPC strategy 2010-2012.

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

Business expenditure on R&D (BERD) has increased since 1998. Iceland's BERD intensity ratio peaked in 2001, at 1.74%, exceeding EU27 average levels. Since then the BERD value has decreased, but remained higher than the EU27 average in 2008. As figure 2 indicates, BERD increased markedly between 1998 and 2001. The increase can largely be traced to the activity of one company, deCODE Genetics, which saw large revenues in the year 2001, in combination with a favourable exchange rate of the Icelandic Kroner against the against the US Dollar.

Figure 2: BERD's share of GDP for Iceland and the EU27, 1998-2008



Source: Eurostat, February 2011

The STCP's three-year strategy emphasises the need to increase private sector investments in research. The previously mentioned Act on tax incentives is one initiative linked to this aim. The strategy also stresses the need for strengthened cooperation between companies, universities and research institutions.

In accordance to the new Act on tax incentives:

- Those defined as innovation companies can deduct 15% from their annual research and development expenses from any income tax liabilities. If the amount of the deduction is higher than the tax liability the difference is reimbursed. The amount of the annual qualifying research and development expenses is limited to €276,304[3] (ISK50m) for each company and €414,456 (ISK75m) if services are purchased from other innovation companies (KPMG, 2010).

Apart from this initiative, Icelandic R&D performing firms do not benefit from specific R&D funding channels, although they are the primary beneficiaries of the Technology Development Fund. Firms in the Fisheries and Fish processing industry can also access the AVS Fund run by the Ministry of Fisheries and Agriculture.

Technology transfer activities from the Innovation Centre, or the new Icelandic Institute for Intelligent Machinery that are selected under the Centre of Excellence

[3] 1 EUR=180.96 ISK. Exchange rate for 01/01/10

Programme, are further policy instruments which could lead some companies to engage in R&D activities (even if this is not an explicit goal of those centres). It would be interesting to know more about the effective needs of these companies, and the way the technology institutions respond to such needs. Here the international dimension plays a key role: lead companies in Iceland should develop their absorptive capacities for sources of information on a worldwide, rather than domestic basis.

A possible explanation for a small country like Iceland achieving the 2% BERD target (a relatively high level compared to the EU27 average) may well be the low number of R&D-active firms and the dominant position of a small number of these companies in research. The main companies involved in R&D activities (those with more than 4% of turnover devoted to R&D) are deCODE, Össur, Actavis, CCP and Marel. In 2005, these five companies performed approximately 80% of all private R&D in Iceland. However, it should be mentioned that the Barcelona target has not been officially adopted in Iceland, meaning that there are no specific targets for reaching the 2% BERD.

In the STCP 2010-2012 it is recognised that user-driven innovation demands new approaches and interdisciplinary cooperation between S&T areas and the creative sector. It recommends that the support given to growth companies is better defined and targeted. A closer cooperation between RANNIS and the Icelandic Centre for Research is therefore being encouraged.

The importance of other policies that affect R&D investments

When it comes to the country's wider economic policy, the key role of developing macroeconomic conditions that encourage businesses to settle, invest and remain in R&D in Iceland cannot be under-estimated, certainly during the current crisis period. A volatile currency, high inflation rates and a shaky financial sector, are all serious problems that cannot be compensated for by R&D-specific incentives.

Education policy, with its key role in providing qualified manpower, is also an important policy field. The shortages of science and engineering graduates are in evidence both in official figures and are referred to by company representatives. However, other types of qualifications are also needed and there is no formal channel in place for the education system to systematically identify labour-market needs in this respect. Alongside increased demand for qualified human resources for the high- tech and knowledge industry sectors, such as the biomedical sciences, Icelandic policy makers also foresee a similarly strong need for qualified people within tourism and the creative sectors (see Iceland 2020 strategy).

Regional development policy and environmental policy are closely interlinked with the debate on RDTI policy for the knowledge economy: investing in resource-based industries, most notably the aluminium industry (based on the exploitation of cheap hydro-electric power sources) is an approach that is currently followed in Iceland, with several large investments implemented and planned around the country. The question of the appropriate priority between such industries and knowledge-based industries is highly politically sensitive, as:

- environmental considerations play a large part in the criticisms of such huge investments, with large environmental impacts;
- regional development considerations are used to support investment in power intensive industries, as they are spread around the country and contribute to

the policy goals of maintaining populations in the sparsely populated areas outside of Reykjavik; and

- S&T policy options include a regional dimension, and this is also present in the internal strategy of the University of Iceland: the establishment of regional knowledge centres is progressing, but no consensus on the relevance and feasibility of this option has been reached.

Regional Growth Agreements are regional development contracts between national government, local businesses, local authorities and regional development agencies. The Growth Agreements clearly reflect the government's emphasis on industrial development, SMEs and innovation policy, as well as the emphasis on policies for competitiveness being developed at the regional level. Growth Agreements have been introduced for seven rural districts outside the capital region. The main emphasis in the execution of the Growth Agreements is on local economic development and innovation, through a cluster methodology. This aims at promoting the active participation of local SMEs, while also involving regional and external Universities, research organisations and business, in line with the Triple Helix approach.

Solutions to those dilemmas that inevitably arise in this approach would necessarily involve political choices at a certain point. The availability of a strong evidence base on the role and contribution of the knowledge sector (including their regional impact) and on the effectiveness and international competitiveness of the research system would be necessary to establish credible arguments in favour of the "Knowledge society road for Iceland".

The increasing volume of scientific and research activity in Iceland has in the past raised questions about the importance of protecting intellectual property and knowledge assets. Reforms have been put in place to encourage innovation through the patent system. Since 2004 Iceland has been part of the European Patent Convention. In the past efforts have been initiated to support small firms in particular to use the patent system to protect their inventions (OECD, 2006).

2.2.3 Providing qualified human resources

In the wake of the financial crisis, Icelandic policy makers have raised concerns about an imminent outflow of qualified human resources. It has been feared that young people would be particularly likely to leave the country, or not return after studies or training abroad. The STPC 2010-2012 argues that Icelandic institutions and companies have not been active enough in using the possibilities provided by international programmes that support the development of human resources. It is moreover recognised that a greater diversity of education and training is needed amongst the Icelandic workforce. Compared to the Nordic countries, Iceland lags behind when it comes to the workforce's general educational level. It is estimated that one third of people currently in the Icelandic labour market have no formal education beyond compulsory schooling. In light of this, a common goal has been set between the authorities and industry to reduce this figure to 10% by 2020. Against this backdrop the STCP recommends a number of actions are implemented in the next three years (2010-2012), including steps:

1. to use the Graduate Research Fund more to connect universities, research institutions and companies and connect its allocations to the Research Fund as well as other funds;

2. to see that the Research Fund places special emphasis on supporting young scientists with generous grants, to enable them to initiate and develop their research activities in Iceland;
3. to encourage institutions and companies to apply for funding in the People programme within the EU 7th Framework Programme (Marie Curie);
4. to considerably enhance measures such as lifelong learning on the labour market, guidance and counselling, recognition of real competences and other solutions that may provide further opportunities and motivations for people and companies to strengthen their position; and
5. to encourage people to enrol in technical and vocational studies.

