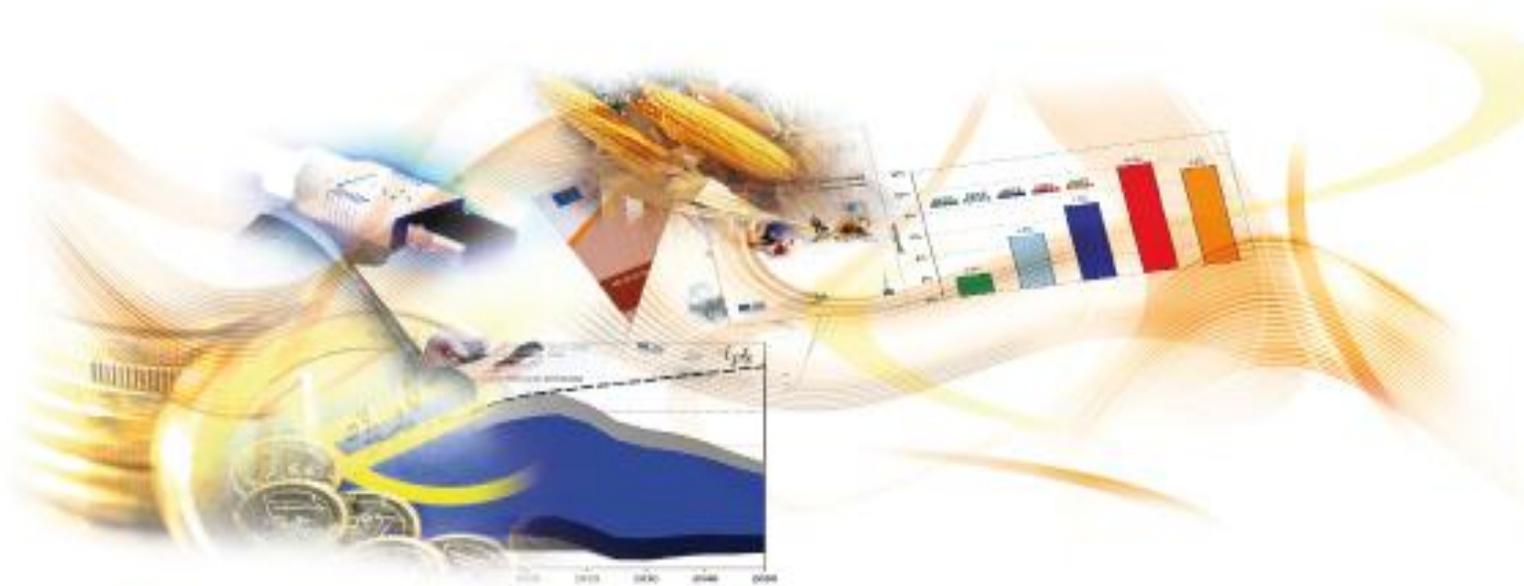


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Based on the 2011 Country Report by Antje Klitkou

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The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

The first draft of this report was produced in December 2012 and was focused on developments taking place in the previous twelve months. In particular, it has benefitted from the comments and suggestions of Susana Elena Perez from JRC-IPTS. The contributions and comments from the Danish Ministry of Science, Innovation and Higher Education are also gratefully acknowledged.

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

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EXECUTIVE SUMMARY

The Danish research and innovation (R&I) system has frequently been characterised as an excellent example of a well-performing R&I system. The country possesses a strong international position in most science, technology and innovation (STI) indicators. Considerable emphasis is placed on the education system with excellent higher education and research. Both the private and the public sector are committed to invest into education, research and innovation at a level necessary to maintain its current highly competitive position. Moreover, STI in Denmark are supported by a strong culture for innovation that reflects the country's open and dynamic welfare society.

In 2011, Denmark's gross domestic expenditure on R&D (GERD) was 3.09 percent of GDP (estimate from Eurostat, December 2012), well above the average for the EU-27 of 2.03 percent. Business enterprise R&D expenditure (BERD) decreased from 2.2 percent of GDP in 2009 to 2.09 percent of GDP in 2011, while the share for EU-27 reached 1.26 percent in 2011 (estimate from Eurostat, December 2012). While Government Intramural Expenditure on R&D (GOVERD) has been stable on a low level, 0.07 percent of GDP in 2011 compared to a share of 0.26 percent for EU-27, the share of Higher Education Expenditure on R&D (HERD) of GDP increased from 0.68 percent in 2007 to 0.92 percent in 2011, compared to 0.49 percent of GDP for EU-27 in 2011 (estimate from Eurostat, December 2012). Denmark or the Danish regions have not yet developed research and innovation strategies for smart specialization (RIS3).

Since the election of the new government in October 2011, STI policy has received renewed attention in Danish policy. The ambition has been to develop Denmark's first comprehensive innovation strategy based on collaborative efforts between the involved ministries, i.e. the Ministry of Science, Innovation and Higher Education, the Ministry of Business and Growth and other relevant sectoral ministries, as well as stakeholders from the Danish innovation system. The innovation strategy is the outcome of a strategy process that started in March 2012 and was completed in December 2012. One important platform for the innovation strategy is the RESEARCH2020 catalogue – which was published in June 2012 and contains a presentation of five visions that are intended to represent strategic research horizons to be pursued until the year 2020:

- A society with a green economy
- A society with health and quality of life
- A high-tech society with innovation capacity
- An efficient and competitive society
- A competent, cohesive society

Another important element of the new innovation strategy is the ERAC peer review of the Danish research and innovation system, carried out in the period from April to September 2012. The peer review highlights strengths and weaknesses of the Danish research and innovation system and provides several recommendations for future action. Taken together, these elements provide a solid ground for the formu-

lation of the innovation strategy. Its vision is that Denmark should become a nation of solutions, in which innovative solutions for the grand societal challenges are converted into growth and employment. With the new innovation strategy, the Danish government sets a focus on three areas:

1. Innovation driven by societal challenges: Demand for solutions to concrete societal challenges must be given higher priority in public innovation policy.
2. More knowledge translated to value: Focus on mutual knowledge exchange between companies and knowledge institutions and more efficient innovation schemes.
3. Education as a means to increase knowledge capacity: A change of culture in the education system with more focus on innovation.

The Danish government translates the vision of the innovation strategy into the following goals:

1. The share of companies introducing innovation should be increased, such that Denmark by 2020 is among the five European OECD countries with the highest share of innovative enterprises.
2. Private investments into R&D should be increased, such that Denmark by 2020 is among the five OECD countries with the highest private investments into R&D as a share of GDP.
3. The share of highly educated employees in the private sector should be increased, such that Denmark by 2020 is among the five European OECD countries with the highest shares of highly educated employees in the private sector.

R&D funding has increased considerably over the last decade, providing a valuable input for knowledge production. The availability of high quality research infrastructure has been addressed in policy actions over several years. The access to human resources in science and technology has been addressed by changing funding priorities for education at the PhD level. R&D funding is provided by several actors, such as the Danish National Research Foundation, the Council for Independent Research, the Council for Strategic Research, the Council for Technology and Innovation, the Danish Advanced Technology Foundation, and several sectoral RD&D programmes. Another key funding source is the University Basic Research Funding, i.e. the earmarked basic university grants provided to the universities on the annual national budget. The main knowledge producers in the Danish R&D system are the universities along with a few government research institutes and a network of private, non-profit R&D organisations. Despite the economic crisis that has also affected Denmark, the government has committed in 2012 considerable additional funds to research at universities, the research councils and other players in the innovation system.

Although Denmark is one of the innovation leaders with above average performance according to the Innovation Union Scoreboard 2011, being grouped together with the peak performers Sweden, Germany and Finland, several challenges need to be addressed.

- R&D intensity in the business sector

In 2011, Denmark still had a lower R&D intensity than the peak performer reference group. Certain barriers to private R&D investments may explain this: a business sector structure dominated by SMEs and only

few large industrial companies, a shortage of capital, the increased relocation of business R&D activities to countries with a lower level of salaries and nearer to the market of the respective companies, and a lack of government incentives.

- Comparatively low share of highly skilled labour in the private sector

Due to a comparatively low share of highly skilled labour in the private sector, the significant increase in the number of students in recent years and the resulting growth in graduates that must be expected in the coming years, Denmark faces a growing challenge to ensure that more students and graduates will seek private sector employment. The new innovation strategy and upcoming reform of the Danish student grant scheme is directed at these challenges. It is important for Denmark to continuously focus on creating high levels of knowledge and skills of graduates and secure a good match with the needs of businesses including small and medium sized enterprises in order to support increased value creation and growth.

- Cooperation between public science and the business sector which aims to turn research results into viable businesses

Although the Danish business sector increasingly invests in R&D conducted at universities or public research organisations, the effectiveness of such cooperation needs improvement. Besides the universities, the GTS system is well functioning as an R&D provider for the business sector. Turning public research results into business opportunities requires more investments in own R&I, R&D collaboration with public research organisations and the purchase of research results from public research organisations, especially universities. Although the volume of private R&D funding of Danish universities has increased from 21 percent to 23 percent in 2011, the level is still rather low.

- Commercialisation of public research results

One of the weaker points in the Danish innovation system in relative terms is the patent intensity, which is at a lower level than in the reference countries Sweden and Finland. However, after years of stagnation, commercialisation of research efforts has been increasing. Both Aarhus and Copenhagen University are significant players when it comes to the commercialisation of research results.

- Creating a simplified funding infrastructure

According to the ERAC peer review the structure of the Danish funding system for research and innovation is overly complex and overlaps in responsibilities. It is questionable whether the funding system effectively accommodates the needs of its customers, i.e. the recipients of funding. Its current state of development is characterized as an “innovation jungle” that is difficult for customers to navigate in.

In conclusion, the Danish policy mix is well aligned with the ERA pillars and objectives. This alignment has been set as an explicit goal by Denmark’s government in several recent policy documents. The policy mix for closing the gap between Denmark and the peak performers in innovation performance has devel-

oped over time in the right direction, but needs some further improvements. The reintroduction of tax incentives is one step in the right direction. However, innovation policy has to ensure that not only high-tech firms are in the centre of policy attention and that low-tech firms are also included, as the voucher programmes has already practiced. Moreover, Denmark needs to ensure that innovation and growth are supported by an appropriate supply of highly skilled graduates. The proposed “national partnership between universities, business sector and public authorities” should be implemented with concrete and coordinated policy actions. Commercialisation of public research results requires a better entrepreneurial culture and education at Danish universities.

