

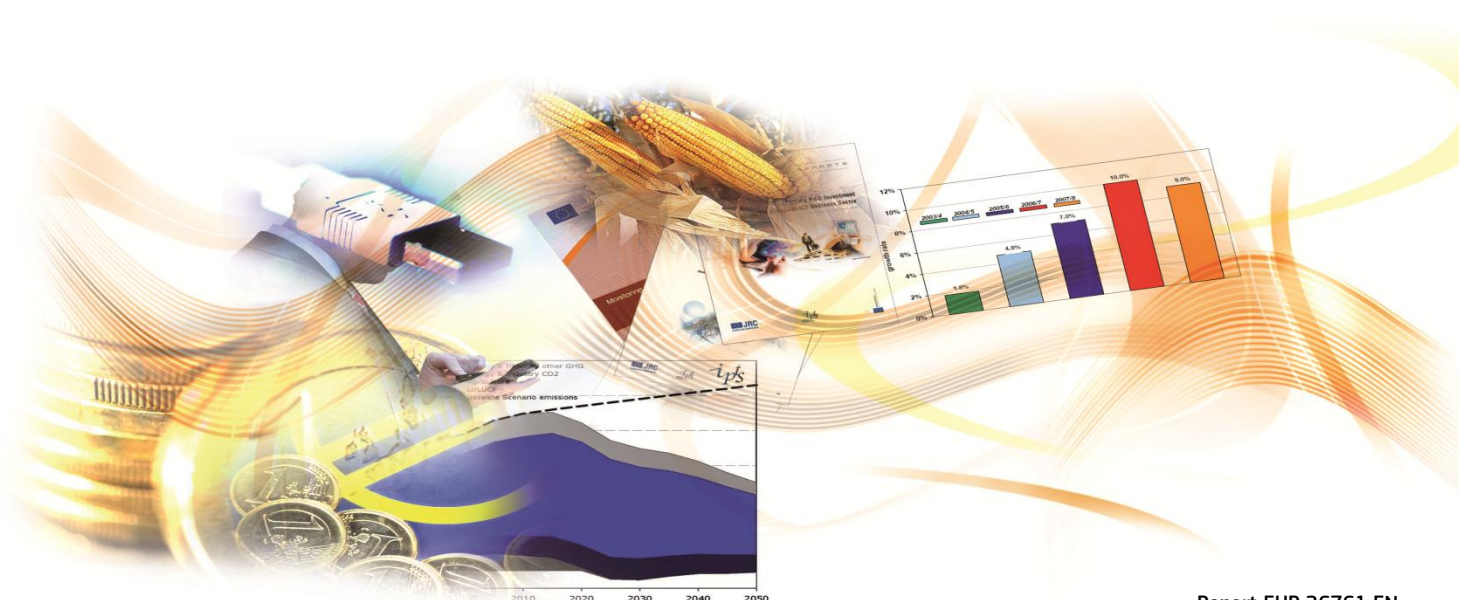


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## ERAWATCH Country Reports 2013: Denmark

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**Abstract**

The Analytical Country Reports analyse and assess in a structured manner the evolution of the national policy research and innovation in the perspective of the wider EU strategy and goals, with a particular focus on the performance of the national research and innovation (R&I) system, their broader policy mix and governance. The 2013 edition of the Country Reports highlight national policy and system developments occurring since late 2012 and assess, through dedicated sections:

- national progress in addressing Research and Innovation system challenges;
- national progress in addressing the 5 ERA priorities;
- the progress at Member State level towards achieving the Innovation Union;
- the status and relevant features of Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3);
- as far relevant, country Specific Research and Innovation (R&I) Recommendations.

Detailed annexes in tabular form provide access to country information in a concise and synthetic manner.

The reports were originally produced in December 2013, focusing on policy developments occurring over the preceding twelve months.

## ACKNOWLEDGMENTS AND FURTHER INFORMATION

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). [ERAWATCH](#) is a joint initiative of the European Commission's [Directorate General for Research and Innovation](#) and [Joint Research Centre](#).

The Country Report 2013 builds on and updates the 2012 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 2013 and was focused on developments taking place in the previous twelve months. In particular, it has benefitted from the comments and suggestions of Patrice dos Santos from JRC-IPTS. The contributions and comments from DG-RTD and the Danish Agency for Science, Technology and Innovation 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](mailto: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 2012, Denmark's gross domestic expenditure on R&D (GERD) reached 2.99 percent of GDP (estimate from Eurostat, December 2013) after 2.98 percent in 2011, well above the average for the EU-27 of 2.06 percent, but significantly decreased since 2010. This decrease is mainly caused by lower business enterprise R&D expenditure (BERD) as a result of the global economic crisis. BERD which decreased from 1.96 percent of GDP in 2009 to 1.79 percent of GDP in 2012 (estimate from Eurostat, December 2013) after 1.79 percent in 2011. BERD contributed with about two thirds to GERD. The main public research performers are concentrated in the university system, performing 32 percent of the total R&D in 2012. 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.

In 2013, the Danish Government has launched Denmark's first comprehensive innovation strategy "Denmark – Nation of Solutions" 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). The process involved an extensive consultation with relevant stakeholders and actors in the innovation system. The innovation strategy has been implemented during 2013 and has since then been guiding STI policy making.

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.