As mentioned earlier, shortages in the numbers of science and engineering graduates are evident but there are no mechanisms in place that specifically target these shortages. However, Iceland's human resources in science and technology (HRST) as share of the economically active population in the age group 25-64 increased in 2009 compared to 2008. When it comes to this indicator, Iceland is above the EU27 average.

About three thousand Full Time Equivalents (FTEs) were active in R&D in Iceland in 2007. Almost half of these (49.7%) were based in the private sector.

Table 4: Human resources in science and technology (HRST) as share of the economically active population in the age group 25-64

	2009	2008
EU27	40.1%	39.6%
Iceland	**50%**	**48.2%**
Denmark	51.8%	52.3%
Finland	50.7%	50.1%
Sweden	49.6%	49.3%
Norway	51.3%	50.1%

Source: Eurostat

2.3 *Knowledge demand*

This section focuses on the structure of knowledge demand, its drivers and also offers an analysis of the role played by recent policy changes.

Business driven knowledge demand

The R&D expenditure of health related companies accounts for about 78% of total R&D expenditure in the field of health research. Around 52% of the total R&D expenditure of *all* companies comes from those who are health related. When the allocation of Government budget appropriations or outlays for R&D (GBAORD) to various socio-economic objectives is considered, it appears that in 2009 the largest allocations went to the 'political and social systems, structures and processes' objective, followed by 'agriculture' and 'general university funds' (GUF). The 'health' objective is also a priority area. Objectives such as 'energy' and 'environment' received relatively low levels of funding.

Table 5: GBAORD by socio-economic objectives for Iceland, in 2009

Socio- economic objectives	Millions of Euro
Political and social systems, structures and processes	49,311
Agriculture	16,309
General advancement of knowledge: R&D financed from general university funds	11,782
Health	7,462
Transportation, telecommunication and other infrastructure	3,162
Energy	2,145
Industrial production and technology	1,184
Environment	0,357

Source: Eurostat, February 2011

Conditions for R&D-active firms in Iceland are of course not only determined by the quality of R&D financing, but also the general business environment of rules, regulations and labour market conditions. The new Act on tax incentives may be seen as a step towards improving support for research intensive firms.

The latest *Global competitiveness report 2010-2011* presents a snapshot of the sectoral structure of the economy. A key extract concerning the conditions for operating a business in Iceland illustrates key strengths and weaknesses:

> "After already falling six places last year, Iceland drops a further five places to 31st position, mainly because of a continuing deterioration in the macroeconomic environment (from 119th to 138th) and weaker financial markets (down from 20th two years ago to 85th last year and 122nd this year). Yet despite these concerns, Iceland also benefits from a number of clear competitive strengths in moving to a more sustainable economic situation. These include the country's top-notch educational system at all levels (4th and 6th in the health and primary education and higher education and training pillars, respectively) coupled with an innovative business sector (17th) that is highly adept at adopting new technologies for productivity enhancements (4th). Business activity is further supported by an extremely flexible labour market (7th) and well-developed infrastructure (12th)." (World Economic Forum, 2010, page 24).

The three factors considered to be most problematic for doing business in Iceland are (in order of importance) access to financing, foreign currency regulations and inflation. Concerns about government instability were also an important factor, ranked as the fifth most important barrier.

Thematic versus generic R&D funding

As was explained in the ERAWATCH Country Report for Iceland 2009, there has been a priority-setting process underway in Icelandic research policy and instruments since 2007. Here we will just briefly mention the main priorities:

- the selection of the three Centres of Excellence;
- internal prioritisation at the University of Iceland; and
- priorities set under the Technology Development Fund (10% of the Fund has been earmarked for activities in the areas of sustainable fuels and sustainable buildings).

As was assessed in the ERAWATCH Country Report 2009, these various prioritisation processes seem to be running largely in parallel to one another, a situation which raises questions about the effectiveness of this prioritisation in effectively narrowing the focus and concentrating support in research. There is also the Grant of Excellence instrument, operating under the Research Fund, for which the selection criterion is, logically, scientific impact. This raises questions about whether such an instrument will remain independent of the new options under the Centres of Excellence programme.

Until recently there has been little evidence from policy documents or assessments of research and innovation instruments, about how far policies or R&D budgets have been mobilised to address major societal challenges. The recommendations of the STPC 2010-2012 strategy are, to a large extent, based on recommendations for organisational changes in the research and innovation system and to the need to create "solid foundations" for research (indeed, the strategy is called "Building on Solid Foundations"). However, some exceptions can be found in the on-going processes of prioritisation. As mentioned above, a tenth of the Technology Development Fund has been earmarked, at the request of the Ministry of Industry, for activities in the areas of sustainable fuels and sustainable buildings. Health is also an important research field in Iceland, as far as GBAORD is considered.

The Icelandic government has formulated a *Long-term Comprehensive Strategy* to run until 2020. This involved broad consultation under the direction of the Prime Minister's office. The objective was to elicit a joint future vision and integrate plans across transport, communications, tourism and regional development groups, together with programmes to expand local government responsibilities, various growth agreements and plans for public works projects which are likely to be revised in the wake of the economic collapse. The plan includes objectives that encourage the development of green industries, including projects where clean, renewable energy is utilized sustainably to create value and employment. Emphasis is placed on mapping Iceland's opportunities in environmentally clean industrial production and encouraging investment through temporary incentives and favourable energy prices. Other issues in the long-term strategy include measures that will, among other things:

- boost research, development and production of domestic, environmentally friendly fuel and increase the number of alternative energy outlets. The aim is to enable Iceland to lead the way in coming years in experiments and production of environmentally friendly energy sources, in part by supporting research and development and building up new energy infrastructure;
- support networks for industrial development, research and innovation will be reinforced, for instance, by building up funding sources, industrial development companies and entrepreneurial efforts throughout Iceland; and
- strengthen marketing in the travel industry. Support will be provided for increased R&D and innovation in the travel industry. Additional effort will be placed on developing and marketing cultural tourism services and Icelandic cuisine.

2.4 *Knowledge production*

The production of scientific and technological knowledge is the core function that any research system must fulfil. While different aspects may be included in the analysis

of this function, the assessment provided in this section focuses on the following dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve knowledge creation.

2.4.1 Quality and excellence of knowledge production

Despite being a small country, Iceland has a fully-fledged research and innovation system. While the share of activities based on primary resources exploitation continue to account for a high proportion of GDP and exports, the growth of R&D activities has been significant, shifting the GERD/GDP ratio from 1.1% in 1991 to 2.65% in 2009. The country has a relatively high share of HRTS in the economically active population (at 50%) and this share has also increased over the years, to above the EU27 average (see Table 5). The issue of high quality research infrastructure did not receive considerable policy attention until 2009, when a road map for the development of research infrastructure in Iceland was complied. The strategic importance of an organised structure of databases and improved access to data has received particular attention from policy makers.

With regards to scientific output, the impact of scientific publications can be assessed in the form of citations per publication, calculated over a 4-year period (2005-2008). Icelandic researchers are ranked third for publication impact, after Switzerland and Denmark, with an average of 7.09 citations per publication. An alternative measure of output is the number of scientific publications per million inhabitants. Switzerland is the highest ranking OECD country (for the same time span) for this measure, immediately followed by the Nordic countries who occupy the next five places ahead of the USA, Australia and Canada. Iceland is ranked fourth, with 8.74 publications per million inhabitants (Ministeriet for Videnskab Teknologi og Udvikling, 2009).