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1 INTRODUCTION

Denmark is a rather small country – covering 42,959.1 km² – with only 5.58 million inhabitants or 1.1 percent of the total EU-27 population. Denmark's Gross Domestic Product (GDP) reached €240,452.8m in 2011. That equates to €43,200 per inhabitant compared to an average of €25,200 per inhabitant for the EU-27 overall (Eurostat, December 2012). The real average growth rate of GDP for 2008-2011 (2009-2011) was -0.95 percent (-1.0 percent), at a lower rate than the -0.1 percent (-0.23 percent) average across the EU-27. The decline of 5.7 percent in 2009 was especially significant for the slowdown in the annual growth rate (Eurostat, December 2012). The unemployment rate increased significantly from 3.4 percent in December 2008 to 7.5 percent in December 2010, peaking in May 2012 at 8.0 percent but it has stabilised since then at 7.5 percent in September 2012. In comparison the unemployment rate for the EU-27 increased from 7.1 percent in December 2008 to 10.6 percent in September 2012 (Eurostat, December 2012).

In 2011, Denmark's gross domestic expenditure on R&D (GERD) was 3.09 percent of GDP (estimate from Eurostat, December 2012), well above the average for the EU-27 of 2.03 percent. Business enterprise R&D expenditure (BERD) decreased from 2.2 percent of GDP in 2009 to 2.09 percent of GDP in 2011, while the share for EU-27 reached 1.26 percent in 2011 (estimate from Eurostat, December 2012). While Government Intramural Expenditure on R&D (GOVERD) has been stable on a low level, 0.07 percent of GDP in 2011 compared to a share of 0.26 percent for EU-27, the share of Higher Education Expenditure on R&D (HERD) of GDP increased from 0.68 percent in 2007 to 0.92 percent in 2011, compared to 0.49 percent of GDP for EU-27 in 2011 (estimate from Eurostat, December 2012).

R&D funding has increased considerably over the last decade, providing a valuable input for knowledge production. The availability of high quality research infrastructure has been addressed in policy actions over several years. The access to human resources in science and technology has been addressed by changing funding priorities for education at the PhD level.

R&D funding is provided by several actors, such as the Danish National Research Foundation, the Council for Independent Research, the Council for Strategic Research, the Council for Technology and Innovation, the Danish Advanced Technology Foundation, and several sectoral research, development and demonstration (RD&D) programmes (see Figure 1).

Besides the business sector, major knowledge producers in the Danish R&D system are the universities along with a few government research institutes and a network of private, non-profit R&D organisations. Some of the Danish universities have a high standing in international comparisons. The University of Copenhagen is one of the most important universities in the ERA. It is ranked 44 among the world's best universities in the 2012 Shanghai ranking list of universities, and with 10th place in Europe it is the best in Northern Europe. The Aarhus University is ranked 86 on this ranking list.

A report on bibliometric research performance indicators for the Nordic countries shows a clear increase in the publication output from Denmark (Schneider, 2010). When applying fractional publication counts,

Denmark's publication output has increased from 29.120 papers in the period from 1999-2003 to 32.448 in the period from 2004-2008 (Schneider, 2010: 11). When considering the impact of Danish publications it appears that they achieve a very high citation rate, ranking just behind Switzerland, the United States and the Netherlands (Schneider, 2010: 23). A bibliometric report on Nordic universities shows that the volume of Danish university publishing increased with 13 percent from the period 2000-2004 (22,915 papers) to the period 2005-2009 (25,973 papers) (Piro, 2011: 24). The report provides some key measures of human resources in the Nordic universities. In 2009 Danish universities had 13,394 scientific personnel and a student-staff ratio of 7.5, which is the lowest ratio of the Nordic countries (Piro, 2011: 8).

Compared with the world average, Danish scientific publications are highly specialised in clinical medicine, biomedicine and agriculture (Schneider, 2010). Denmark has a lower scientific specialisation in chemistry, material science, physics, mathematics, ICT and engineering, and Denmark is close to world average in geosciences and social sciences.

The Danish economy has a specialisation profile characterised by a mixture of low- technology industries such as food, furniture, textiles and toys (Kallerud, 2008) and more knowledge-intensive service areas, such as software consultancy or supply and engineering consultancy. The manufacture of pharmaceuticals and medical chemicals as well as software consultancy and supply are the largest sectors regarding intramural R&D expenditures. It is important to mention developments in the manufacturing industry, especially the R&D expenditure by high-tech and low-tech enterprises. Between 2001 and 2006 Denmark increased the knowledge-intensity in both high-tech/medium high-tech and medium and low-tech sectors. "Denmark shows changes in its economic structure with an increasing weight of the high-tech sector electrical machinery. However, a decreasing knowledge-intensity in more traditional sectors of the Danish economy, such as food products or machinery & equipment, should be noticed as well as the decreasing weight of many of the high and medium-high tech sectors (particularly noticeable for the Radio, TV and communication equipment sector)" (European Commission, 2011: 4).

The technical specialisation of Denmark as measured by patent specialisation is changing. When analysing patent applications to the EPO by priority year and by IPC sections it becomes clear that some technology fields have gained more attention, such as mechanical engineering and here especially machines or engines for liquids, wind, spring, weight, or miscellaneous motors; and electricity, and here especially generation, conversion, or distribution of electric power and electric communication techniques. This trend shows Danish activities in the field of wind energy technology, smart grid, energy efficiency and related technologies. Patent specialisation in the field of human necessities is still the most important technology field, but its importance is decreasing. Only the fields of medical or veterinary science and hygiene keep their position at the same level.

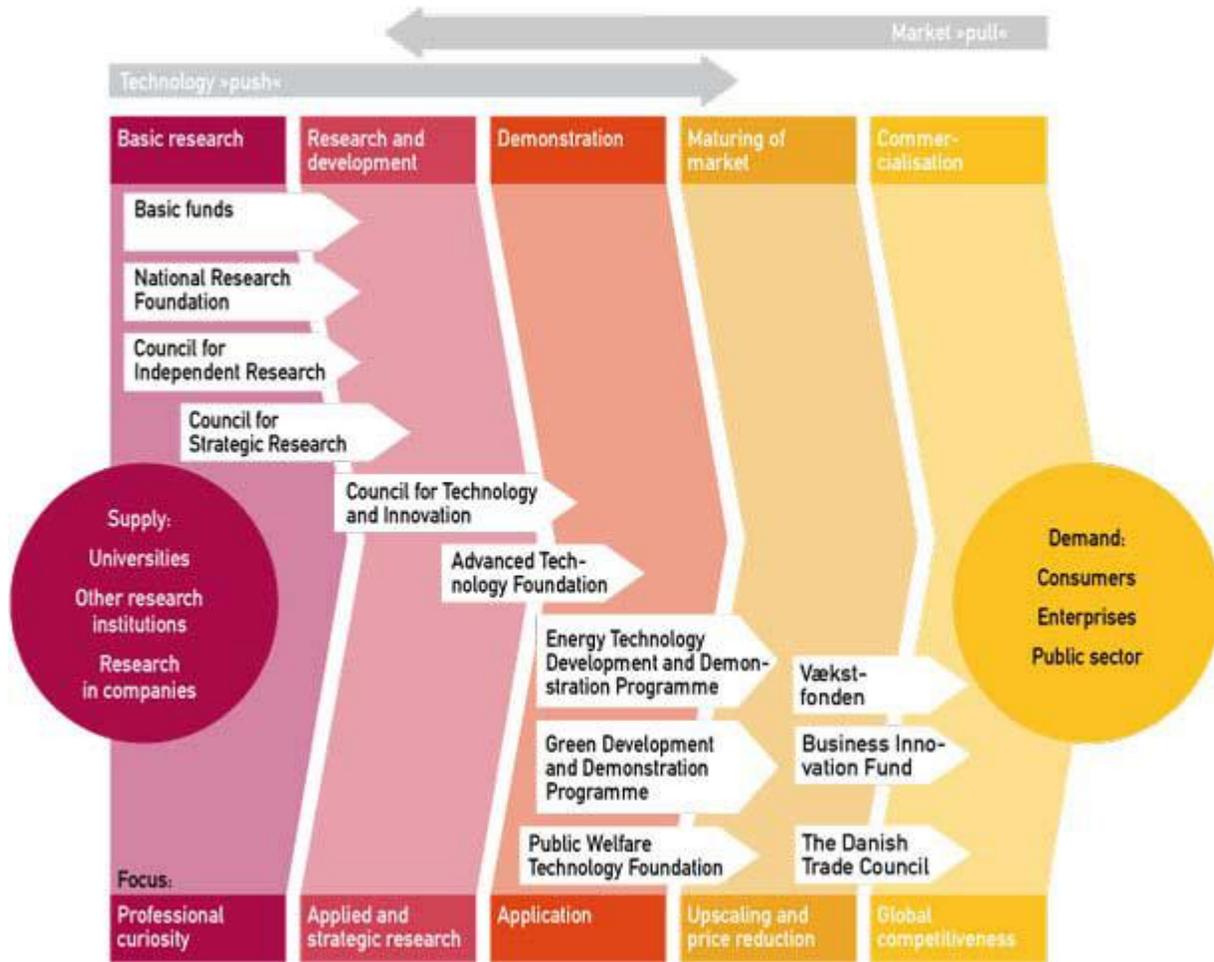
According to the Innovation Union Scoreboard 2011, Denmark is one of the innovation leaders with an above average performance. Relative strengths of the Danish Innovation system lie in open, excellent and attractive research systems, linkages & entrepreneurship as well as intellectual assets. The scoreboard points to relative weaknesses in human resources, firm investments, innovators and economic effects.

The main responsibility for research and innovation is placed within the authority of the Ministry of Science, Innovation and Higher Education. The Ministry of Business and Growth has certain tasks related to business development, and several sectoral ministries – the Ministry of Climate, Energy and Building, the Ministry of Food, Agriculture and Fisheries, the Ministry of Environment, the Ministry of Finance and the Ministry of Foreign Affairs – have larger RD&D programmes. The ministries have specific agencies which implement the respective policies. Regions do not play a decisive role in the R&D governance process. The main research performers in the public sector are the universities. The nine GTS institutes (Godkendte Teknologiske Serviceinstitutter) – Advanced Technology Group are the main collaboration partners of the private sector.