In connection with the new innovation strategy the Danish Government has started a process that led to the creation of the first INNO+ catalogue presented in September 2013 (Danish Government, 2013c). Based on the involvement of a multitude of actors from the innovation system and made in arm's length to the politicians, INNO+ identifies 21 concrete focus areas for research and innovation that are geared towards finding solutions to the grand societal challenges. The thematic focus is on transportation, environment, urban development, food, bio-economy, health, production, digital solutions and energy. The Parliament has used the catalogue in the negotiations on the Budget Bill for prioritization of five societal partnerships on innovation to be launched in 2014:

- Blue jobs via green solutions
- Intelligent, sustainable and efficient plant production
- Denmark as preferred country for early clinical testing and new medicines
- Water-efficient industrial production
- Innovatorium for building renovation of world class standard

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 Danish Council for Independent Research, the Danish Council for Strategic Research, the Danish Council for Technology and Innovation, the Danish National Advanced Technology Foundation, and several sectoral RD&D programmes. 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.

Although Denmark is one of the innovation leaders with above average performance according to the Innovation Union Scoreboard 2013, being grouped together with the peak performers Sweden, Germany and Finland, the Danish R&I system is challenged by a comparatively low R&D intensity in the business sector, a comparatively low share of highly skilled labour in the private sector, sub-optimal cooperation between public science and the business sector and commercialisation of public research results, and a complicated research funding infrastructure.

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 developed over time in the right direction, but needs some further improvements. 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. Moreover, Denmark needs to ensure that innovation and growth are supported by an appropriate supply of highly skilled graduates. The Commercialisation of public research results requires a better entrepreneurial culture and education at Danish universities.

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# 1 BASIC CHARACTERISATION OF THE RESEARCH AND INNOVATION SYSTEM

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The Danish research and innovation system has frequently been characterised as a well-functioning system. According to the Innovation Union Scoreboards, Denmark has continuously been occupying a top-ranking position (European Commission, 2013a). Relative strengths of the Danish Innovation system lie in open, excellent and attractive research systems, linkages & entrepreneurship as well as intellectual assets. The 2013 scoreboard points to relative weaknesses in human resources, firm investments, innovators and economic effects. Danish 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.

In 2012, Denmark's gross domestic expenditure on R&D (GERD) reached 2.99 percent of GDP (estimate from Eurostat, December 2013) after 2.98 percent in 2011, well above the average for the EU-27 of 2.06 percent, but significantly decreased since 2010. This decrease is mainly caused by lower business enterprise R&D expenditure (BERD) as a result of the global economic crisis. BERD which decreased from 1.96 percent of GDP in 2009 to 1.79 percent of GDP in 2012 (estimate from Eurostat, December 2013) after 1.79 percent in 2011. BERD contributed with about two thirds to GERD. The main public research performers are concentrated in the university system, performing 32 percent of the total R&D in 2012. 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.

R&D funding is provided by several actors, such as the Danish National Research Foundation, the Danish Council for Independent Research, the Danish Council for Strategic Research, the Danish Council for Technology and Innovation, the Danish National 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 42 among the world's best universities in the 2013 Shanghai ranking list of universities, and with 9th place in Europe it is the best in Northern Europe. Aarhus University is ranked 81 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.

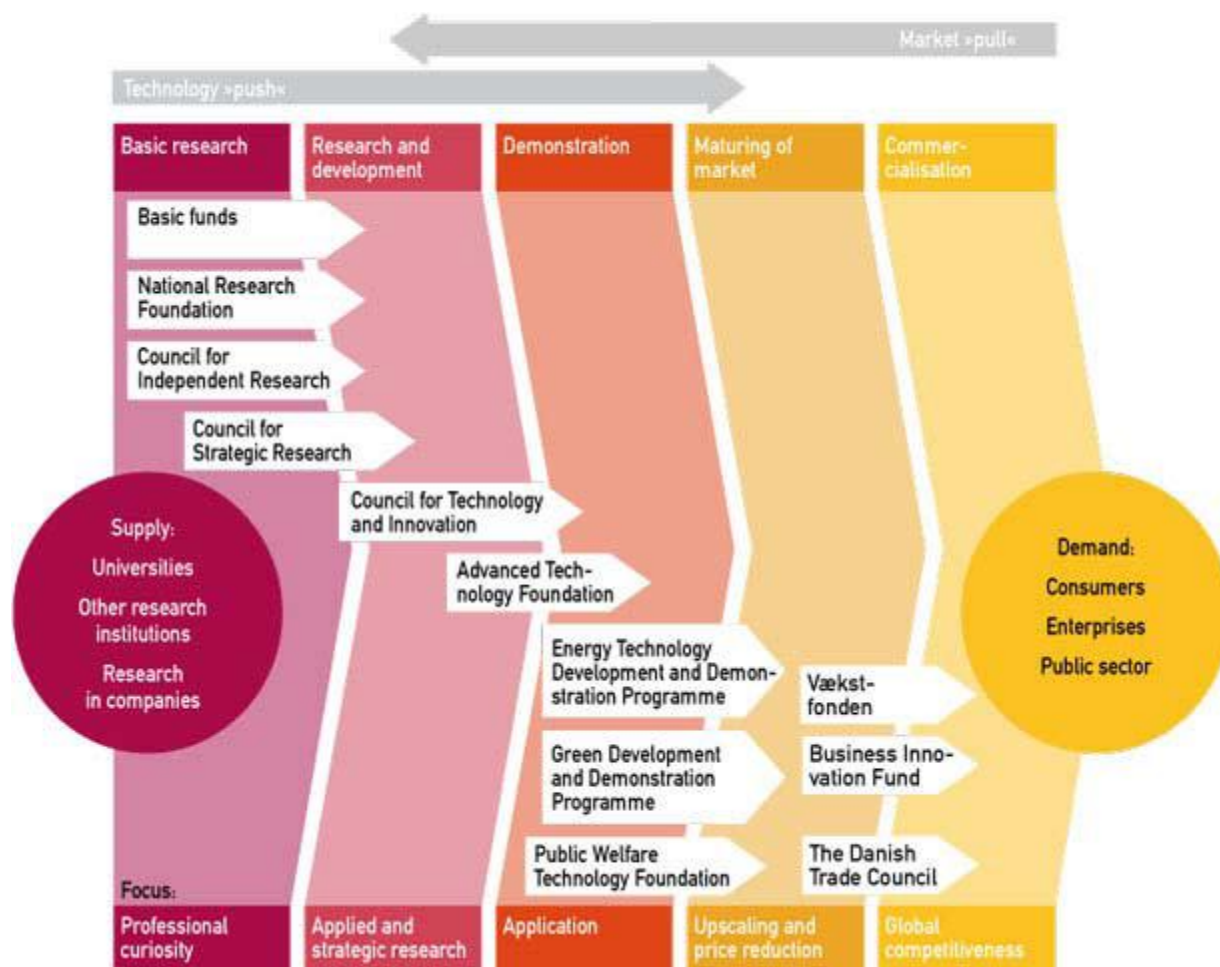
The main responsibility for research and innovation is placed within the authority of the Ministry of Science, Innovation and Higher Education. The Ministry of Business and Growth has certain tasks related to business development, and several sectoral ministries – the Ministry of Climate, Energy and 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.