For Iceland, the Geosciences stand out as providing a very large share of all publications; they also have a high citation rate. Geoscience publications constitute 13.2% of all Icelandic output for the period, which makes Geosciences the third largest research area in Iceland, in terms of publication output (Schneider, J. W., Ed., 2010).

Iceland has increased its number of patent applications, especially since the 1990s. According to the latest figures from RANNIS, the number of Icelandic patent applications made to the EPO, per one million inhabitants, was 84 in 2006 (of which 7 were high tech patents). This indicates a doubling of patent applications compared to 1995 levels.

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

The previously mentioned *Centre of Excellence programme*, launched in 2009 is the most recent policy measure to foster excellent collaborative research in Iceland. The objectives are to reinforce science and technology research and encourage successful collaboration between different parties, nationally and internationally.

Icelandic policy makers do not make extensive use of evaluation tools. International benchmarking is important, and Icelandic performance is often measured against performance in the other Nordic countries.

A key criticism in previous expert assessments of the Icelandic research, education and innovation system is focused on a lack of evidence based policies, to a large extent due to the inadequate policy intelligence preparation of the advisory bodies (Taxell et al., 2009). As a response to these assessments, the STPC 2010-2012 has

recommended strengthening RANNIS's role as the main body for supporting and analysing research and innovation in Iceland.

2.5 Knowledge circulation

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

2.5.1 Knowledge circulation between the universities, PROs and business sectors

The issue of knowledge circulation and the need to capitalise fully on public investments in research have become prominent policy issues as a result of the economic downturn.

The mandate for the 'crisis think tanks' established at the beginning of 2009 by the Minister of Science, Education and Culture includes their being tasked with questions about the ways to mobilize national funds for research and innovation, with the view of strengthening closer cooperation between the public sector research organizations and private sector organizations. Their mandate states they are "to stimulate innovation in the short term as well as underpin long term knowledge-based growth and future competitiveness of the economy".

The *Centres of Excellence programme*, launched in 2009, includes the idea of fostering knowledge circulation between university, Public Research Organisations (PRO) and business sectors as a key objective. The endeavours under the funded projects should span a whole range of scientific, technological and innovation activities. The link with innovative businesses and high-tech industries needs to be present at the heart of projects. Users are to be closely associated with the Centres, in order to ensure a good flow of knowledge and user-driven orientation of the centres.

It is too early to assess the effectiveness of the measure, but it is of interest to follow this up closely, to monitor the development and nature of the cooperation established by the centres.

The goal of the *Company and Institution Grants* (CI-grants) managed by Rannis is to strengthen the cooperation between institutions, companies and universities. Businesses and institutions define which professional field is to receive the grant in advance. The grant is then created by joint financing between a business/institution and the Icelandic Research Fund for Graduate Students.

The Icelandic Centre for Research offers an initiative called *Scientist for Rent* where companies can obtain expert advice for a reasonable fee.

A successful initiative launched in the wake of the financial crisis has been *Starfsorka* which aims to employ workers in existing SMEs using their unemployment benefit as part of their salary. This helps SMEs to employ skilled workers without having to assimilate the whole cost.

2.5.2 Cross-border knowledge circulation

Like all previous S&T policy strategies, the latest from the STPC for the period 2010-2012 also emphasises the vital importance of international cooperation for the development of research and innovation in Iceland.

Policy discussions on international cooperation have largely been characterised by an outward-oriented approach, in terms of researchers and firms seeking collaboration abroad. Strategies for attracting foreign R&D performers to Iceland have thus not been explicitly encouraged.

Icelandic researchers participate actively in the European Framework Programmes for research. The EU FPs are the most important instrument for research cooperation between national and foreign research organisations. The Nordic collaborative framework is also important, operated through the Nordic Centre of Excellence schemes and other networking programmes, supported by the Nordic Research Board (NordForsk) and the Nordic Innovation Centre (NICe). Nordic cooperation in research is also taking place with regards to research infrastructure. Steps have been taken recently to strengthen the field of electronic science (eScience) as a common Nordic area of effort[4].

As a follow up to the STPC strategy, a working group on Iceland's participation in international programmes was set up in early 2010, by the Minister of Education, Science and Culture. The group's tasks have been to: assess costs, obligations and opportunities in international programmes in the field of education, research and innovation; to review the support services for Icelandic participants; and put forward proposals on how these services could be reorganized in a more efficient way.

The group's main findings point out a number of fundamental challenges in the research system:

- insufficient and sporadic support for applicants in international programmes, combined with weak overall policies in support of international cooperation;
- support services for candidates in international cooperation programmes related to research, innovation and education were assessed as being inefficiently organised and not serving the best interests of potential users;
- the degree or the extent of support is considered to be inconsistent with the size or the extent of programmes;
- it is difficult to get information about the number of Icelandic applications and funded projects with Icelandic participation, which makes it difficult to assess the success of Iceland's participation in these programmes; and
- it was concluded that there is not a straightforward way for applicants to get a comprehensive overview of what international programmes Icelanders have access to.

The weaknesses of the official policy strategies and the lack of prioritisation for international cooperation (for education, research or innovation) were raised as further major causes of concern. The need for a more focused strategy based on prioritisation is considered to be crucial, considering the current developments at the

[4] eScience can be defined as "research into new ways of using the Internet to do science". eScience encompasses the application of ICT in research and in research cooperation within key scientific fields, as well as large-scale research cooperation via distributed electronic networks/high speed research infrastructure and the development of the next generation of ICT infrastructure.

EU level, which imply that national funds will have a more important role than previously. New European cooperation initiatives such as ERA-Nets and Joint Programming require that countries actively take decisions on participation and whether to commit domestic resources to them. It was suggested that such decisions should be based on a careful assessment of interests and opportunities for the Icelandic R&D community. This would also require policies and prioritising based on a well-informed and evidenced, comprehensive overview of opportunities, demand and the success of Iceland's role in international cooperation[5].

In brief, it was recommended that:

- support services for Icelandic participants in international programmes should be combined into one service-organisation, providing services on Nordic, European, EU and other international programmes to provide a one-stop-shop for all applicants in international R&D and Education programmes.
- the board of this new service-organisation should be the decision-making body when it comes to determining which new programmes and initiatives Iceland will participate in, based on overall interests and resources.

The conclusions and recommendations were approved by the STPC on 19th March 2010. A second working group was established with the objective to put forward an implementation plan before the STPC's meeting in June 2010.

2.5.3 Main societal challenges

As previously mentioned, the Centre of Excellence programme has been established with the objective of creating better cooperation between national and international research actors. The establishment of the current three centres was preceded by a meticulous selection procedure. The final outcome and the specific research fields selected (artificial intelligence and simulation technologies, geothermal research and gender / equality research) may therefore be considered to reflect the areas prioritised for inter-sectoral and cross-border knowledge circulation.