The business enterprise sector is the main R&D performer, funded mainly by the business sector and performing 67.6 percent of total R&D in 2011. In 2011, Danish industry invested 2.09 percent of GDP in R&D (estimate from Eurostat, December 2012). The main public research performers are concentrated in the university system, performing 29.9 percent of the total R&D in 2011. There are eight universities: Copenhagen University, Aarhus University, the Technical University of Denmark, the University of Southern Denmark, Aalborg University, Roskilde University, Copenhagen Business School and the IT University. The universities are organised under their own stakeholder organisation, Universities Denmark.

Figure 1 gives an overview of the Danish research and innovation system with a focus on the funding bodies.

Figure 1: Overview of the Danish research and innovation system



Source: Danish Government (2012g).

2 RECENT DEVELOPMENTS OF THE RESEARCH AND INNOVATION POLICY AND SYSTEM

National economic and political context

Denmark has frequently been characterised as an excellent example of a well-performing research and innovation (R&I) system. The country possesses a strong international position in most science, technology and innovation (STI) indicators. Considerable emphasis is placed on the education system with excellent higher education and research. Both the private and the public sector are committed to invest into education, research and innovation at a level necessary to maintain its current highly competitive position. Moreover, STI in Denmark are supported by a strong culture for innovation that reflects the country's open and dynamic welfare society.

With the election of a new government in October 2011 the political landscape in Denmark shifted. The new government is based on a coalition between Social Democrats, the Social Liberals and Socialists. The global economic crisis has also affected Denmark to a large extent and in that regard also had a profound impact on STI policy. The Danish government expects the economy to enter a relatively long period during which the economic situation is gradually normalized (Danish Government, 2012a). In 2012 economic growth has been supported by the Government's kick start and the reimbursement of the voluntary early retirement contributions (Efterløn). From 2013 the government expects growth to become more self-sustaining with the largest contributions stemming from private consumption and business investment, which both have been relatively low for a long period, as well as exports. Against this background economic growth is expected to reach 1.2 percent in 2012 and 1.5 percent in 2013. At the same time the structural balance is expected to improve from a deficit of 1.5 percent of GDP in 2010 to balance in 2013. The structural deficit has been calculated with 0.4 percent of GDP in 2011 and 0.9 percent of GDP in 2012 (Danish Government, 2012a). Therefore, Denmark is expected to respect the EU recommendation according to the procedure for excessive deficits.

Funding trends

The financial and economic crisis had a profound impact on the Danish business sector: The intramural R&D expenditure of the business sector (BERD) as a share of the GDP decreased from 2.21 percent in 2009 to 2.09 percent in 2011. Nevertheless, the absolute amount spent by the business enterprise sector increased slightly over these years from €4.9 billion to €5.0 billion. These indicators are still in the range of the national investment targets: GERD reached 3.09 percent of GDP in 2011 and the BERD contributed with slightly more than two thirds of this. Table 1 gives an overview of key research and innovation funding figures.

Table 1: Overview of key research and innovation funding figures

	2009	2010	2011	2012	2020 national target	EU average 2011
GDP growth rate (%)	-5.7	1.6	1.1	0.6 ^f	n/a	1.5
GERD as % of GDP	3.16	3.07	3.09 ^{ep}	n/a	3.0	2.03 ^s
GBAORD (€ million)	2,199.820	2,286.359	2,458.889	2,478.176 ^p	n/a	92,308.339 ^s
GBAORD as % of GDP	0.98	0.97	1.03	1.0 ^p	n/a	0.73 ^s
BERD (€ million)	4,930.609	4,948.505	5,024.871 ^{ep}	n/a	n/a	159,975.937 ^s
BERD as % of GDP	2.21	2.09	2.09 ^{ep}	n/a	n/a	1.26 ^s
HERD as % of GERD	27.7	29.3	29.9	n/a	n/a	24.0
GOVERD as % of GERD	2.07	2.12	2.16	n/a	n/a	12.7
BERD as % of GERD	69.8	68.2	67.6	n/a	n/a	62.4

Source: Eurostat, December 2012; s: Eurostat estimate; ep: estimate provisional; f: forecast

The main share of government funding is traditionally channelled via institutional funding of universities: Institutional funding of universities has increased continuously over the last years: from 27.7 percent of GERD in 2009 to 29.9 percent in 2011. In 2011 the universities received €2,011 million institutional funding over the government budget. Moreover, in the period from 2010-2012 an amount of €1.1 billion is being distributed to universities and public research through the Globalisation Fund (Danish Government, 2012a).

The most important competitive funding instruments are managed by the two research councils, the Danish Councils for Independent Research (DCIR) and the Danish Council for Strategic Research (DCSR). The funding via the research council system increased from 2008 – €292 million – to €350 million in 2010, but decreased in 2011 to €306 million. Moreover, there are competitive funds from the state of €292 million in 2011. In that regard, 23 percent of total university funding stem from these competitive research funding instruments (Danish Government, 2012b).

There have been notable increases in funding for Danish organisations working on innovation, such as for the Danish National Advanced Technology Foundation, the Council for Technology and Innovation, the Business Development Finance and the funding of energy research, development and demonstration under the Ministry of Climate and Energy. Examples of sectoral funding are the Energy development and demonstration programme, the GreenLab.dk programme and the Green development and demonstration programme.

Public-private partnerships have become very important over the last few years. The Danish government has gradually developed an institutional and regulatory framework to support this trend. Moreover, the Business Innovation Fund focuses on public-private partnership. Collaborative funding is available when research projects include the participation of industrial participants. The share of the required private co-funding differs between the funding schemes, but is lowest for SMEs.

The Structural Funds (SF) will be deployed only where there is a lack of national funding, and where such intervention is crucial to improving regional competitiveness. In the period 2007-2013 Denmark has allo-

cated €613 million, a clear decrease compared to the previous programme period. Basic research activities will not receive financial support from the SF. However, SF investments will support the improvement of transfer of knowledge. The focus is primarily on the interaction between research and innovation. There is no support foreseen for international collaboration between research institutions or for large research infrastructure. Denmark has launched two operational programmes: “Innovation and Knowledge”, which will receive €255 million from the European Regional Development Fund, and, “More and Better Jobs”, which will receive about €255 million from the European Social Fund. The funding from the ERDF will be matched by the same amount from the Danish government (Klitkou, 2012).

New policy measures

Since the election of the new government in October 2011, STI policy has received renewed attention in Danish policy. The ambition has been to develop Denmark’s first comprehensive innovation strategy based on collaborative efforts between the involved ministries, i.e. the Ministry of Science, Innovation and Higher Education, the Ministry of Business and Growth and other relevant sectoral ministries, as well as stakeholders from the Danish innovation system. The innovation strategy is the outcome of a strategy process that started in March 2012 and was completed by the end of 2012 (Danish Government, 2012c). Both the arrival of a new government as well as the ambition to formulate a comprehensive innovation strategy have led to an extensive consultation process with relevant stakeholders and actors in the innovation system. It is therefore expected that the innovation strategy will unfold its potential starting in 2013.

RESEARCH2020

Mandated by a large majority of the Danish Parliament, the process leading up to “RESEARCH2020 – Strategic Research Horizons” started in May 2011 and was completed in June 2012. During the process a wide group of representatives of businesses, the public sector, interest organisations and universities among others have contributed to identifying important challenge-driven research needs. RESEARCH2020 reflects the society’s demand for research. The society’s most important users of research and research-based knowledge and technology have pointed out the most promising areas for future public research investments in Denmark.

RESEARCH2020 is meant to create the basis for future prioritisation of public investment into research and innovation. It provides a guideline for the parliament in the allocation process for strategic funding of research. The government stresses that the catalogue is not an expression of the political priorities of the Government or the other political parties behind the project but instead the result of an extensive mapping and dialogue process (Danish Government, 2012d).

The RESEARCH2020 catalogue which was published in June 2012 contains a presentation of five visions for Danish strategic investments in research (Danish Government, 2012d):

- **A society with a green economy**

This vision is intended to push Denmark to adopt a green agenda as a cross-cutting theme through many different policy fields. Research is aimed at finding technological and knowledge-based answers to global challenges that ideally should contribute towards growth, welfare and employment in Denmark. Moreover, research should be able to contribute towards an efficient, competitive, and sustainable and health-promoting production of food and other biological products. Tackling the challenges of climate change and increasing competition for limited global resources is another priority within this vision.

- **A society with health and quality of life**

The vision is to create a society focused on health and the quality of life that is characterised by cost-effective healthcare and a health care sector that is oriented towards the individual citizen. Research should therefore be geared towards a fulfilment of these objectives. This is partly done by creating a connection between basic biological and medical research and the clinical research in order to more rapidly find targeted solutions to treatments. And partly it is done by developing innovative and citizen-centred welfare-technological and organisational solutions

- **A high-tech society with innovation capacity**

The vision is to develop Denmark into a high-tech society that develops knowledge, technologies and competences in order to secure long-term economic competitiveness. Research should therefore be directed towards exploring strategic growth technologies – such as the Key Enabling Technologies – as well as future production systems and new digital solutions. Being at the technological forefront has frequently been characterised as a cornerstone to competitive advantage.

- **An efficient and competitive society**

This vision is about creating an efficient and competitive societal organisation that is characterised by good resource utilisation, high productivity and strong competitiveness. Research should in this regard primarily be targeted towards preventing cost-intensive diseases and social problem, as well as strengthening productivity development and competitiveness. Such research should enable a high quality of life for the citizens while at the same time ensuring that more people remain in the labour market. Moreover, research should aim at allowing safe and efficient mobility for people and goods and the development of an attractive infrastructure.

- **A competent, cohesive society**

The last vision focuses on the level of education and competence of the individual citizen which should generally be raised in order to make use of the opportunities that the globalisation provides to Denmark. Research efforts should therefore be directed towards a well-functioning education system that holds opportunities for everybody to get involved as a citizen in a globalised world and that allows the acquisition of relevant competences and qualifications. The vision also aims at strengthening cultural understanding and cross-cultural competences so that businesses and society in general will be prepared to make proactive use of globalisation.