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

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### 2.1 National economic and political context

Denmark has frequently been characterised as an excellent example of a well-performing research and innovation (R&I) system (e.g., European Commission, 2012a). The country possesses a strong international position in most science, technology and innovation (STI) indicators (European Commission, 2013a). 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.

The global economic crisis has affected Denmark, even though not to the extent other European countries had been affected, but with a measurable 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 0.7 percent in 2013. In 2014, GDP growth is expected to reach 1.6 percent (Danish Government, 2013e). 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.

Despite the effects of the economic crisis, a new study by the Danish Council for Technology and Innovation has revealed that Danish small and medium sized enterprises in the manufacturing sector have very well mastered the challenges of the highly competitive world market and achieved a leading position in their industry. The study refers to these firms as "hidden champions" since their success has been rather unnoticed by the public. The study expects these firms to become a future engine of growth and job creation. Moreover, these firms contribute significantly towards increasing productivity which has frequently been characterised as a focus area of Danish industrial policy (Råd for Teknologi og Innovation, 2013).

### 2.2 Funding trends

#### 2.2.1 Funding flows

**Error! Reference source not found.** gives an overview of key research and innovation funding figures. The figures suggest that the financial and economic crisis had a profound impact on the

Danish economy. GDP decreased slightly from 2011 to 2012 after two years of meagre growth. In the business sector the intramural R&D expenditure of the business sector (BERD) as a share of the GDP decreased from 1.96 percent in 2009 to 1.79 percent in 2012, leading to an overall decrease of the national investment targets for research and development: GERD reached 3.16 percent of GDP in 2009 and decreased to 2.99 percent in 2012. BERD contributed with about two thirds of this.

**Table 1: Basic indicators for R&D investments**

Indicator	2009	2010	2011	2012	EU (2012)*
GDP growth rate	-5.7	1.4	1.1	-0.4	-0.4
GERD (% of GDP)	3.16	3.00	2.98	2.99 <sup>ap</sup>	2.06 <sup>e</sup>
GERD (euro per capita)	1,282.0	1,281.6	1,287.1	1,311.5 <sup>ap</sup>	525.8 <sup>e</sup>
GBAORD - Total R&D appropriations (€ million)	2,188.875	2,276.14	2,451.145	2,509.438	86,309.497
R&D funded by Business Enterprise Sector (% of GDP)	1.96	1.83	1.79	1.79 <sup>ap</sup>	n/a
R&D performed by HEIs (% of GERD)	28	30	32	32	24
R&D performed by Government Sector (% of GERD)	2	2	2	2	12
R&D performed by Business Enterprise Sector (% of GERD)	70	67	66	66	63
Share of competitive vs. institutional public funding for R&D (in %)	n/a	n/a	n/a	41 vs. 59	n/a
Venture Capital as % of GDP ( <i>Eurostat table code tin00141</i> )	0.049	0.044	0.036	0.032	0.025
Employment in high- and medium-high-technology manufacturing sectors as share of total employment ( <i>Eurostat table code tin00141</i> )	3.7	3.9	3.8	n/a	n/a
Employment in knowledge-intensive service sectors as share of total employment ( <i>Eurostat table code tsc00012</i> )	33.1	34.5	35.6	n/a	n/a
<b>Data available for the years</b>	<b>2004</b>	<b>2006</b>	<b>2008</b>		<b>2008</b>
Turnover from Innovation as % of total turnover ( <i>Eurostat table code tscdec340</i> )	13.8	15.9	15.9		13.3

Source: Eurostat, December 2013; s: Eurostat estimate; e: estimated; p: provisional

\* EU27 (or 28 as far as available) average data

There have been notable increases in funding for Danish organisations working on innovation, such as for the Danish National Advanced Technology Foundation, the Danish 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), both the European Regional Development Fund (ERDF) and the European Social Fund (ESF), 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 allocated €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).