As part of the Nordic cooperation under the auspices of the Nordic Council of Ministers, Iceland also benefits for Nordic level research and innovation initiatives. The Top-level Research Initiative (TRI) is the largest joint Nordic research and innovation initiative to date and has been set up with the aim of contributing towards solving the global climate crisis. The TRI will last for five years, with a total budget for that period of €45m. The first round of calls for proposals opened in 2009.

Finally, it should be mentioned that the Iceland 2020 strategy emphasised the importance of eco-innovations for the Icelandic economy. The rationale underpinning this goal is reflected in this particular statement in the strategy: "eco-innovation and its products will be the main growth sector of this decade, with an annual growth in turnover of 20%, which will double between 2011 and 2015".

[5] Tækifæri til sóknar: Skýrsla starfshóps um þátttöku islands i alþjóðlegum samstarfsáætlunum (2010). Report from the *Working Group on Iceland's participation in international programmes* to the Science and Technology Policy Council, 19th March 2010. Reykjavik.

2.6 *Overall assessment*

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	Pooling of resources, merging of funds and public universities; increased awareness of the importance of monitoring and analysis for evidence-based policies; the appointment of national working groups to assess and make recommendations on future policy needs; 4% R&D target by 2020.	Continued cuts in state funding as a consequence of a prolonged economic crisis; continued lack of coordination between the two sub committees of the STPC
Knowledge demand	Centres of Excellence programme to set focus and research prioritisation; new tax incentive for R&D to improve support for research intensive firms.	Shortages of S&T graduates and outflow of talented people as a consequence of the economic downturn; large increase of registered university students putting pressure on universities' resources.
Knowledge production	Policy attention on mergers of public universities and university colleges	The voluntary policy on university mergers has so far met resistance from universities. Prolonged cuts to public funds for universities have a negative effect on research activities.
Knowledge circulation	Centre of excellence programme to foster cooperation between research organisations nationally and internationally	New programme for researcher mobility open for national and international researchers. The programme represents an unprecedented measure fostering inward mobility.

Table 7: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Lack of attractiveness of the country for inward R&D investments	Better coordination of macroeconomic policy with innovation policy/ EU membership process and eventual future adoption of the Euro
Low number of R&D-active domestic firms	Cooperative research programmes, user oriented research programmes
	New Act on tax incentives

3 Interactions between national policies and the European Research Area

3.1 *Towards a European labour market for researchers*

The European Commission proposed a Communication 'Better careers and more mobility: A European Partnership for Researchers' in May 2008 that aimed to accelerate progress in four key areas:

- open recruitment and portability of grants;
- meeting the social security and supplementary pension needs of mobile researchers;
- providing attractive employment and working conditions; and
- enhancing the training, skills and experience of researchers.

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

3.1.1 Stocks and mobility flows of researchers

In 2008 the NORBAL statistical database[6] on doctoral degrees and doctoral students in the Nordic region, collected information about citizenship for awarded doctoral degrees was for the first time. Of all degrees awarded in the region, 80% of doctoral students were native citizens, while 16% were foreign. There were 23 doctoral degrees awarded in Iceland in 2008, of which four were awarded to non-native citizens, which corresponds to a share of 17% (NORBAL statistics). Unfortunately, there is no information on outward flows of Icelandic doctoral students.

Because of the small size of the domestic tertiary education and research system, PhD programmes in Iceland now tend towards granting joint degrees with foreign organizations. Increasing numbers of programmes are also taught in English. The University of Iceland offers a diverse selection of courses taught in English. A few academic programmes are offered entirely in English, both at the undergraduate and graduate levels, and all schools offer at least some courses taught in English. Travel grants are offered to master and doctoral students at the University of Iceland and are intended for attending conferences.

Financial resources for researcher mobility have been scarce. The STPC however acknowledges that institutions and companies have not been making satisfactory use of international programmes that support the development of human resources. There are no explicit strategies for attracting foreign researchers to Iceland. The lack of policies for inward researcher mobility has been subject to criticism in the past (see Taxell et al. 2009). There is also limited information on the outward mobility flows of Icelandic researchers.

The Icelandic Research Fund, managed by the Icelandic Centre for Research, is currently establishing the first programme dedicated to researchers' mobility with co-funding from the FP7 People programme. The programme will offer incoming, outgoing and reintegration grants, irrespective of the applicant's nationality.

[6] http://www.nifu.no/English/Pages/STATISTICS/NORBAL/NORBAL.aspx?ItemId=1855&ListId=8252dfaf-6056-4ccc-b6e1-7806d4dc4878

3.1.2 Providing attractive employment and working conditions

Salaries for researchers in HEIs in Iceland compare reasonably well with those of other developed countries, though not with US salaries. In 2006 the yearly average salary of researchers in Iceland (€50,803) was well above the average for other Associated States (€34,730). The difference between the remuneration of a female researcher and a male researcher is significant in most of the countries (over 35%) but for Iceland this gap is significantly smaller, at just 10%.

No significant difference could be detected in the yearly salaries of researchers in the government and in the higher education sector (no survey data was collected for the business enterprise sector for Iceland). Salaries for researchers also compare relatively well to other similar professions. There are however some differences depending on researchers' scientific domain. Total yearly salary costs of researchers in the life sciences are lower than in similar professions, while they are much higher in the social sciences and humanities (European Commission, 2007).

The depreciation of the Icelandic Krona is eroding the competitive position of these jobs, although the cost of living in Iceland has been reduced for those people paid in foreign currencies.

All seven Icelandic universities (see Table 1) have signed up to the "European Charter for Researchers" and to the "Code of conduct for the recruitment of researchers". Iceland does not participate in the Scientific Visa Package for long term admission.

There is no information available on the situation in Iceland in the 2009 *Report on the implementation on the European Partnership for Researchers (EPR) by member states and countries associated to the FP7*.

3.1.3 Open recruitment and portability of grants

Despite the lack of an official policy to attract foreign researchers to Iceland, there are no formal barriers to recruiting non-nationals for permanent research and academic positions.

On the Icelandic EURAXESS (the European Researcher's mobility portal) pages there is information for foreign researchers on vacant positions in Icelandic universities, research institutions, and companies.

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

Iceland participates in the EURAXESS initiative. The responsibility for the maintenance of relevant information is held by the Icelandic Centre of Research, Rannis. On the Icelandic EURAXESS pages there is information for foreign researchers on vacant positions (as above) and information for companies on social security access and health insurance. There are no tax incentives to facilitate the participation in supplementary pension schemes.

Iceland takes part in the EU internal market which includes free movement of people. EU citizens do not therefore need work permits to access the Icelandic labour market. Iceland and the other EEA states, Norway and Lichtenstein, have been incorporated in the Schengen area.

3.1.5 Enhancing the training, skills and experience of European researchers

For a small country like Iceland cooperation with international universities is essential. There are some fields of study that are not available in Iceland at postgraduate level, however, there is a strong tradition in Iceland for students to go abroad to study these fields. The University of Iceland collaborates with several foreign universities in terms of student, research and staff exchange programmes.

There are a number of institutions in the Nordic countries and the Baltic region who collaborate in the Nordplus network, which in Europe forms a part of the Erasmus network. The University of Iceland also has several bilateral agreements, including those with the USA, Canada and Australia. Students and lecturers can apply for grants through Nordplus. Students, lecturers and other staff can apply for grants through Erasmus.