Denmark – Nation of Solutions

The vision of the new innovation strategy is that Denmark should become a nation of solutions, in which innovative solutions for the grand societal challenges are converted into growth and employment (Danish Government, 2012f). With the new innovation strategy, the Danish government sets a focus on three areas:

1. Innovation driven by societal challenges: Demand for solutions to concrete societal challenges must be given higher priority in public innovation policy.
2. More knowledge translated to value: Focus on mutual knowledge exchange between companies and knowledge institutions and more efficient innovation schemes.
3. Education as a means to increase knowledge capacity: A change of culture in the education system with more focus on innovation.

Within these focus areas, 27 individual policy initiatives are defined that the government wishes to implement with the start of 2013. In order to measure the effectiveness of the innovation strategy, the Danish government translates the vision of the innovation strategy into the following STI policy goals:

1. The share of companies introducing innovation should be increased, such that Denmark by 2020 is among the five European OECD countries with the highest share of innovative enterprises.
2. Private investments into R&D should be increased, such that Denmark by 2020 is among the five OECD countries with the highest private investments into R&D as a share of GDP.
3. The share of highly educated employees in the private sector should be increased, such that Denmark by 2020 is among the five European OECD countries with the highest shares of highly educated employees in the private sector.

It is worth noting that the research policy goals set out in the innovation strategy aim at a “moving target” in the sense that the goals are oriented towards the “best in class” in terms of innovation performance. If the three goals should be fulfilled in 2013, it would mean both the share of innovative enterprises and their R&D investments should be increased by 15 percent while the share of highly educated employees in the public sector should be increased by 28 percent.

The innovation strategy presents an ambitious vision for the integration of innovation and entrepreneurial skills in courses and programmes throughout the Danish education system. The purpose is twofold: first, to ensure that the future Danish workforce has the competences required in a context where companies’ competitiveness increasingly depend on their ability to be innovative; second, to ensure that students, also while they are studying, are being viewed as a resource that can benefit society and companies with their skills and knowledge. Among key initiatives, the strategy aims to extend practical elements to all educational programmes on all levels, e.g. in the form of internships, theses written in collaboration with companies etc. Moreover, the strategy seeks to strengthen innovation and vocational skills among talents on higher education programmes, including PhDs.

Education

Besides the planned implementation of the new innovation strategy, Danish STI policy has brought forward a number of new initiatives outlined in the Budget Bill 2012 that centre around education (Danish Government, 2012a). The initiatives generally aim at improving the quality of the education system. In order to reduce drop-out rates, new efforts are made to provide guidance, good study environments as well as various ways of planning the instruction and teaching methods, including how to use IT as a supportive tool to target different learning behaviour among pupils and students.

More specifically, an agreement has been made to ensure more practical training placements in 2012 (“Aftale om en forstærket indsats for flere praktikpladser i 2012”). The agreement establishes the framework for the creation of an additional 10,400 practical training placements compared to the level specified in 2009. Approximately €350 million will be set aside for this purpose, of which almost €310 million will be funded by private and public employers through the employers’ reimbursement scheme for apprentices and trainees (AER). Moreover, 3,000 school-based practical training placements will be established in 2012 in programmes with restricted admission to school-based practical training. This is twice as many as in 2010 and 2011.

Moreover, the Budget Bill 2013 includes several measures to increase funding for higher education. About an additional €400 million are set aside for higher education, including increased student stipends (“SU study grant”) (Danish Government, 2012h). Further, the government has recently proposed a reform of the SU study grant scheme in order to reduce the age of graduates and a reform of the accreditation programme for higher education to reduce bureaucracy and improve quality at institutions of higher education (Danish Government, 2013).

Recent policy documents

Recent initiatives within research, development and innovation include those initiatives that have been added since the NRP 2011 as well as those initiatives that are still under implementation and that are aimed at strengthening research and development. A distinction can be drawn between measures aimed at the public sector and the private sector (Danish Government, 2012a).

Public research and universities:

- €1.1 billion have been allocated for research and innovation in the period 2010-2012 from the Globalisation Fund. Funds are to be used for PhD education, a talent development programme for elite researchers, a comprehensive modernisation of university laboratories, an increase in the payment per student, an increase in base funding for universities, a Match Fund to encourage universities to attract external funding, increased focus on strategic research within fields where Denmark has an international position of strength, a green research stimulus package and the improvement of a number of innovation and knowledge transfer initiatives among others.

- The research reserve has been increased by €40 million as part of the agreement on the Budget Bill for 2012.
- The annual intake of PhD students was doubled from 1,200 in 2003 to 2,400 in 2010 and onwards. The increased number will be maintained in the future, and there will be a focus on ensuring that a larger number of PhD recipients gain employment in private companies.
- €6.7 million have been allocated as part of the Budget Bill for 2012 for the implementation of an environmental technology development and demonstration programme in 2012.
- In the period 2010-2012 four Strategic Platforms for Research and Innovation (SPIR) have been established with a budget of €6.7-€10.7 million per SPIR.
- The capital base for the innovative incubators has been expanded to €27 million per year in 2010-2012.

Company research, development and innovation:

- A Business Innovation Fund of €100 million has been established in the period 2010-2012 with the aim of supporting innovation and market maturity within the green and welfare areas.
- An initiative for healthy growth and welfare solutions ("Sund vækst og velfærdsløsninger") has been launched with 23 elements that will strengthen opportunities for innovation in Danish health and welfare companies, among others.
- A new platform www.IP-Handelsportal.dk has been launched, which will make it easier for Danish companies to trade with knowledge.
- As a trial, a new intelligent public procurement of new welfare technology has been implemented via output-based performance specifications in public procurement.
- In order to strengthen the growth culture and get more entrepreneurs into solid growth courses, the Fund for Entrepreneurship has been established, which will spread education in entrepreneurship and innovation in the education system, and the regional growth houses, which will strengthen the growth competencies of enterprises.
- The small and medium-sized businesses initiative for interaction between SMEs and knowledge institutions has been opened with a doubling of the contribution for knowledge-coupons from €3.3 million to €6.6 million in 2011 and 2012.
- A national programme for innovation networks in SMEs (The Innovation Network Denmark Programme) with a yearly budget of on average €10.7 million in 2010-2012 has been launched.
- The number of knowledge pilot projects in SMEs in 2012 compared to 2010-2011 has tripled with a doubling of budgets from around €1.6 million to €3.2 million per year.

It can be concluded that R&D funding has increased considerably over the period from 2011-2012, providing a valuable input for knowledge production. The availability of high quality research infrastructure has been addressed in several policy actions. Particularly the focus on innovation in SMEs is expected to provide stimuli for growth and employment.

Research and innovation system changes

The Danish research and innovation system is composed of several actors, such as the Danish National Research Foundation, the Council for Independent Research, the Council for Strategic Research, the Council for Technology and Innovation, the Danish Advanced Technology Foundation, and several sectoral RD&D programmes that provide R&D funding. The main knowledge producers in the Danish R&D system are the universities along with a few government research institutes and a network of private, non-profit R&D organisations. Within this system, no significant changes have occurred in 2011-2012.

Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)

Denmark or the Danish regions have not yet developed research and innovation strategies for smart specialization (RIS3).

Evaluations, consultations

Evaluations provide essential information to policy makers with regard to the viability of policy measures and their effectiveness and efficiency for reaching the stipulated goals. In this regard, the production of analytical reports and evaluations has been strengthened substantially over the last years by the Danish Agency for Science, Technology and Innovation (DASTI). For instance, there have been several reports on the impact of policy measures and the productivity effects of STI policy schemes and corporate investment in R&D (Alslev Christensen, 2011; DAMVAD, 2011; DASTI, 2011c; Frosch and Alslev Christensen, 2011; Klitkou, 2011b; DASTI, 2012). These reports show that the policy measures had a significant impact on productivity, production, export and employment of Danish companies.

In 2012, the Business Innovation Fund was undergoing a mid-term review (Deloitte, 2012). The review concludes that the Business Innovation Fund contributes to overcoming critical barriers. While the projects evaluated are still at an early stage, complicating the assessment of the expected effects, the review shows that the fund helps companies to get access to capital and thus increases the success chances of the projects considerably. Moreover, the Business Innovation Fund is found to be a profitable economic investment. At the same time, the review cautions against considerably enlarging the Fund since there is a relative scarcity of promising projects to be financed.

Another important evaluation has been the ERAC peer review of the Danish research and innovation system, carried out in the period from April to September 2012. The peer review highlights strengths and weaknesses of the Danish research and innovation system and provides several recommendations for future action. In that regard, the ERAC peer review sets a focus on increasing the innovation capacity throughout the educational system (European Commission, 2012a). Ensuring the employability of graduates – in the light of the ambition to increase the intake of students considerably – poses significant challenges to Danish higher education. Particularly innovative and entrepreneurial skills of future graduates are to be fostered in order to support economic growth. Moreover, the ERAC peer review points to difficulties in increasing the innovation capacity and growth of SMEs (European Commission, 2012a). Danish

support for innovation in SMEs has been relatively underemphasized and the instruments are deemed too small. There is further a need to stimulate collaboration between SMEs and larger businesses, also internationally, in order to grow into a better position in the global market place. Furthermore, the ERAC peer review suggests that the structure of the Danish funding system for research and innovation is overly complex and overlaps in responsibilities (European Commission, 2012a). In that sense, it is questioned whether the funding system effectively accommodates the needs of its customers, i.e. the recipients of funding. Its current state of development is characterized as an “innovation jungle” that is difficult for customers to navigate.

3 STRUCTURAL CHALLENGES FACING THE NATIONAL SYSTEM

According to the Innovation Union Scoreboard 2011, Denmark is part of the group of innovation leaders that exhibit above average innovation performance (European Commission, 2012b). In this regard, Denmark's innovation performance has been persistent over the past couple of years, occupying a top-ranking position in the EU-27. Denmark is grouped together with the peak performers Sweden, Germany and Finland. Denmark also holds a top-ranking position in the Innovation Union Competitiveness Report 2011, in which the country is grouped together with the peak performers Finland, Sweden and Switzerland (European Commission, 2011). Table 2 gives an overview of selected Innovation Union Scoreboard indicators.