## **2.2.2 Funding mechanisms**

### **2.2.2.1 Competitive vs. institutional public funding**

The main share of government funding is traditionally channelled via institutional funding of universities: In 2012, 59 percent were given to universities as so-called basic funds (“basismidler”) while 49 percent were handed out on a competitive basis (“konkurrenceudsatte midler”). The most important competitive funding instruments are managed by the two research councils, the Danish Council 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 2012 to €272 million (DASTI, 2013).

In June 2009 a political agreement was reached on a new distribution model of core funding to universities. The new model is a modification of the former model, which covered indicators for education, external funding and PhD graduates. The new model also includes bibliometric indicators and was introduced stepwise over the period 2010-2012. In 2013 it was agreed to continue the distribution model for five more years. The principles for the bibliometric indicator are summarised in a report published by the DASTI in October 2009. The most recent results for the bibliometric indicators are published on the homepage of DASTI.

Bottom-up project funding is either transferred to the universities directly or channelled through the Danish Council for Independent Research. The Danish Council for Independent Research consists of five area-specific research councils, and supports research projects (competitive funding) based on the research initiatives of the researchers themselves. The main source of funding is the Ministry of Science, Innovation and Higher Education.

The five area-specific research councils are:

- The Danish Council for Independent Research | Humanities;
- The Danish Council for Independent Research | Natural Sciences;
- The Danish Council for Independent Research | Social Sciences;
- The Danish Council for Independent Research | Medical Sciences;
- The Danish Council for Independent Research | Technology and Production Sciences.

#### 2.2.2.2 Government direct vs. indirect R&D funding<sup>1</sup>

The ministry with the highest share of R&D funding is the Ministry for Science, Innovation and Higher Education (formerly the Ministry of Science, technology and Innovation). The Danish Council for Independent Research is responsible for researcher-driven research. This council funds research based in a responsive mode (without predefined focus, thematic areas or policy-related goals). The Danish Council for Strategic Research administers strategic research programmes in areas of political priority. It funds research projects and gives advice to applicants. The council is also contributing to increased university-industry collaboration. The two councils together had a budget of €272m in 2012. These research councils manage approximately 12 percent of the budget of the Ministry of Science, Innovation and Higher Education. The Danish National Advanced Technology Foundation had a budget of €70m in 2012 while the Danish Council for Technology and Innovation had a budget of €146m. Finally, there is the independent Danish National Research Foundation, which funds research of a high international standard. In 2012, it received a budget of €53m (DASTI, 2013)

There are several policy instruments implemented and administered by the Danish Council for Technology and Innovation which target R&D and innovation in SMEs, such as:

##### *Knowledge pilots:*

A grant can be given to SMEs with limited experiences in hiring highly educated employees to cover some of the salary of a new employee with a higher education and who is to execute a development or innovation project in the enterprise. The measure is to enhance the cooperation between SMEs and knowledge institutions and to increase the share of highly educated employees at SMEs. The enterprise can be given €1,333 a month for the salary of the new knowledge pilot, for a period of 6-12 months.

##### *Innovation vouchers:*

The measure consists of a 40 percent co-funding of development projects applied for by SMEs who wish to use the funding for knowledge acquisition from a public research organisation or a member of the GTS-network. It is an objective to expand the utilisation of collaboration with knowledge organisations to a wider group of the Danish SMEs and to raise the attention of

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<sup>1</sup> *Government direct R&D funding* includes grants, loans and procurement. *Government indirect R&D funding* includes tax incentives such as R&D tax credits, R&D allowances, reductions in R&D workers' wage taxes and social security contributions, and accelerated depreciation of R&D capital.

SMEs of the opportunities within utilisation of the knowledge of public research and technology institutions. The voucher can fund a maximum amount of about €14,000.

*Business Innovation Fund and Market Development Fund:*

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. The Fund has since then been converted into the Market Development Fund which helps firms bringing their new products to the market faster and which makes it easier for public-sector institutions to obtain innovative solutions. An amount of €20m is allocated for the Market Development Fund each year from 2013 up to and including 2015.

*R&D tax credit:*

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.

### **2.2.3 Thematic versus generic funding**

Project funding is also provided by research programmes, such as the programmes managed mainly by the Danish Council for Strategic Research, the Danish National Advanced Technology Foundation, the Energy technology, development and demonstration programme (EDDP, launched in 2008) under the Ministry of Climate and Energy, and recently the Green Development and Demonstration Programme (GDDP) under the Ministry of Food, Agriculture and Fisheries (launched in December 2009). The main funding source for the research programmes under the Danish Council for Strategic Research and the Danish National Advanced Technology Foundation is the Ministry of Science, Innovation and Higher Education. The Danish National Advanced Technology Foundation requires co-funding from industry.

The Danish Council for Strategic Research finances research based on politically defined programmes. Programme committees allocate funding. Thematic priorities are:

- sustainable energy production and use of energy;
- food, nutrition and health;
- Nanotechnology, biotechnology and ICT.