An initiative labelled the *ABEL Extraordinary Chair* has been created under the project "Improving student, researchers and artist's mobility and cooperation between Spain, Norway, Iceland and Liechtenstein", which aims at strengthening academic and research relations between Spain and the three other countries.

The *Abel Extraordinary Chair* has an objective to promote the temporary incorporation of high level researchers from Spain into research centres in Norway, Iceland and Liechtenstein, and to then reincorporate them into Spanish research institutions. During their stay researchers will have the opportunity to collaborate with local research groups in experimental science topics, with a primary focus on mathematics and related disciplines, but within any discipline using mathematic approaches. The Chair aims at launching further research lines in collaboration with Norway, Iceland and Liechtenstein, to strengthen the already established ones.

A *National Qualification Framework for higher education in Iceland* was brought into force in 2006. The *National Qualification Framework* is in accordance with the *European Qualification Framework* and describes the skills that graduated students are expected to have mastered when they finish their studies at different levels within HEI.

Under the new act on universities, Icelandic higher education institutions are now able to offer and recognise joint degrees or double degrees. All the universities use a credit system comparable to the ECTS system and they all issue Diploma Supplements to their graduates.

3.2 *Research infrastructures*

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

in April 2002, to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section assesses the research infrastructures within Iceland, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

In the spring of 2009, a committee appointed by the STPC developed a roadmap for the development of research infrastructures in Iceland. The roadmap identified the most important facilities in the Icelandic research community. Since the publication of the roadmap, a number of its main objectives have been further developed.

One important outcome from the roadmap was to ensure continued national access to electronic journals and databases. It is assumed by policy makers that such access is a critical part of the infrastructure needed to maintain high impact research and innovation activities in Iceland.

Another point stressed in the roadmap is the importance of access to high-speed internet connections, to link up with international research networks in Europe and North-America. This is seen as a way to provide better opportunities for international cooperation in fields that rely on an electronic science (eScience) methodology.

A large number of diverse scientific databases exist in Iceland, containing substantial quantities of data and valuable research material. A key project prioritised by the government is to better organise and structure these databases, to improve access to data. This is considered to be crucial for advancing Icelandic research in different fields.

The STPC 2010-2012 strategy emphasises a problematic issue for Icelandic researchers, compared to those operating within EU regulations. In Europe, the value added tax (VAT) on equipment and research supplies is refunded or waived, but this is not the case in Iceland. Furthermore, international competitive funding such as that provided thorough European Commission framework programmes, does not allow VAT to be paid with research funds. The Icelandic Equipment Fund was established to support the purchase of expensive research equipment and instruments. The total annual available funds from the Equipment Fund recent (2007-2009) were €641,437[7] (ISK110m) (Rannis). However this does not support other research infrastructures such as databases. Policymakers also point out this as an important area of difference from the other Nordic countries, which have specific research infrastructure funds (STPC, 2009).

In brief, the STPC emphasises the following recommendations in the roadmap on research infrastructures:

1. To ensure future national access to databases and electronic journals.
2. To encourage Icelandic scientists to participate more actively in international research cooperation that uses eScience.
3. To form a task group to lead the project “Future arrangement of databases in Iceland” that will focus on database coordination, open access, intellectual property rights, accessible interface, security and usefulness, and administration and maintenance of databases.
4. To revise rules for refunding value added tax (VAT) for research supplies and equipment used in publicly-funded scientific research.

[7] 1 EUR=171.49 ISK. Exchange rate 01/01/09

5. To revise the legislation on the Equipment Fund to promote support for a variety of research infrastructures and to change the name to The Infrastructure Fund.
6. To target participation in international cooperation on research infrastructure, enabling Icelanders to participate more actively in international development of research infrastructures.
7. To promote the development of research infrastructures in high impact, well-established fields in Iceland.

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

The recommendations outlined in the report on research infrastructures, published in 2008, have been strongly affected by the economic crisis.

As a consequence a new working group on RI was appointed in early 2011, with a somewhat different mandate. The main task of the group is now to come up with suggestions for how Iceland can better connect with Nordic infrastructure and possibly establish a Council for research infrastructure. The results from the working group are to be presented and discussed at the spring STPC meeting.

To date, Iceland has participated in the following five ESFRI projects during the preparatory stages: CLARIN, EPOS, ESS, BBMRI and ELIXIR. It is unclear at the time of writing if Iceland will continue to participate in the upcoming implementation phases of these groups, due to financial constraints. This is also an issue for discussion in the RI working group in the coming months.

3.3 *Strengthening research organisations*

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

3.3.1 Quality of National Higher Education System

In the last three decades the Icelandic higher education system has grown more diverse. New higher education institutions have been established and several post-secondary institutions have been upgraded to higher education status.

In 2010 there were seven higher education institutions in Iceland (see Table 2). Higher education institutions include both traditional universities and other institutions which do not carry out research. Five higher education institutions are operated by the state, while private parties (government dependent private institutions) operate three institutions with state support. Institutions of higher education vary in the extent to which they engage in research and the number of programmes of study offered. The HEIs can also be categorized into four groups according to their specialisation:

- two agricultural institutions;
- one academy of arts;
- one business school; and

- three institutions offering a wide range of studies.

Other differences include the number of enrolled students, the mix of programmes offered and the level of education and research activity. The Ministry of Education, Science and Culture agrees performance-related contracts with all higher education institutions under its administration.

Private institutions are recognized by the Ministry of Education, Science and Culture and are subject to the same provisions as public institutions concerning external reviews and quality control.

Expenditure on R&D in the higher education sector (HERD) was €68.469m in 2008. The value of R&D performed in the higher education sector increased gradually between 1998 and 2006. In 2008 this expenditure diminished quite remarkably compared to 2006 levels of €94.499m.

Table 8: R&D performed in the higher education sector in Iceland, 1998-2008

	1998	2000	2002	2004	2006	2008
HERD in millions of euro	36.84	40.85	44.95	:	94.45	68.47

The *HERD intensity ratio* (HERD as percentage of GDP) was 0.67% in 2008, which is above the EU27 average of 0.43%.

Table 9: HERD as percentage of GDP

	1998	2000	2002	2004	2006	2008*
OECD	0.34%	0.35%	0.39%	0.39%	0.39%	0.39%
EU27	0.37%	0.38%	0.41%	0.4%	0.41%	0.43%
HERD/GDP Iceland	0.5%	0.43%	0.47%	:	0.71%	0.67%

* Estimate

The number of students has increased during recent years. Due to the economic downturn in 2008, the universities have seen a dramatic increase in the number of students. The total number of students in 2009 was 18,051, an increase of 1,107 students from 2008.

Table 10: Icelandic students by field of study and gender, 2009

Field of education	Total	Males	Females
Education	2,819	519	2,300
Humanities and Arts	2,639	921	1,718
Social sciences, Business and Law	6,661	2,690	3,971
Sciences, Mathematics and Computing	1,461	901	560
Engineering, Manufacturing and Construction	1,671	1,110	561
Agriculture and Veterinary	112	41	71
Health and Welfare	2,375	318	2,057
Services	313	98	215
Total	*18,051*	*6,598*	*11,453*
• *of which in doctoral studies (PhD)*	*314*	*134*	*180*
• *of which students abroad*	*2,129*	*1,034*	*1,095*

Source: Statistics Iceland; Note: The data comprises students enrolled at university and doctoral level.