Table 2: Overview of selected Innovation Union Scoreboard indicators

Human resources	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2009: 1.7
Percentage population aged 30-34 having completed tertiary education	2010: 47.0%
Open, excellent and attractive research systems	
International scientific co-publications per million population	2010: 1532.9
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	2010: 0.93%
Finance and support	
R&D expenditure in the public sector as % of GDP	2011 HERD: 0.92% 2011 GOVERD: 0.07% 2011 total: 0.99%
Firm activities	
R&D expenditure in the business sector as % of GDP	2011: 2.09%
Linkages & entrepreneurship	
Public-private co-publications per million population	2008: 123.2
Intellectual assets	
PCT patents applications per billion GDP (in PPP€)	2008: 7.52
PCT patents applications in societal challenges per billion GDP (in PPP€) (climate change mitigation; health)	2008: 2.65
Economic effects	
Medium and high-tech product exports as % total product exports	2010: 37.8%
Knowledge-intensive services exports as % total service exports	2009: 61.6%
License and patent revenues from abroad as % of GDP	2010: 0.91%

Source: Innovation Union Scoreboard 2011; Eurostat, December 2012.

Despite the excellent performance of the Danish research and innovation system, there are several challenges to be addressed:

1. R&D intensity in the business sector

Although among the peak performers in Europe, Denmark still had a lower R&D intensity than similar knowledge-intensive countries like Sweden and Finland according to the Innovation Union Competitiveness Report 2011. Taking gross domestic expenditures on R&D as a proxy for R&D intensity, Denmark

achieved 3.09 percent while the reference group achieved 3.28 percent. Denmark had a much better result than the European Union (2.03 percent) and also a better result than the United States (2.87 percent in 2009) (estimate from Eurostat, December 2012). However, the average annual growth of public expenditure on R&D is falling behind both the reference group and the European Union (European Commission, 2011).

The share of business enterprise expenditure on R&D (BERD) as percentage of GDP has increased markedly over the last decade, with an average annual growth rate since 2000 that is even higher than the reference group, the European Union and the United States (European Commission, 2011). However, the share is still much lower (2.09 percent) than for the reference group (2.30 percent) (estimate from Eurostat, December 2012). The Innovation Union Competitiveness Report highlights that knowledge-intensity in more traditional sectors of the Danish economy is decreasing, such as food products or machinery and equipment. In addition, the weight of several of the high and medium-high tech sectors in the overall Danish economy is decreasing (particularly noticeable for the Radio, TV and communication equipment sector) (European Commission, 2011).

Certain barriers to private R&D investments may explain this lower share of BERD as percentage of GDP compared to similar knowledge-intensive countries. One explanation is a shortage of capital. Another explanation is the increased relocation of business R&D activities to countries with a lower level of salaries. Moreover, relocation moves R&D also typically closer to the market of the respective companies (Klitkou, 2011c). The lack of government incentives may be a third factor contributing to this problem. A former tax-incentive for business R&D was abolished in 2006 (Klitkou, 2009). The introduction of a new business R&D tax-incentive in 2012 addresses this barrier. A new system came into force that features a tax credit on R&D expenditures. The tax credit amounts to 25 percent and is applied to the business expenses that relate to R&D. A maximum of approximately €170,000 may be claimed per financial year. Moreover, the Danish government has heavily relied on innovation policy instruments that focus on the supply side (i.e. technology-push) and largely disregarded a demand-driven innovation policy (Danish Government, 2012a). Such measures are still at a very early stage and require further development to support business R&D.

These barriers to private R&D investments may also be a reason for the lower innovativeness of the Danish business sector. The Commission's assessment of the National Reform Programme (NRP) 2011 points out that a number of indicators suggest that Danish businesses are less innovative than their foreign competitors (Danish Government, 2012a). The NRP highlights especially that productivity growth has been lower than in many comparable countries (Danish Government, 2011b). Moreover, the ERAC peer review of the Danish research and innovation system points to difficulties in increasing the innovation capacity and growth of SMEs (European Commission, 2012a). Danish support for innovation in SMEs has been relatively underemphasized and the instruments are deemed too small. There is further a need to stimulate collaboration between SMEs and larger businesses, also internationally, in order to grow into a better position in the global market place.

2. Comparatively low share of highly skilled labour in the private sector

The increased intake of new students in the last five years means that Denmark is en route to fulfil the government's national target that 60 percent of a youth cohort must complete a higher education and 25 percent must complete long-cycle higher education. The share of new doctoral graduates has increased in Denmark over the past years due to an investment made in doubling the admission of PhD students from 1,200 in 2003 to 2,400 in 2010 and onwards. But due to the low share of highly skilled labour in the private sector, the significant increase in the number of students and the resulting growth in graduates that must be expected in the coming years, Denmark faces a growing challenge to ensure that more students and graduates will seek private sector employment. This challenge is amplified by the increase in unemployment including high unemployment numbers for recent graduates since the beginning of the financial crisis. Also, students have to be encouraged to move more rapidly into and through tertiary education (OECD, 2009) and barriers to immigration may endanger the attraction of foreign researchers (Klitkou and Kaloudis, 2009: 46). The low share of non-EU doctorate students compared to EU-27 confirms this assessment (European Commission, 2011: 2).

By including the educational system in the innovation strategy, committing to increase innovation- and entrepreneurial skills in courses and programmes throughout the education system and setting targets for the share of highly skilled labour in the private sector, the Danish government is already on the right path. Reform of the student grant scheme will support this. However, it will be important for Denmark to continuously focus on creating high levels of the knowledge and skills of graduates and secure a good match with the needs of businesses including small and medium sized businesses in order to support increased value creation and growth.

3. Cooperation between public science and the business sector which aims to turn research results into viable businesses

The TrendChart report for 2011 identified improving cooperation between public science and the business sector as one of the challenges for innovation policy in Denmark in the next two years (Klitkou 2011b: 16). "The Danish industry has a high absorptive capacity and R&D intensity compared to the European average. However, the linkages between industry and public research organisations need further strengthening. The limited purchase of R&D results from universities and the limited licensing of university patents, are two indications for the same weakness" (Klitkou and Kaloudis, 2009: 44). A recently published report on cooperation between private enterprises and universities concluded that universities mainly cooperate with larger companies, larger companies both in terms of value added and in terms of number of employees, and that these firms are very satisfied with the cooperation (Oxford Research, 2011). Nevertheless, the Danish business sector invests in R&D conducted at universities only to a small extent (Universities Denmark, 2012).

Turning public research results into business opportunities requires more investments into research, development and innovation by the larger business enterprises. This refers to both R&D in collaboration with public research and the purchase of research results from public science. There is evidence that joint R&D

increase the innovation performance of participating firms (Frosch and Alslev Christensen, 2011). However, only the GTS system is currently well functioning as an R&D provider for the business sector. In that sense, the public research organisations have to become better at marketing their research to the business sector.

4. Commercialisation of public research results

One of the weaker points in the Danish innovation system in relative terms is the patent intensity, which is at a lower level than in the reference countries (European Commission, 2012a). In recent years, the share of patent applications being exploited (through licenses, options, assignments and spinouts) has increased, as universities have become more professional and selective in regard to patenting. A new report from the Danish government shows that particularly in 2011 the number of inventions, patent applications, spinouts and licenses has increased considerably (DASTI, 2012). Nevertheless, the universities' income from commercialization efforts remains relatively low compared to the GTS institutes and it has been fluctuating over the last couple of years (DASTI, 2012). This reflects the basic division of labour between universities and the GTS system, the latter providing a wide range of R&D-related services. To avoid unfair competition with the private sector, budgetary provisions allow Danish universities only to engage in commissioned research when this is directly linked to the basic activities of the university.

One problem is that university IPR policies may disturb inter-sectoral knowledge exchange. IPR issues have been experienced to be a barrier in collaborative R&D projects (Valentin and Jensen, 2007). Over the last years technology transfer has been strengthened and possible conflicts of interests have been addressed in standard agreements on IPR and in strategic collaboration agreements between universities and industry partners. In 2009 the commercialisation strategy of the Danish Council for Technology and Innovation (DCTI) suggested that the remaining obstacles in the field of commercialisation are not primarily related to the technology transfer system and legislation (DASTI, 2009). DCTI recommends instead fostering an innovative culture and changing the mindset at the universities via incentive systems, research management and entrepreneurship training.

5. Creating a simplified funding system for research and innovation

The ERAC peer review of the Danish research and innovation system suggests that the structure of the Danish funding system for research and innovation is overly complex and overlaps in responsibilities (European Commission, 2012a). In that sense, it is questioned whether the funding system effectively accommodates the needs of its customers, i.e. the recipients of funding. Its current state of development is characterized as an “innovation jungle” that is difficult for customers to navigate.

This creates two challenges. On the one hand, steps have to be undertaken in order to rationalise the number and range of available policy measures and funding schemes. The overall objective here should be to streamline the availability of funding schemes in order to reduce fragmentation and the sub-critical size of many of the instruments – particularly in view of the size of the Danish economy. On the other hand, it is pivotal to balance the available measures and funding schemes on the continuum from basic research to

development. The current funding landscape seems to feature many overlaps of funding schemes towards basic research and relatively fewer schemes towards development. This would as a consequence also provide an opportunity to organisationally separate responsibilities for funding, i.e. one research council for basic/strategic research and another one for applied/innovation oriented research.

Summing up, we can say that the Danish research and innovation system faces five main challenges:

- 1. Denmark has a lower business R&D intensity than the peak performer reference group.*
- 2. The shortage of highly skilled labour is critical for growth in high-tech sectors.*
- 3. Collaboration between public science and the business sector is lacking.*
- 4. Commercialisation of public research results does not unfold its full potential.*
- 5. The complex funding system does not accommodate the needs of recipients.*

4 ASSESSMENT OF THE NATIONAL INNOVATION STRATEGY

National research and innovation priorities

In 2008 a bottom-up process of consultation on research priorities resulted in a catalogue of strategic research fields, named RESEARCH2015 with 21 strategic research fields distributed over six key research areas. The research fields were used to decide political priorities for strategic research areas. Since spring 2011 a new bottom-up process has started – RESEARCH2020 – which has resulted in a new catalogue of priorities. RESEARCH2020 was published in June 2012 and shares the ‘challenge-driven’ approach of Denmark’s first comprehensive innovation strategy which is based on collaborative efforts between the involved ministries, i.e. the Ministry of Science, Innovation and Higher Education, the Ministry of Business and Growth and other relevant sectoral ministries, as well as stakeholders from the Danish innovation system. The innovation strategy is the outcome of a strategy process that started in March 2012 and was completed by the end of 2012.