The Danish Council for Strategic Research has allotted €88m in 2012 to programme funded projects and centres of excellence in the following areas (DASTI, 2013):

- Health, Food and Welfare;
- Sustainable Energy and Environment;
- Strategic Growth Technologies;
- Peace and Conflict;
- Sustainable Transport and Infrastructure ;
- Individuals, Disease and Society;
- Strategic Platforms for Innovation and Research.

The research activities are carried out in public-private collaboration and with the involvement of end-users and international researchers.

*The Energy Technology, Development and Demonstration Programme (EDDP):*

The programme was launched in 2007 and is administered by the Danish Energy Agency under the Ministry of Climate and Energy. The total budget is €157.4m. The programme is based on annual fixed calls.

*Strategic Platforms for Innovation and Research (SPIR)*

Funding of combined research and innovation activities is another type of instrument. SPIR finances strategic research and innovation platforms within specific areas. In 2013 funding was granted to a SPIR – platform manufacturing. The call was launched by the Danish Council for Strategic Research and the Danish Council for Technology and Innovation, and both administer the programme.

Funding of the centers of excellence is the fourth type of instrument, mainly practiced by the Danish National Research Foundation. Funding is given to units based at research institutions (the vast majority at universities) sharing a common idea or vision and an overall and clearly defined set of research objectives. The centers must have a well-defined framework for cooperation. The foundation gives funding to basic research and frontier research. The first centers were established in the early 1990s.

## **2.2.4 Innovation funding**

There are several support schemes available addressing market failures in the provision of private funding for innovation, particularly for SMEs. Initiatives that target private R&D investments include 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. Moreover, the introduction of tax incentives for business R&D expenditures in 2012 provides a greater incentive for investing in R&D.

On the other side, funding for research is provided through the Danish Council for Independent Research which is responsible for researcher-driven research. The council funds research based in a responsive mode (without predefined focus, thematic areas or policy-related goals). Further, the Danish Council for Strategic Research administers strategic research programmes in areas of

political priority. It funds research projects and gives advice to applicants. The council is also contributing to increased university-industry collaboration. Moreover, the Danish National Research Foundation as well as private foundations provide innovation funding.

In that regard, it can be concluded that research versus innovation funding seems to be well-balanced.

### **2.3 Research and innovation system changes**

The Danish research and innovation system is composed of several actors, such as the Danish National Research Foundation, the Danish Council for Independent Research, the Danish Council for Strategic Research, the Danish Council for Technology and Innovation, the Danish National 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 2012-2013. However, the Danish government has started a process that is aimed at combining the Danish Council for Strategic Research, the Danish Council for Technology and Innovation, and the Danish National Advanced Technology Foundation into one single funding body: the Danish National Innovation Foundation. The process has been started in June 2013 with an invitation to the parties for initial negotiations (Danish Government, 2013b). An agreement has been reached in October 2013 that the new innovation fund shall be equipped with an annual budget of €200 million. The fund is expected to be operational in April 2014.

### **2.4 Recent policy developments**

In 2013, the Danish Government has launched 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). The process involved an extensive consultation with relevant stakeholders and actors in the innovation system. It is therefore expected that the innovation strategy will unfold its potential starting in 2013.

#### *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.



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.

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 depends 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.

#### *INNO+: The Innovative Denmark*

In connection with the new innovation strategy the Danish Government has started a process that led to the creation of the first INNO+ catalogue presented in September 2013 (Danish Government, 2013c). Based on the involvement of a multitude of actors from the innovation system and made in arm’s length to the politicians, INNO+ identifies 21 concrete focus areas for research and innovation that are geared towards finding solutions to the grand societal challenges. The thematic focus is on transportation, environment, urban development, food, bio-economy, health, production, digital solutions and energy. The Parliament has used the catalogue in the negotiations on the Budget Bill for prioritisation of five societal partnerships on innovation to be launched in 2014:

- Blue jobs via green solutions
- Intelligent, sustainable and efficient plant production
- Denmark as preferred country for early clinical testing on new medicines
- Water-efficient industrial production

- Innovatorium for building renovation of world class standard

Funding for the partnerships will be allocated by the coming foundation Denmark's Innovation Fund. Public authorities will contribute with knowledge and regulation.

INNO+ complements the previously introduced RESEARCH2020 initiative in that the catalogue focuses on the innovation policy that results from many of the same societal challenges and Danish strongholds in academia and industry that are outlined in RESEARCH2020. The RESEARCH2020 catalogue which was based on the involvement of a multitude of actors from the research system and made in arm's length to the politicians was published in June 2012 and 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.

The RESEARCH2020-catalogue has been used to prioritise strategic research investments on the Budget Bills of 2013 and 2014. Most of the funding has been allocated for research within the vision of a society with a green economy.

### *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 2014 that centre around education (Danish Government, 2013d). 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. About €335 million additional funds are set aside for these purposes. 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, 2013a). The Budget Bill 2014 also aims at supporting a higher number of students with SU study grants.

It can be concluded that funding for R&D and education has increased considerably over the period from 2011-2013, 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.