On 1 July 2006 a new Act on Higher Education Institutions (Act no. 63/2006) was adopted by the Icelandic Parliament. Following that decision, all universities had to apply for accreditation for operation in their respective fields of study. Thus, from

2006 through 2007 all HEIs in Iceland had to go through an accreditation process that resulted in a major revision of all study programmes in accordance with the National Qualification Framework from 2006. The process was officially completed in May 2008.

There is no independent National Quality Assurance Agency in Iceland. In the Act on HEIs the provision on external evaluation is as follows: “The Minister of Education, Science and Culture can delegate the administration of an external evaluation of teaching and research to a committee, an institution, a company or other relevant agent, national or international. Implementation of an external evaluation shall be assigned to an independent agent. The evaluation process shall involve both domestic and foreign experts, as well as a student representative”.

With the Higher Education Act of 2006, the regulations of the Bologna Process were fully implemented.

Higher education institutions carry out systematic quality control of teaching and research, on the basis of internal evaluations. According to national legislation, the internal evaluation of higher education institutions and their individual units should be carried out regularly and deal with policy and objectives, study content, teaching, teaching methods, assessment, research, research effectiveness, working conditions, administration and external relations. Active participation of staff and students in the internal quality control process of higher education institutions should be ensured. The Minister of Education, Science and Culture determines the time for conducting an external evaluation of teaching and research and sets the agenda for such evaluations for three years. In addition, the Minister of Education, Science and Culture may decide to conduct a special evaluation of a higher education institution or its specific units upon the Minister’s discretion.

3.3.2 Academic autonomy

On 12 May 2008 a new Act on Public Universities (Act no. 85/2008) was adopted by the Icelandic Parliament. It resulted in a new management structure for university councils in public universities, with the majority of members coming from external bodies. A new definition of the overall organisation of public universities was also introduced, by establishing Schools/Faculties according to fields of study, introducing more decentralisation and increased autonomy of HEIs.

The institutions have private boards that have a significant degree of autonomy: they can, for example, decide such matters as admission requirements, progression of students from one year to the next, certification etc. These matters do not differ much between public and private institutions.

For the private institutions, strategic research plans constitute the basis for the negotiation of the performance agreement signed between the university and the government.

In Iceland the Rector of each university is appointed by the Ministry of Education, Science and Culture according to the recommendation of the University Council, for a limited period of time, normally four or five year (European University Observatory).

3.3.3 Academic funding

In recent years there has been a significant rise in the number of students in higher education, followed by an increase in the availability of higher education programmes of various lengths. In relation to this, there is on-going debate about the finances of

higher education institutions. Private institutions receive state support and can also charge tuition fees. Public institutions are only authorized to charge registration fees.

The Universities Act stipulates the internal financial and management autonomy of the HEIs. The formal relationship with the Ministry of Education, Science and Culture is further defined in performance-related agreements with public institutions and service contracts with private institutions. The private institutions receive more than 50% of their core funding for teaching and facilities from the central government, according to the same funding formula as the public institutions. In addition they charge students tuition fees, whereas the public institutions do not have the legal authority to do so. The research allocation is based on a three year agreement between the Ministry of Education, Science and Culture and individual institutions under its auspices. The institutions differ in the extent to which they engage in research.

Institutional funding to universities and research institutes primarily takes the form of block grants, but the trend is for these to be replaced in part by competitive grants, based on research performance assessment. The government has decided that public support should increasingly rely on competition, based on criteria of originality, well-defined projects and competent applicants, who might be individuals, firms or institutions. Institutional funding is seen as necessary to enable institutions to participate in the competition for resources. The definition of performance indicators for research has been included in the University of Iceland's Strategic Plan, in negotiation with the Ministry of Education, Science and Culture. Annual reports on these indicators are provided by the University to the Ministry, and are subject to follow-up. Similar agreements are being prepared with the other universities. In the future, research performance indicators should also be established for public research organisations.

3.4 Knowledge transfer

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

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

3.4.1 Intellectual Property Policies

The Icelandic Patent Office – a governmental agency under supervision of the Ministry of Industry and Commerce – handles all patent disputes in Iceland. The Icelandic legal framework concerning intellectual property rights (IPR) is in all respects equivalent to that of other industrialized countries in Europe.

The recent changes in IPR-ownership in universities, and the adoption of the European Patent Convention are expected to further accelerate Iceland's patenting activity.

Legal framework

The Icelandic Act "Respecting Employees' Inventions" (Act No 72/2004) was put into effect on January 1st, 2005. In essence, the law stipulates that all companies, institutions, educational institutions (including universities) etc. have the initial rights to exploit the intellectual achievements of their employees. The law covers intellectual property which could lead to patent applications. Certain basic rules of procedures are also outlined.

National policy

With regard to open access to research funding, the STPC 2010-2012 demands that publicly funded research findings be accessible to all. It recommends:

- developing public policy to ensure open access of publicly-funded research findings;
- evaluating the necessary open access infrastructure that can be used for coordinating databases and accessing them and ensuring permanent reservation;
- defining utilisation rights for data derived from public institutions and cooperative inter-sectoral research; and
- raising general awareness of the importance of open access within the research and innovation community.

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

Involvement of private sectors in the governance bodies of HEIs and PROs

On 12 May 2008 a new Act on Public Universities (Act no. 85/2008) was adopted by the Icelandic Parliament. It resulted in a new management structure for university councils in public universities, with the majority of members coming from external bodies.

The private institutions have private boards and a significant degree of autonomy; they can, for example, decide matters such as admission requirements, progression of students from one year to the next, certification, etc.

Inter-sectoral mobility

There are limited connections between technology transfer professionals in official institutions such as universities and innovation centres. At present, there is no organized platform connecting technology transfer staff from the universities in Iceland. While there are only a few examples of connections between universities and private companies, the University of Iceland has been quite active over the years in establishing spin–off companies. Some of these companies have been very successful and are now recognised as international success stories (Nordic Innovation Centre, 2008).

There is limited expertise in technology transfer in Iceland. In the last decade or so there has been an increase in expertise within the field of technology transfer through the operations of successful research and development active companies, like Marel

Food Systems Ltd, CCP (multi-player game developer), Decode Genetics etc. (Nordic Innovation Centre, 2008).

Promoting research institutions – SME interactions

The lack of interaction between HEI, PRO, the business sector is an explicit policy concern (Nauwelaers, 2009). The fact that collaborative research and involvement of users are core criterions for the Centres of Excellence programme is an innovative feature of Icelandic programmes. The relatively recent implementation of the programmes (in early 2009) makes it difficult to assess their success. This will require programme-specific monitoring on behalf of Icelandic authorities.

The Innovation Centre Iceland (ICI) has the central role of disseminating technology towards SMEs. This is achieved through education and training of staff and managers of SMEs, as well as offering various means of support to entrepreneurs, growth companies and innovative enterprises. Within ICI, the Enterprise Europe Network office also disseminates technology profiles introducing the latest European technology and trends to SMEs in Iceland.

The Federation of Icelandic Industries takes an active part in promoting technology dissemination in cooperation with industrial companies, their customers, universities and institutions in the fields of research, product development and problem solving.