The vision of the new innovation strategy is that Denmark should become a nation of solutions, in which innovative solutions for the grand societal challenges are converted into growth and employment (Danish Government, 2012f). With the new innovation strategy, the Danish government sets a focus on three areas:

1. Innovation driven by societal challenges: Demand for solutions to concrete societal challenges must be given higher priority in public innovation policy.
2. More knowledge translated to value: Focus on mutual knowledge exchange between companies and knowledge institutions and more efficient innovation schemes.

3. Education as a means to increase knowledge capacity: A change of culture in the education system with more focus on innovation.

Within these focus areas, 27 individual policy initiatives are defined that the government wishes to implement from the start of 2013. The individual initiatives can be grouped under the following headings (Danish Government, 2012c):

- Increased cooperation between knowledge institutions, companies and other stakeholders to foster growth and employment; a higher focus on utilising research results, commercialisation and market maturation.
- Integration of innovative competences and entrepreneurship in education programmes; closer coordination of education, research and innovation policy.
- Active participation in the global knowledge and innovation network; better preparation of Danish companies and knowledge institutions for global development.
- Securing better cohesion and impact in the innovation system; alignment of the innovation system with political priorities and the needs of users.

In order to measure the effectiveness of the innovation strategy, the Danish government translates the vision of the innovation strategy into the following STI policy goals:

- The share of companies introducing innovation should be increased, such that Denmark by 2020 is among the five European OECD countries with the highest share of innovative enterprises.
- Private investments into R&D should be increased, such that Denmark by 2020 is among the five OECD countries with the highest private investments into R&D as a share of GDP.
- The share of highly educated employees in the private sector should be increased, such that Denmark by 2020 is among the five European OECD countries with the highest shares of highly educated employees in the private sector.

Denmark's new innovation strategy also needs to be seen in relation to the governments other initiatives to secure growth of the Danish economy (Danish Government, 2012c). The strategy is part of a reform package called "Danmark i arbejde – udfordringer for dansk økonomi mod 2020" (Denmark at work – challenges for the Danish economy towards 2020).

The interaction between the different ministries for developing an innovation strategy is a new development in policy making. There are many policy measures in different ministries targeting improved innovation. The Minister of Science, Innovation and Higher Education addresses Danish innovation policy and implements some high impact policy measures, such as the Danish competence and innovation network scheme which is a national cluster programme, the Danish Innovation Consortium scheme, the Industrial PhD Programme, and the GTS Advanced Technology Group (Alslev Christensen, 2011). However there were also many minor policy measures with lower impact and the interaction with other ministries with

relevant innovation policies was not so well developed in the past. The Minister of Science, Innovation and Higher Education has also become one of the members of the Government Coordination Committee, which was not the case before.

Until the new innovation strategy will unfold in 2013, national research and innovation priorities can be described as follows. One of the key priorities of the Danish National Reform Programme (NRP) 2011 and 2012 and the Globalisation Strategy for Denmark has been to secure long-term investments in R&D. An analysis of the strengths and weaknesses of the Danish research and innovation system provided the basis for this strategy. In 2010 the Council for Technology and Innovation developed a long-term action plan for promoting innovation in Denmark which describes the main innovation policy initiatives under the Ministry of Science, Technology and Innovation for the period 2010-2013 (DASTI, 2010b; DASTI, 2011d). This action plan is an update of the former action plan for the period 2007-2010. It includes many of the policy measures proposed also in the government report “Strengthened innovation in business” (Danish Government, 2010b). This list of specific initiatives proposed there was considered and the results of the discussions laid the ground for the new NRP 2012.

The usage of analytical reports and evaluations has been strengthened substantially over the last years by the Danish Agency for Science, Technology and Innovation (DASTI). For instance, there have been reports on the impact of policy measures (DAMVAD, 2011; DASTI, 2011c; Frosch and Alslev Christensen, 2011). In 2010 and 2011 several new Danish research studies evaluated the productivity effects of STI policy schemes and corporate investment in R&D (Alslev Christensen, 2011). In 2012, the Business Innovation Fund was undergoing a mid-term review (Deloitte, 2012).

Another important evaluation has been the ERAC peer review of the Danish research and innovation system, carried out in the period from April to September 2012. The peer review highlights strengths and weaknesses of the Danish research and innovation system and provides several recommendations for future action.

Over the last three years there has been increased policy focus on promoting innovation partnerships, policy measures which support the combination of research and innovation and on innovative regions or clusters. For maximising regional and social benefits, innovation in the public sector has been strengthened. Denmark has developed a policy focus on developing, demonstrating and testing innovative technologies in the field of energy and environment, the food sector, agriculture, fishery and aquaculture, and the welfare sector. This policy focus will contribute to increased R&D intensity in these business sectors. As the ERAWATCH Country Reports for 2010 and 2011 have shown, there are several policy routes being taken to stimulate public and private R&D investments.

1. Stimulating greater R&D investment in R&D performing firms

The Ministry of Science, Innovation and Higher Education has introduced several measures to foster R&D collaboration between public research organisations and business enterprises, with the overall aim of stimulating greater R&D investments in the private sector. These policy measures are intended to enhance

the R&D intensity of Danish firms and are administered by the Danish Council for Technology and Innovation. The introduction of a new business R&D tax-incentive in 2012 is also likely to contribute to an increase in the R&D intensity in the business sector.

2. Stimulating firms not yet performing R&D

The national aim of increasing R&D personnel in the business sector, especially in SMEs, is a great challenge. The shortage of highly skilled labour is critical for growth in high-tech sectors. Specific goals for increasing such employment have been accomplished, such as the goal that 12 percent of small enterprises and 70 percent of medium sized enterprises should employ R&D personnel (DASTI, 2010a). The government presently focuses on higher and further education to address the shortage of highly skilled labour.

3. Increasing extramural R&D carried out in cooperation with the public sector

Direct funding of firms is not prioritised, but R&D collaborations between public science and business enterprises have been more of a focus in Danish innovation and research policy, in order to stimulate greater R&D investments in the private sector. It remains to be seen how the new innovation strategy will change this.

4. Increasing R&D in the public sector

Danish policy is concentrated on improving the framework conditions for R&D in the public sector. The National Reform Programmes and the Globalisation Strategy both focus on increased public R&D funding.

5. Intelligent public procurement

One of the new policy initiatives that has also been highlighted in the NRP 2012 and the ERAC peer review is the development of an intelligent public procurement strategy in order to foster innovation. The government seeks to use the potential of public demand in order to enhance innovation in the public and private sector (Danish Government, 2012a).

It can be concluded that the government is in a good position to address the first two challenges (R&D intensity in the business sector and shortage of highly skilled labour) using the aforementioned policy measures, but the remaining challenges require much more systematic efforts. The new innovation strategy can be expected to contribute in these areas, particularly because it is based on a well-designed process that not only includes several ministries but also other relevant stakeholders from the Danish research and innovation system.

Evolution and analysis of the policy mixes

The role of research and innovation

The former Ministry of Science, Technology and Innovation had innovation as one of its main tasks, but industrial policy has been for a responsibility of the former Ministry of Economic and Business Affairs.

Formerly higher education was divided between the former Ministry of Science, Technology and Innovation and the Ministry of Education. In the new government higher education is the responsibility of one ministry, the Ministry of Science, Innovation and Higher Education. This allows for better opportunities for coordinated policy actions. The integration of innovation policy with industrial policy and other sectoral policies, however, should be improved and embodied at highest political level to overcome non-aligned policy.

Current research and innovation policy is strongly oriented towards addressing major societal challenges. The decision to invest in research and innovation reflects the need to restructure the Danish economy towards more knowledge-intensive industries addressing major societal challenges and strengthening the competitive advantage of Danish industry and universities. In fields such as renewable energy, environment, food, health and ageing, research and innovation are key instruments to enhance competitiveness and to create new jobs.

Design and implementation of research and innovation policies

There is a broad set of political initiatives which address societal challenges, especially in sustainable development, energy and climate. However, there has been a tendency to develop multiple new strategies without having enough stakeholder backup and by that risking the realisation of those strategies. Fewer and better coordinated strategies might improve the impact of such policy actions (European Commission, 2012a).

Several governmental strategies have strengthened the R&D specialisation of Denmark in food, biotechnology, climate and energy, such as the Climate Adaptation Strategy, the Danish Business Strategy on Climate Change, the Green Growth agreement, the Energy Agreement 2012-2020, and the Energy Strategy 2050.

The Climate Adaptation Strategy (2008) included a research strategy and the establishment of a coordinating unit for research in climate adaptation to ensure that Danish climate research addresses adaptation issues to a greater extent and to promote cooperation and knowledge-sharing among the research centres.

The Danish Business Strategy on Climate Change (2009) shows ways of exploiting growth opportunities arising from climate change by developing, disseminating and utilising Danish climate-related solutions. The strategy focuses on entrepreneurship, commercialisation, demonstration and public-private cooperation on green solutions.

The Green Growth agreement (2009) states that a high level of environmental, nature and climate protection goes hand in hand with modern and competitive agriculture and food industries. The agreement includes research and innovation initiatives within agricultural and food sectors aimed at making them more dynamic, and including environmental technologies related to the industry. The Green Development and Demonstration Programme (GDDP) was established as a follow-up of this.

The Energy Agreement 2012-2022 was reached in March 2012. The Agreement contains a wide range of ambitious initiatives, bringing Denmark closer to the target of 100 percent renewable energy in the energy and transport sectors by 2050. The Agreement encompasses large investments up to 2020 in energy efficiency, renewable energy and the energy system which implies considerable investments in innovation activities in these areas (Danish Government, 2012e).

The Energy Strategy 2050 of the Danish Government (2011c) sets out a strategy aimed at making Denmark independent of fossil energy sources by 2050. The strategy identifies three tracks, and one of them is research, development and demonstration, followed up by large demonstration and preparation for the market and finally the utilisation and integration in the transport and energy system. The government is going to review “the public research, development and demonstration initiatives in the climate and energy area in order to support the transition to fossil fuel independence as well as the needs of the business community. Ways to improve coordination and interaction between relevant programmes and councils will also be identified” (Danish Government, 2011c: 40).

Broad innovation policy

Demand-side innovation policy has become more relevant over the last three years. It is a “hot” issue in relation to public-private partnerships and in the welfare sector. Innovation in the public sector has been strengthened by the introduction of the Business Innovation Fund and the Danish Public Welfare Technology Fund.