## **2.5 National Reform Programme 2013 and R&I**

In July 2012, Denmark received five country-specific recommendations from the Council of which one can be related to science, technology, and innovation (STI) policy. The Council recommends implementing measures to improve the cost-effectiveness of the education system, reducing drop-out rates, in particular within vocational education, and increasing the number of apprenticeships. A major step in this direction has been the reform of the state education grant system ("SU") and framework for higher education programmes in April 2013. The aim of the reform is to stimulate early entry to higher education and reduce the average study time for students in higher education. The reform consists of several initiatives, among others increased demands regarding progress in studies and a bonus for faster completion of the study programme. The Danish Government expects the reform to yield €295 million in savings by

2020 that will be invested into strengthening the competitiveness of the Danish economy (Danish Government, 2013e).

Besides the reform of the study grant system, the government has also established a vocational education committee whose task it is to provide recommendations for a long-term solution of the training place challenge as well as to increase the overall quality of the vocational education system. In connection to this, the government has also reached an agreement on better vocational education and training programmes and a strengthened education guarantee with the Finance Act Agreement for 2013 (Danish Government, 2013e). The objective of the agreement is, among other things, to contribute to reducing drop out in the vocational education and training programmes and increasing the number of pupils who enter in-company practical work experience.

Besides these measures that have been implemented, the government has also plans for several other measures that are expected to address the country-specific recommendations by the Council, for example regarding the educational quality in the primary and lower secondary school, the upper secondary education programmes, as well as adult and continuing education. In conclusion, the Danish government has clearly addressed the recommendations set out by the Council. The measures taken can be expected to contribute towards the objectives formulated in the National Reform Programme 2013.

## **2.6 Recent evaluations, consultations, foresight exercises**

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.

Recently, the Danish Agency for Higher Education has commissioned an evaluation of the Academies of Professional Higher Education (“Erhvervsakademier”). These institutions, of which there are nine in Denmark, offer two yearlong Academy Profession (AP) degree programmes as well as Professional Bachelor degree programmes in partnerships with university colleges. The subject focus of these academies lies primarily on technical and business-oriented education programmes. The evaluation has been carried out in the period from October 2012 to April 2013 by Rambøll Management Consulting (Rambøll, 2013). The evaluation concludes that the academies play an important role in achieving the government’s objective that 60 percent of a youth cohort should undergo a higher education programme. While the general quality of the education provided by the academies is assessed as good, the evaluation also shows quite some heterogeneity in the extent to which the academies achieve their objectives. The evaluation

outlines how those academies lagging behind may implement more systematic and strategic practices to assist them in the design of their educational programmes.

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.

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

Denmark and the Danish regions have been in the process of developing a strategy on smart specialisation. The information will be updated once the strategy has been officially communicated.

Already since 2006, the Danish government has established the Danish Growth Council which advises the government on the growth policy and changes for Denmark in the global economy (Danmarks Vækstråd, 2013). Its primary purpose is to promote coordination between the national growth strategy and the regional business development strategies. The latter are set by the regional growth fora in order to contribute to an effective and continuous process enhancing growth and business development in all parts of Denmark. There are currently five regions in Denmark: the Capital Region, Region Zealand, the North Denmark Region, the Central Denmark region, and the Region of Southern Denmark. In order to stimulate both national and regional growth policy, the Danish Growth Council contributes with new knowledge and new ideas focused on about one to two themes per year.

The Council has 20 members appointed by the Minister for Business and Growth. The chairman and the members are appointed for up to four years. They represent private firms, knowledge



institutions, local authorities, the six regional growth fora, labour unions and the employers' organizations. The Council strives to ensure a global focus through the learning from international experiences and international best practices. For that reason, the Council also invites international experts to contribute to the Council's discussions.

## 3 PERFORMANCE OF THE NATIONAL RESEARCH AND INNOVATION SYSTEM

### 3.1 National Research and Innovation policy

According to the Innovation Union Scoreboard 2013, Denmark is part of the group of innovation leaders that exhibit above average innovation performance (European Commission, 2013a). 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 2013, in which the country is grouped together with the peak performers Finland, Sweden and Switzerland (European Commission, 2013b). Table 2 gives an overview of selected Innovation Union Scoreboard indicators.

**Table 2: Overview of selected Innovation Union Scoreboard indicators**

<b>Human resources</b>	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2.1
Percentage population aged 30-34 having completed tertiary education	41.2
<b>Open, excellent and attractive research systems</b>	
International scientific co-publications per million population	1692
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	14.6
<b>Finance and support</b>	
R&D expenditure in the public sector as % of GDP	0.99
Public Funding for innovation (innovation vouchers, venture/seed capital, access to finance granted by the public sector to innovative companies)	0.104
<b>Firm activities</b>	
R&D expenditure in the business sector as % of GDP	2.09
Venture capital and seed capital as % of GDP	0.51
<b>Linkages &amp; entrepreneurship</b>	
Public-private co-publications per million population	179.9
<b>Intellectual assets</b>	
PCT patents applications per billion GDP (in PPP€)	7.04
PCT patents applications in societal challenges per billion GDP (in PPP€) (climate change mitigation; health)	2.30
<b>Economic effects</b>	
Contribution of medium and high-tech products exports to the trade balance (in % of total trade)	-2.77
Knowledge-intensive services exports as % total service exports	63.33
License and patent revenues from abroad as % of GDP	0.79

Source: Innovation Union Scoreboard 2013.