EU cohesion policy

EU cohesion instruments are not relevant for the country, as Iceland is not an EU Member State.

Spin-offs

The *Technical Development Fund* generally operates as a competitive fund through which firms, research institutes and universities have the possibility to obtain project financing in support of technological development and innovation. The Fund also provides support to spin-off ventures and innovative firms to secure the economic benefits that accrue to society from scientific and technical knowledge, and from the innovation arising from the application of these new ventures.

The University of Iceland is an affiliate of the Tæknigarður Innovation Centre, while a Biotechnology Centre is operated at Keldnaholt by the applied research institutes. Several other technology based firms have started operations at these locations.

The Innovation Centre currently runs eight incubating centres, offering office space, business services, counselling and professional assistance to the SMEs and start-up companies. In 2009 there were 75 companies in total at the incubating centres of Innovation Centre Iceland, with approximately 200 employees. Other main incubator centres in Iceland are the following:

- Tæknigarður, an incubating centre run by the University of Iceland in cooperation with Reykjavík City and Innovation Centre Iceland. Tæknigarður houses eight companies;
- Innovit, an incubating centre especially aimed at university students who may be harbouring business ideas. Innovit is run in close cooperation with the University of Iceland and is housed in Tæknigarður; and
- Klak, a private innovation centre which emphasizes education for entrepreneurs and offers office space and support services for start-up companies.

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

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

3.5.1 National participation in intergovernmental organisations and schemes

Participation in COST, EUREKA and FP7

Iceland's research community participates actively in the EU FP and sees its contribution as providing positive rewards, both in terms of funding sources (the returns are seen as positive) and in terms of networking opportunities.

Instruments for internationalisation include a number of limited grants for preparation of international cooperative projects, as well as soft support for access to international funding sources (mostly from the EU). RANNIS coordinates and promotes Icelandic participation in collaborative international projects in science and technology.

Iceland has been an active member of EUREKA since 1986, making it one of the very first members. The Icelandic innovation Centre acts as the EUREKA office in Iceland. By November 2010 Iceland was participating in eight on-going EUREKA projects, of which three were approved EUROSTARS projects in the following fields:

- image processing, for automated sea lice detection by computer vision (cost: €532,000) with the UK;
- protein engineering, based in a green indoor growth factory for production of high value compounds through GMO, with Norway (cost: €1,150,000); and
- biotechnology focused on the production, process development and quality control of recombinant plant-made proteins using hydrophobins, with Finland and Sweden (cost: €1,537,416).

Iceland is also a member of COST, the European Cooperation in Science and Technology.

Table 11: Overview of Icelandic participation in EU FP7 in 2007-2008

	applications	Icelandic partners	Projects funded	Success (%)	EU contribution to project (€)	EU contribution to Iceland (€)
1. Health	33	42	11	33%	97.693.369	5.745.896
2. Food, agriculture, fisheries and biotech	27	32	4	15%	11.721.535	787.719
3. ICT	29	39	3	10%	18.429.536	834.104
4. NMP	9	9	–	22%	6.000.000	–
5. Energy	7	8	3	43%	299.856	66.002
6. Environment	29	32	7	24%	57.250.143	1.584.017
7. Transport	8	8	2	40%	4.152.728	148.210
8. Socio-economic and humanities	14	19	3	21%	6.292.883	626.947
9. Space	1	1	1	100%	–	51.960
10. Security	5	7	1	20%	3.495.612	–
11. Ideas	12	12	1	8%	3.491.171	3.491.171
12. People	38	40	12	32%	2.783.551	1.367.169
13. Infrastructure	5	6	4	80%	16.576.382	144.680
14. SME	21	31	5	24%	5.413.990	210.639
15. Regions of knowledge	3	6	–	–	–	–
16. Research potential	–	–	–	–	–	–
17. Science in society	10	11	2	20%	2.375.026	18.618
18. Support for research policies	2	2	2	100%	1.998.788	209.987
19. International cooperation	–	–	–	–	–	–
Total	**253**	**305**	**61**	**24%**	**237.974.570**	**15.287.119**

Source: Rannis

National participation in inter-governmental Research Infrastructures

The general view among Icelandic stakeholders seems to be that there is a great potential for improvement regarding Iceland's participation in international research facilities, and room for raised awareness of the importance of increased participation.

Apart from the participation in research facilities such as CERN, EMBO and EMBL, Iceland has a relatively low participation in international research infrastructures overall. Iceland is also involved in the ESFRI process and is a member of a number of RIs under this framework.

3.5.2 Bi- and multilateral agreements with other ERA countries

The European Research space is not the only focus for Icelandic S&T policy. Iceland places a great emphasis on its integration in Nordic R&D co-operation programmes, including the Nordic Research and Innovation Area (NORIA).

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

Rannis leads Icelandic participation in a number of ERA-Net projects. Some of those projects have the objective of becoming Article 185 initiatives in the future. Eurostars has been running as an Article 169 initiative since 2008, with Icelandic participation from the start. Iceland has not yet had an official policy regarding participation in the governing bodies of Article 187 initiatives (JTI). Icelandic organisations do, however, participate in *Innovative Medicines and Hydrogen and Fuel Cells initiatives* (European Commission, 2010). Iceland also participates in the joint programming on *Cultural Heritage and Global Change,* together with 14 other ERA countries.

Rannis also participates in the following nine ERA-NETs:

- RASME;
- CORNET;

- EuroNanoMed;
- HERA;
- NORFACE;
- MARFISH;
- MATERA+;
- SAFEFOODERA; and
- SEASERA.

3.5.4 Opening up of national R&D programmes

International cooperation is present as a key criterion in Icelandic funding programmes. It is not given particular emphasis in the work of the two main competitive funds, except for the "grants of excellence" in the Research Fund. The new Centres of Excellence programme includes this as a compulsory criterion. However, funding is always allocated to Icelandic organisations, and there are no cases of trans-border funding flows from national programmes.

3.6 *International science and technology cooperation*

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

3.6.1 International cooperation

Official policy in Iceland emphasises the importance of international cooperation. The main focus is on the European Research Space and integration in the Nordic R&D cooperation programmes. Many research linkages and funding flows also link Iceland with the US.

Before the financial crisis there were attempts to establish closer cooperation with India, but due to the need to prioritise, this initiative has been abandoned.

3.6.2 Mobility schemes for researchers from third countries

The first programme dedicated to researchers' mobility is being managed by Rannis, with co-funding from the FP7 People programme. The programme offers incoming, outgoing and reintegration grants for researchers, irrespective of the applicant's nationality.

However no specific mobility schemes exist to particularly target researchers from third countries.

4 Conclusions

4.1 *Effectiveness of the knowledge triangle*

The following table gives a short assessment on the effectiveness of policies in the knowledge triangle.