Public investment in research and innovation

Public investments in research and innovation have been prioritised and budgeted over the last years to ensure predictability and long term impact. In the field of high quality knowledge infrastructure Denmark had some weaknesses, but multi-annual programmes have improved this situation (DASTI, 2011a).

The role of excellence in research and education policy

Research funding is increasingly allocated on a competitive basis. Universities are benchmarked on the basis of internationally recognised criteria and their development contracts with the Ministry of Science, Innovation and Higher Education. Research projects are selected on the basis of the quality of proposals and expected results, subject to external peer review. Universities apply open recruitment methods.

The legal, financial and social frameworks for researcher careers, including doctoral studies, have some weaknesses related to different practices at the Danish universities. Danish universities lack competence in career planning and their tradition of favouring temporary positions and Postdoc positions is not conducive to attracting the best researchers or to returning Danish researchers (DASTI, 2011b). A new programme, Sapere Aude, is targeting the career of young researchers. In 2010 a report on researcher careers was published (DASTI, 2010). The universities and The Danish Agency for Universities and Internationalization are currently following up on the results of the report, for example adjustments of the academic career structure are considered. There are incentives in place to attract leading international researchers.

Education and training systems

In 2011, the share of human resources in science and technology aged between 25 and 64 has been 52 percent, which is far above the average for EU-27 (42.3 percent). Although the number of graduates in science, technology, engineering and mathematics has decreased in the EU-27 over the last years, it increased in Denmark, but is still not sufficient. The recruitment of doctorate students has increased from 2,061 in 2008 to 2,603 in 2010. However, the highest growth rates are in the agricultural and veterinary sciences (38 percent) and social sciences (30 percent), while the natural sciences (27 percent), the technical sciences (27 percent) and the medical sciences (20 percent) fall somewhat behind (Klitkou, 2012c).

In 2010 a strategy for education and training in entrepreneurship was developed in a partnership between the former Ministry for Science, Technology and Innovation, Ministry of Culture, Ministry of Education and the Ministry of Economic and Business Affairs (DASTI, 2010d). The Danish Agency for Science Technology and Innovation sponsors the initiative Young Enterprise Denmark providing entrepreneurship training for students at universities and other educational institutions. The new innovation strategy surpasses these educational initiatives from 2013 on.

Partnerships between higher education institutes, research centres and businesses

Several R&D funding instruments favour partnerships between universities, research institutes and enterprises. Such instruments are for example SPIR – Strategic Platforms for Innovation and Research, Strategic Research Centres, Strategic Research Alliances, the Innovation networks programme and Innovation Consortiums. Many instruments have been opened up to international participation which supports international collaboration.

Framework conditions for business investment in R&D, entrepreneurship and innovation

Denmark has developed a policy focus on turning knowledge into business by supporting the commercialisation of public research results (proof of concept – to be phased out, venture capital and risk capital). The Growth Fund (Vækstfonden), a state investment fund, provides venture capital to entrepreneurial growth companies. Since 1992 the Growth Fund has, in cooperation with private investors, co-financed growth in 4,100 Danish companies with a total commitment of approx. EUR 1.5 billion. The Growth Fund invests equity or provides loans and guarantees in collaboration with private partners and Danish financial institutions. The companies which the Fund has co-financed since 2001 represent a total turnover of approx. EUR 3.6 billion and employ approx. 22,000 people all over the country (Vækstfonden, 2012).

Public funding of research and innovation in businesses

There are many support schemes available addressing market failures in the provision of private funding for innovation, particularly for SMEs. They have proved to have some positive impact (Alslev Christensen, 2011). However, these support schemes should be bundled into fewer and more effective schemes.

The public sector a driver of innovation

The innovativeness of the public sector has great importance for the innovativeness of the business sector. There has been an increased focus on easing the bureaucratic burden of the private sector by further digitalisation of public services. Denmark has implemented policy initiatives related to public procurement of green innovations and in the health sector.

Assessment of the policy mix

The production of analytical reports and evaluations has been strengthened substantially over the last years by the Danish Agency for Science, Technology and Innovation (DASTI). For instance, there have been several reports on the impact of policy measures (Alslev Christensen, 2011; DAMVAD, 2011; DASTI, 2011c; Frosch and Alslev Christensen, 2011; Klitkou, 2011b; DASTI, 2012). These reports show that the policy measures had a significant impact on productivity, production, export and employment of Danish companies. Initiatives that target private R&D investments include increased “intelligent” public procurement, the issuing of “knowledge coupons” for SMEs to interact with public science, an innovation network for SMEs, support for large demonstration facilities, the launch of the Business Innovation Fund and a risk capital fund. The decreasing knowledge-intensity in traditional business sectors can be explained by the lack of financial incentives. A former tax incentive for business R&D was abolished in 2006 (Klitkou, 2009). The introduction of tax incentives for business R&D expenditures in 2012 provides a greater incentive for investing in R&D. Another explanation for the decreasing knowledge-intensity in traditional business sectors is the political focus on high-tech firms while policies supporting an increased innovativeness in low-tech firms might provide much greater effects.

In 2007 the government set specific goals for increasing the employment of R&D personnel in the Danish business sector, such as the goal that 12 percent of small enterprises and 70 percent of medium sized enterprises should employ R&D personnel. In 2010 it could be reported that both goals have been accomplished (DASTI, 2010a: 23). Important policy instruments which support this process include the Business Innovation Fund, Industrial PhD programme, the “knowledge pilots” and the knowledge coupons for SMEs. The number of knowledge pilot projects in SMEs has tripled in 2012 compared to 2010-2011 with a doubling of budgets from around €1.5 million to €3 million per year (Danish Government, 2012a). Moreover, most policy measures require collaboration or favour collaborative proposals (e.g., Strategic Platforms for Research and Innovation, SPIR; GreenLabs DK).

It is clear that an important prerequisite for sustaining growth in the prioritised sectors is a critical supply of human resources. Especially engineers are perceived as being essential for a future growth of new knowledge intensive sectors. The Danish government has focused on this challenge for a number of years and the issue is pervasive in policy debates and documents. The shortage of human resources in science and technology and here especially of engineers has been addressed by stakeholders in the private sector. The government has addressed this problem especially via education policy and as a result of this policy the number of newly enrolled students increased significantly over the last years and the numbers of PhD candidates in engineering doubled from 2003 to 2010. The successful Industrial PhD programme has contrib-

uted to an increased absorptive capacity in the private sector. Education is also a key priority for the new government. The government has as a goal that 95 percent of a year group shall complete at least a youth education programme, 60% shall complete higher education and at least 25% shall complete a long-cycle higher education (Danish Government, 2012b). Job-training is accepted as a standard and successful procedure for the continuous development of skills. Life-long learning has been a policy priority for several years in the National Reform Programmes. Denmark is a country with a flexible, mobile labour force and it also has a long tradition of on-the-job training and funding schemes. In this policy context, the Quality Reform (agreed in 2007) further institutionalised the processes for upgrading of skills, qualifications and further education amongst the labour force. Approximately €633 million have been allocated for 2008-2011 to measures aimed at improving possibilities for enhancing skills of employees in the public service sector. Moreover, the Globalisation Fund has set approximately €1.1 billion aside for the period from 2010-2012 for a talent development program for elite researchers, a comprehensive modernization of university laboratories and an increase in the base funding for universities.

The Ministry of Science, Innovation and Higher Education has introduced several measures to foster R&D collaboration between public research organisations and business enterprises, with the overall aim of stimulating greater R&D investments in the private sector. Currently, however, only the GTS system is well functioning as a domestic R&D provider for the business sector. Presently, innovation policy is facilitating innovation in SMEs in collaboration with GTS institutes. Policy measures are intended to enhance the R&D intensity of Danish firms and are administered by the Danish Council for Technology and Innovation. These policy measures are innovation consortia, innovation networks, knowledge coupons for SMEs, as well as the knowledge pilot initiative.

Danish firms collaborate more with foreign universities than with Danish universities (Danmarks Forskningspolitiske Råd, 2011). However, those firms which cooperate with Danish universities, mainly for applied research projects, assess the cooperation as positive (Oxford Research, 2011). These are mainly larger companies and not small firms. Funding for such cooperation projects comes mainly from public sources.

Since 2003 policy has focused on turning knowledge into business by supporting the commercialisation of public research results. Policy measures support proof of concept (to be phased out), and secure venture capital and risk capital. However, the rather low patent intensity of Danish universities, with the exception of the Technical University of Denmark (DTU) and Aalborg University, remains a challenge if increased university patenting is the goal. Technology transfer offices (TTO) at the different universities have very different framework conditions, the formation of spin-off companies is rather low and only the DTU has actually made significant profits from licensing. This can also be an indication for possible conflicts between universities and industry: industry players argue that universities claim too high profits. Moreover, most TTOs are subcritical in terms of the size of patent and technology portfolios to be commercialized which suggests benefits from higher collaboration between universities in this area. Table 3 provides an overview of the policy mix.

Table 3: Assessment of the policy mix

Challenges	Policy measures/actions addressing the challenge	Assessment in terms of appropriateness, efficiency and effectiveness
Lower R&D intensity than the peak performer reference group	R&D collaboration with GTS system Knowledge Vouchers and Knowledge Coupons for SMEs, Knowledge Pilots Business Innovation Fund Growth Fund (Vækstfonden) Intelligent public procurement Tax incentive for business R&D	Decreasing knowledge-intensity in traditional business sectors is not prevented by existing policy measures – focus on high-tech firms and SMEs may be too narrow. Low-tech firms should be targeted. The Growth Fund is an appropriate measure for supporting ongoing business development in sectors of high societal importance. Intelligent public procurement will probably strengthen R&D intensity through demand-pull innovation incentives.
Comparatively low share of highly skilled labour in the private sector	Funding for increased enrolment in tertiary education programmes in the national budget for 2013. Innovations strategy Upcoming reform of study grants Industrial PhD programme Doubling of PhD student intake Increasing university enrolment Strategy for life-long learning	Denmark is en route to fulfil its ambitious goals for tertiary education levels and has doubled its number of PhDs. The industrial PhDs are an effective measure and will over time probably succeed.
Cooperation between public science and the business sector	Environmental technology development and demonstration programme Strategic Platforms for Research and Innovation (SPIR) Strengthening of GTS system Innovation consortia Innovation networks Knowledge and Research coupons Knowledge Pilots Strategic Research Centres Strategic Research Alliances GreenLabs DK	Cooperation with the GTS-system has developed very well, but cooperation of firms with Danish universities is less successful. Danish firms prefer to cooperate with foreign universities. University IPR legislation might be an obstacle for good cooperation. The new policy measures address this, but it is too early to say if they can succeed.