### 3.2 Structural challenges of the national R&I system

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 2013. Taking gross domestic expenditures on R&D as a proxy for R&D intensity, Denmark achieved 2.99 percent while the reference group achieved substantially more than 3 percent. Denmark had however a much better result than the European Union (2.06 percent) (estimate from Eurostat, December 2013). However, the average annual growth of public expenditure on R&D is falling behind both the reference group and the European Union (European Commission, 2013a).

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, 2013a). However, growth slowed down markedly with the global economic crisis. 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, 2013b).

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. 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 by the year 2020 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 face 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 mind-set 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.

For this reason, the Danish government has started a process that is aimed at combining the Danish Council for Strategic Research, the Danish Council for Technology and Innovation, and the Danish National Advanced Technology Foundation into one single funding body: Denmark's Innovation Fund. The process has been started in June 2013 with an invitation to the parties for initial negotiations (Danish Government, 2013b). An agreement has been reached in October 2013 that the new innovation fund shall be equipped with an annual budget of €200 million. The fund is expected to be operational in April 2014.

### 3.3 Meeting structural challenges

Several policy actions have been developed to meet the identified structural challenges. Table 3 provides an overview of how the policy mix addresses these challenges.

**Table 3: Assessment of the policy mix**

Challenges	Policy measures/actions addressing the challenge	Assessment in terms of appropriateness, efficiency and effectiveness
1. Lower R&D intensity than the peak performer reference group	R&D collaboration with GTS system Knowledge Vouchers for SMEs, Knowledge Pilots Business Innovation Fund/Market Development 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 on-going business development in sectors of high societal importance. Intelligent public procurement will probably strengthen R&D intensity through demand-pull innovation incentives.
2. 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.
3. 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.
4. Commercialisation of public research results	The Danish Foundation for Entrepreneurship – Young Enterprise (FFE-YE) Expansion of the capital base for the innovation environments Growth Fund	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

	Proof of concept Strategy for education and training in entrepreneurship Strategy for strengthening of entrepreneurial universities	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.
5. Creating a simplified funding system for research and innovation	The new innovation strategy is expected to outline policy actions to address this challenge. The new fund is called Denmark's Innovation Fund and is expected to be operational by April 2014.	Not yet implemented

To support these actions, the production of analytical reports and evaluations has become pivotal. Particularly the Danish Agency for Science, Technology and Innovation (DASTI) has been responsible for facilitating such policy developments over the last couple of years. 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 vouchers 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 contributed 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 percent shall complete higher education and at least 25 percent 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.

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, innovation vouchers 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.

## 4 NATIONAL PROGRESS IN INNOVATION UNION KEY POLICY ACTIONS

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### 4.1 Strengthening the knowledge base and reducing fragmentation

#### Promoting excellence in education and skills development

The share of human resources working in science and technology of the total workforce in Denmark has constantly increased over the last couple of years, from 49.4 percent in 2008 to 52.9 percent in 2012 (Eurostat, September 2013). The share of employees in R&D of the total labour force has also constantly increased to 1.96 percent in 2011. Almost 24,000 researchers are employed in the higher education sector, compared to almost 29,000 researchers in the business enterprise sector (most recent figures from 2010, Eurostat, September 2013).

Open and competition-based recruitment of researchers has been implemented at Danish higher education institutions and other public research organisations. Research job vacancies are published on the EURES Portal, the EURAXESS portal or at the job portals of the different organisations. The Ministerial order on the Appointment of Academic Staff at universities stipulates that positions at professor and associate professor levels have to be posted internationally. For assistant professor, post-doc or PhD levels positions (SGHRM, 2009) it is not mandatory but still common practice.

Universities Denmark declared its commitment to the European Charter for Researchers and the Code of Conduct for the recruitment of researchers in January 2009. Prior to this endorsement, the Charter and Code were debated by the Human Resources group, the Danish Committee of University Directors and the Danish Rectors' Conference. Universities Denmark and the Danish Agency for Universities and Internationalisation (UI) both argued that, overall, Danish universities met the European Commission's standards with regard to the Charter and the Code of Conduct. However, to date only one of the eight Danish universities, Copenhagen Business School (CBS), has been added to the list of "HRS4R Acknowledged Institutions". The recognition was awarded in 2012.

The Danish Council for Independent Research participates in the EUROHORCS initiative and its follow-up Science Europe, authorizing researchers moving to other countries to take the remainder of any awarded grant with them, while the DCSR has not signed the letter of intent 'Money follows researchers' (SGHRM, 2009).

Doctoral training in Denmark features both the "traditional" model of PhD education oriented towards internationally competitive education standards and a path referred to as the Industrial PhD Programme. The Industrial PhD Programme was established in Denmark in 1970 and has been a growing success ever since. It is internationally recognised for its combination of industrial experience and academic research. Since 2002, it has been part of the Danish Council for Technology and Innovation's umbrella of innovation promotion initiatives, and has been run on behalf of the council by the Danish Agency for Science, Technology and Innovation. The programme has been evaluated several times and in 2011 an impact assessment was conducted.

It was found that the programme has contributed to an increased absorptive capacity in the private sector that can be expected to facilitate knowledge and technology transfer from academia to industry and hence to foster innovation in firms.