Table 12: Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	• New target for R&D spending: 4% of GDP for R&D by 2020, with 70% of spending to come from companies and 30% from public funds.	• - The severe economic and financial crisis which hit the country in October 2008 continues to negatively affect public research spending. The envisaged target to increase public expenditure for competitive funding could not be maintained in 2011. The 2011 budget included a 9% overall cut to the state budget (compared to 2010) with a 7.5% cut for universities and 5% cut for competitive funds. Public expenditure on competitive funds remained stable in 2010. Continued budget cuts are expected in the coming years.
Innovation policy	• New act on tax incentives for R&D • Merging of the Research Fund and the Technology Development Fund	• + Tax incentives for R&D have been discussed for some years as a way to strengthen the competitiveness of innovative companies. The first effective tax year was 2010. • + The merging of the research and industrial funds, under the umbrella of RANNÍS is being recognised by the government as both timely and important. A broad consensus has been reached on a policy to ensure research and development is conducted through competitive funds and the strategic research programmes of the Science and Technology Policy Council.
Education policy	• Recommendations on merging public universities and tertiary institutions	• + The economic crisis has brought policymakers to think in terms of effectiveness and pooling of existing resources. University mergers are seen as an important step in this direction. • - Attempts to merge universities during 2010 have met resistance from university administrations and have been suspended.
Other policies	• EU accession process	• + Since July 2010 Iceland has held formal EU Candidate Country status. It remains to be seen if there is political will to set a date for an EU membership referendum in a near future.

4.2 *ERA 2020 objectives – a summary*

The following table gives a short assessment of national policies supporting the ERA 2020 objectives.

Table 13: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	• All universities have signed the European charter for researchers and their code of conduct. • RANNIS participates actively in the EURAXESS service network that provides practical assistance to mobile researchers and their families. • New programme dedicated to researchers' mobility under the Research Fund to offer incoming, outgoing and reintegration grants irrespective of the applicant's nationality.	• - The supply for science & engineering considered to be inadequate, no formal channel for the education system to systematically identify the need in this respect. • - The weak Icelandic currency may be a considerable barrier for researchers with Icelandic salaries to go abroad.
2	Increase public support for research	• New target for R&D spending to reach 4% of GDP by 2020, with 70% of spending to come from companies and 30% from public funds.	• - The envisaged increase of competitive funding was not met in 2010; the budget for 2011 foresees cuts in competitive spending.
3	Increase European coordination and integration of research funding	• In 2010 the government appointed a number of working groups to assess the status of, and future possibilities for enhanced Icelandic participation in European and international research.	• + Access to EU research funding has increased in importance and the number of applications for both national and EU framework programmes are rising.
4	Enhance research capacity across Europe	• No policy changes	
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	• A new working group on research infrastructure has been set up with the mandate to make recommendations on how Iceland can better link up with Nordic RI. • The STPC strategy 2010-2012 emphasises the importance of eScience for Icelandic researchers.	• + Iceland has participated actively in five ESFRI groups. • - Due to budgetary constraints it is unclear if Iceland will be able to continue its engagement in the implementation phase.
6	Strengthen research institutions, including notably universities	• Recommendations on merging public universities and tertiary institutions.	• - Attempts to merge universities in 2010 have failed.

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
7	Improve framework conditions for private investment in R&D	• New act on tax incentives for R&D.	• + The policy measure has been discussed for some years as a way to strengthen the competitiveness of innovative companies. The first effective tax year was 2010.
8	Promote public-private cooperation and knowledge transfer	• The "Centres of Excellence" programme, launched in 2009, includes a key objective about fostering knowledge circulation between university, Public Research Organisations (PRO) and business sectors.	• + The issue of knowledge circulation and the need to capitalise on public investments in research have become prominent policy issues as a result of the economic downturn. • It is too early to assess the effectiveness of the measure, but it is of interest and should be followed up closely in terms of the development and nature of the cooperation established by the centres.
9	Enhance knowledge circulation across Europe and beyond	• Introduction of the first programme dedicated to researchers' mobility with co-funding from the FP7 People programme to offer incoming, outgoing and reintegration grants, irrespective of the applicant's nationality.	• + Like all previous S&T policy strategies, the latest strategy from the STPC for the period 2010-2012 emphasises the vital importance of international cooperation for the development of research and innovation in Iceland. +Icelandic research establishments and funding rules are traditionally open to researchers' mobility, although financial resources have been scarce.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	• No policy changes.	
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	• A process aiming at improving the coordination of strategic programmes under the ministries is underway. The process is headed by the Ministry of Education, Research and Culture.	• - Lack of coordination of research programmes is perceived as a problem in Icelandic research policy governance. There are particular tensions regarding coordination and alignment of programmes under the auspices of Ministry of Agriculture and Fisheries (notably the AVS fund).

	ERA objectives	Main national policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
12	Develop and sustain excellence and overall quality of European research	• The Centre of Excellence programme has been in place since 2009.	• + The setting up of centres of excellence under the scheme is in line with the recent process of prioritisation in Icelandic research. • - The lack of prioritisation between research policies has been under criticism for some time.
13	Promote structural change and specialisation towards a more knowledge-intensive economy	• In January 2011, the government issued a policy paper called 'Iceland 2020 – Action plan for industry and society; knowledge, sustainability and welfare'. One of its main goals is: to reduce the percentage of Icelanders aged between 20 and 66 who have not received any formal secondary education, from 30% to 10%, by 2020.	• + The economic crisis has led Icelandic policymakers to re-orient science policy and prioritise areas with Icelandic strength. • - A particular concern is the high dropout rate from secondary school. The number of people of working age who have only completed primary education is a further source of concern. • + The Iceland 2020 strategy points at particularly strong opportunities for innovation in the production of agriculture and marine products and eco-innovations.
14	Mobilise research to address major societal challenges and contribute to sustainable development	• The Iceland 2020 strategy emphasised the importance of eco-innovations for the Icelandic economy. The aim is to make eco-innovation and its products a main growth sector for this decade, with an annual growth in turnover of 20%, which will double between 2011 and 2015. Other policies emphasise ambitions to boost research, development and production of domestic, environmentally friendly fuels.	• Icelandic policy for research has not traditionally emphasised particular priority areas such as solving societal challenges or contributing to sustainable development. • + From recent policy strategies it is evident that a shift in this direction is taking place. There is a stronger policy focus on eco-innovations and sustainable fuels especially.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	• The STPC strategy 2010-2012 emphasises the importance of strengthening policy intelligence and evidence-based policy making. It is recommended that RANNIS should be strengthened, as the main body involved in supporting and analysing research and innovation processes in the country.	• - Icelandic policy makers do not make extensive use of evaluation tools. A key criticism from independent expert assessments of the Icelandic research system is the lack of evidence-based policies, to a large extent due to the inadequate policy intelligence preparation of the advisory bodies.

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List of Abbreviations

AVS	Added Value for food programme
BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Researchh
CI	Company and Institution Grants
COST	European Cooperation in Science and Technology
ECTS	European Credit Transfer and Accumulation System
EEA	European Economic Area

EFTA	European Free Trade Agreement
ERA	European Research Area
ERA-NET	European Research Area Network
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GMO	Genetically Modified Organisms
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
HRST	Human Resources in Science and Technology
ICI	Innovation Centre Iceland
IP	Intellectual Property
NICe	Nordic Innovation Centre
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and development
RANNIS	Icelandic Centre for Research
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
S&TT	Science and technology
SF	Structural Funds
SME	Small and Medium Sized Enterprise
STPC	Science and Technology Policy Council
TRI	Top-Level research initiative
VAT	Value Added Tax
VC	Venture Capital