Commercialisation of public research results	<p>The Danish Foundation for Entrepreneurship – Young Enterprise (FFE-YE)</p> <p>Expansion of the capital base for the innovation environments</p> <p>Growth Fund</p> <p>Proof of concept</p> <p>Strategy for education and training in entrepreneurship</p> <p>Strategy for strengthening of entrepreneurial universities</p>	<p>Only a few universities do succeed (DTU and Aalborg University). There is a need for a better entrepreneurial culture and education at Danish universities. A swift accreditation of new entrepreneurship education needs to be prioritised. A new accreditation system that will fulfill this has been proposed by the government and an agreement has been reached in parliament. The law implementing this agreement will be introduced in the spring of 2013.</p>
Creating a simplified funding system for research and innovation	The new innovation strategy is expected to outline policy actions to address this challenge.	Not yet implemented

5 NATIONAL POLICY AND THE EUROPEAN PERSPECTIVE

The Danish policy mix for closing the gap between Denmark and the peak performers regarding R&D intensity has been developed over time in the right direction, but needs some further improvements. The reintroduction of tax-incentives is one step in the right direction. Another one is the implementation of the Business Innovation Fund and the Growth Fund. However, innovation policy has to ensure that not only high-tech firms are at the centre of policy attention and that low-tech firms are also included. The shortage of highly skilled labour has been addressed by a right mix of policies and will over time probably improve. The cooperation between science and the business sector has been targeted in a range of policy actions, mainly focused on the GTS system. The new innovation strategy should be implemented with concrete and coordinated policy actions. It is still too early to say if the government will succeed here. Commercialisation of public research results requires a better entrepreneurial culture and education at Danish universities. The new strategies do address this, but it remains unclear how they are implemented and if they will succeed. The improved coordination of initiatives has shown to be important. Such coordination is important for avoiding a multitude of minor initiatives, which may compete with each other and endanger their intended impacts. This is especially important for research and innovation policy since there are several ministries which develop own policy actions in these fields. In fact, the “innovation jungle” with a mul-

titude of funding instruments and policy actions requires considerable streamlining in order to reduce the complexity of the system.

In general, the Danish policy mix is well aligned with the ERA pillars and objectives. This alignment has been set as an explicit goal by Denmark’s government in several recent policy documents. Table 4 provides an overview of the national policies and measures supporting the ERA priorities (European Commission, 2012c).

Table 4: Assessment of the national policies/measures supporting the ERA priorities

	ERA priority	Main challenges at national level	Recent policy changes
1	More effective national research systems	<p>Research infrastructure needs improvement in some areas and university laboratories require modernization.</p> <p>In June 2009, a political agreement on a new distribution model for core funding to the universities was reached. The new distribution model is a modification of the former 50–40–10 model, which covered indicators for education, external funding and PhD graduates.</p> <p>In an evaluation report published in September 2010, an international panel presented the results of an evaluation of several funding schemes which aimed at fostering such co-operation (Svedberg et al., 2010). The evaluation panel concluded that these funding instruments are functioning well and that the evaluated projects appear to be based on a high level of knowledge transfer between the public and the private sector. This evaluation also highlighted that the participation of SMEs appears to be too low and should be investigated further.</p>	<p>The Globalisation Fund includes funds earmarked to a comprehensive modernization of research infrastructure, including a green stimulus package and other measures.</p> <p>A road map for the development of research infrastructure was published in September 2011 (DASTI, 2011a).</p> <p>The new model includes bibliometric indicators and has been introduced stepwise over the period 2010–2012. The envisioned distribution for 2012 is as follows: 45 percent based on education appropriations, 20 percent based on external funding of R&D activities, 25 percent based on bibliometric indicators, and 10 percent based on PhD graduates.</p> <p>In 2010, the Council for Strategic Research and the Council for Technology and Innovation launched a new initiative, inviting proposals for Strategic Platforms for Innovation and Research (SPRI).</p> <p>In 2012, the SME initiative received €4.7 million to foster interaction between SMEs and public research through knowledge coupons.</p>

	ERA priority	Main challenges at national level	Recent policy changes
			Furthermore, there are public-private partnership initiatives in the innovation strategy.
2	Optimal transnational cooperation and competition	<p>Denmark is active in a number of other ERA related cooperative actions, such as European Technology Platforms (ETP), Joint Technology Initiatives, Article 169 initiatives, ERA-NETs, and ERA-NET Plus.</p> <p>The Ministry of Science, Innovation and Higher Education (former Ministry of Science, Technology and Innovation) initiated several collaboration agreements and other policy measures to ensure an improved knowledge exchange between Danish and knowledge communities outside Europe.</p> <p>Denmark is actively cooperating with other Nordic countries in joint programmes and institutions within the Nordic Council of Ministers. The organisation of Nordic collaboration in research and innovation rests on two main pillars, one for research, NordForsk, and one for innovation, Nordic Innovation (formerly The Nordic Innovation Centre, NICE). In 2008 the Nordic Prime Ministers initiated the top-level Research Initiative (TRI) and it is to date the largest joint Nordic research and innovation initiative that has a research focus within climate, environment and energy.</p>	<p>Danish funding schemes are open to researchers based abroad, regardless of their nationality, provided that their research is judged to be of benefit to Danish research.</p> <p>Denmark has developed specific strategies for the so-called BRIC-countries (Brazil, Russia, India and China) to improve trade and investment cooperation and to market Danish strengths and competencies, in fields such as climate and energy, welfare, architecture, research, education and food (Danish Government, 2011a: 4).</p> <p>Moreover, Denmark has innovation centres in hotspots around the world; in Silicon Valley, Munich and Shanghai. During 2013 and as part of the national Innovation Strategy, Denmark will open three new innovation centres; in Bangalore, Seoul and Sao Paulo.</p>
3	An open labour market for researchers	<p>Danish university researchers are less internationally mobile than in the European Union (MORE 2010).</p> <p>The share of graduated international PhDs who leave Denmark after getting their degree has increased from 2001 to 2010 (Universitets- og Bygningsstyrelsen, 2011). Mobility is highest among</p>	<p>In 2004-2006 an agreement was made to double the annual intake of PhD students in the period from 1.200 in 2003 to 2.400 in 2010 and onwards (Danish Government, 2012a).</p> <p>The promotion of talent at higher education institutes is one of the</p>

	ERA priority	Main challenges at national level	Recent policy changes
		<p>natural scientists and lowest among researchers specialised in humanities (DASTI, 2011b).</p> <p>All Danish universities have joined the 'Charter for Researchers' and the 'Code of Conduct for the Recruitment of Researchers'. Denmark participates in international co-operation through the Europass Framework.</p> <p>EU gender equality directives have been implemented in Danish law via the Act on Gender Equality and the Act on Equal Treatment of Men and Women.</p>	<p>priorities in the innovation strategy. A better framework for the development of a culture of talent shall be developed.</p>
4	Gender equality and gender mainstreaming in research	<p>In 2013, the Council of Independent Research commissioned a study on the role of gender in research and excellence (Det Frie Forskningsråd, 2013). The report maps gender aspects and differences in the Danish R&I system. In 2011, 84% of the professorial positions in Denmark were held by men and only 16% by women. Moreover, the role of gender is analysed in the context of funding decisions.</p>	<p>In March 2013, the Council of Independent Research held a conference on the role of gender in research and excellence. The objective of the conference was to stimulate the debate about the role of gender and how to achieve equality between the genders in all research contexts.</p>
5	Optimal circulation, access to and transfer of scientific knowledge including via digital ERA	<p>In 2007, the Danish Government approved the Council of the European Union's conclusions about scientific information in the digital age. In this regard, the Danish Ministry of Science, Innovation and Higher Education is currently analysing possible scenarios concerning the further implementation of Open Science in Denmark.</p>	<p>The implementation of Open Access is well under way among Danish universities and public research councils and foundations. As such, the public research councils and foundations implemented a joint Open Access-policy in June 2012. Danish universities are in the process of implementing institutional Open Access policies. Thus, five of eight universities in Denmark have introduced Open Access policies, which their researchers have to comply with.</p>

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LIST OF ABBREVIATIONS

BERD	Business Expenditures for Research and Development
BRIC	Brazil, Russia, India and China
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
DASTI	Danish Agency for Science, Technology and Innovation
DCIR	Danish Councils for Independent Research (Det Frie Forskningsråd)
DCSR	Danish Council for Strategic Research (Det Strategiske Forskningsråd)
DCTI	Danish Council for Technology and Innovation (Rådet for Teknologi og Innovation)
DEFF	Denmark's Electronic Research Library
DK	Denmark
DTU	Technical University of Denmark
EBST	Danish Enterprise and Construction Authority (Erhvervs- og Byggestyrelsen)
EDDP	Energy Technology, Development and Demonstration Programme (Energiteknologisk Udviklings- og Demonstrationsprogram)
EPO	European Patent Organisation
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
EU-27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP	Framework Programme
FP7	7th Framework Programme
GBAORD	Government Budget Appropriations or Outlays on R&D
GDDP	Green Development and Demonstration Programme
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GTS	Godkendte Teknologiske Serviceinstitutter (Advanced Technology Group)
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HRST	Human resources for science and technology
IP	Intellectual Property
IPC	International Patent Classification
IPR	Intellectual Property Rights
NICE	Nordic Innovation Centre
NRP	National Reform Programme

OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and development
RD&I	Research, Development and Innovation
RD&D	Research, Development and Demonstration
RI	Research Infrastructures
RTDI	Research, technological development and innovation
STI	Science, technology and innovation
SF	Structural Funds
SME	Small and Medium Sized Enterprise
SPIR	Strategic Platforms for Innovation and Research (Strategiske forsknings- og innovationsplatforme)
TRI	Top-level Research Initiative
TTO	Technology transfer office
UNIK	University Research Investment Capital (UNiversitetsforskningens Investeringskapital)
VC	Venture Capital

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Abstract

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.

The reports were produced by independent experts under direct contract with IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from external experts.

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

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

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