### **Research Infrastructures**

The availability of high quality research infrastructures has been addressed in policy actions over several years. 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 Globalisation Fund includes funds earmarked to a comprehensive modernization of research infrastructure, including a green stimulus package and other measures. A 'road map' for the development of research infrastructure was to be developed, based on a mapping of the short-term and long-term infrastructure needs in the following six areas (DASTI, 2011a):

- material and nano technology;
- biotechnology, health and life sciences;
- physics and astronomy;
- energy, climate and environment;
- humanities and social sciences; and
- e-Science

EuroCenter under DASTI is the National Contact Point for FP7, together with the Danish EU Research Office in Brussels, and is specialised in information and advice to Danish researchers and enterprises and promotes Danish participation in FP7; other measures from DASTI include the START-scheme which provides grants during the proposal writing and negotiation phase. In most programmes under the DCSR and the DCTI foreign participation and cooperation is encouraged, through higher rankings in the evaluation process and through the inclusion of foreign research institutes in project consortia.

Moreover, in 2007 the Danish Government approved the Council of the European Union's conclusions about scientific information in the digital age. As a result of this, in March 2011 an appointed Open Access Committee published its recommendations on how to implement Open Access in Denmark. In 2012, all the Danish public research councils and foundations implemented their joint Open Access policy. Based on the green model of Open Access, this policy requires grant holders to seek permission to archive their research articles in institutional or subject-specific repositories no later than 6-12 months after publication. Through dialogue and collaboration with relevant stakeholders DASTI has been monitoring and analyzing the implementation of Open Access across Danish research institutions. As a result, in December 2013 a decision was taken to appoint the National Steering Group on Open Access. With representatives from all Danish universities, research councils and other relevant stakeholders the task of this group is to streamline the implementation of Open Access in Denmark. The National Steering Group on Open Access will commence its work in 2014.

## 4.2 Getting good ideas to market

### Improving access to finance

#### *The Growth Fund (“Vækstfonden”)*

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, 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). Initiatives that target private R&D investments include 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.

### Protect and enhance the value of intellectual property and boosting creativity

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.

### **Public procurement**

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.

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).

### **4.3 Working in partnership to address societal challenges**

One of the key points in the Innovation Union Plan is the formation of European Innovation Partnerships (EIP). EIPs are a new way of bringing together public and private actors at various levels to address the grand societal challenges such as climate change, energy and food security, health and an ageing population. At the same time, the grand challenges represent opportunities for new business. EIPs aim at giving the EU a first-mover advantage in these markets.

Denmark is involved in numerous initiatives, among them in 60 initiatives within the pilot EIP on Active and Healthy Ageing. Only few of those initiatives are single-country initiatives, i.e. only comprise Denmark, while the vast majority comprises seven and more countries. There is no systematic information available yet on Danish participation in the other EIPs.

### **4.4 Maximising social and territorial cohesion**

Denmark and the Danish regions have been in the process of developing a strategy on smart specialisation. The information will be updated once the strategy has been officially communicated.

Moreover, social and territorial cohesion is fostered by the establishment of regional growth fora of the five Danish regions: the Capital region, Region Zealand, the North Denmark region, the Central Denmark region, and the Region of Southern Denmark. Coordination between the national and regional level with regard to competitiveness and economic growth is achieved through the establishment of the Danish Growth Council in 2006 which advises the government on the growth policy and changes for Denmark in the global economy (Danmarks Vækstråd, 2013).

#### **4.5 International Scientific Cooperation**

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. Accordingly, both DCIR and DCSR welcome applications that comprise elements of international research cooperation, to support the best Danish researchers and groups of researchers in their efforts to coordinate and develop their cross-border research collaboration. DCIR and DCSR therefore make no requirements regarding the applicant's citizenship, to the registered office of the research institutions or to a specific geographical location for the implementation of the research activities in question, but in all events, the application will be assessed on the basis of whether the project applied for benefits Danish research. All the strategic research programmes with recent calls promote this openness. The rationale for this openness is to strengthen Danish research groups through cooperation with excellent researchers from third countries.

Furthermore, the Ministry of Science, Innovation and Higher Education encourages international cooperation with the following countries outside Europe through the International Network Programme: Brazil, China, Japan, Israel, India, The Republic of Korea and USA. The International Network Programme supports networking activities, scientific explorative workshops and visiting scientist grants, with the participation of researchers from Denmark and researchers from one or more of the seven countries mentioned above.

## 5 NATIONAL PROGRESS TOWARDS THE REALISATION OF ERA

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### 5.1 More effective national research systems

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.

The reform of the university system in Denmark has led to a high level of autonomy regarding management of research budgets and hiring of research personnel. The universities sign development contracts with the Minister for Science, Innovation and Higher Education, lasting for 3 years. These contracts are based on mandatory and self-imposed targets and describe the level of ambition for the universities in the included areas. A share of the universities' funding is based on performance indicators, with funding received as a lump sum, allowing autonomy to decide on its distribution. The government is not involved and does not interfere with the appointment of new researchers, but has defined the overall framework for how to proceed. However, this management process is due to the reforms of the university sector, mentioned earlier, and not based on staff democracy but on professional management. Decisions about researchers' salaries are delegated to the universities, but salary negotiations are determined by an agreement between the government and trade unions. The decision on research agendas or research specialisation is reserved by the university to ensure that the research is independent. However, the increased share of competitive funding for mission-oriented research, based on strategic priorities, means that on universities in these strategic areas align their research specialisation with nationally agreed priorities.

### 5.2 Optimal transnational co-operation and competition

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. 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.

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). 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 has opened three new innovation centres in New Delhi/Bangalore, Seoul and São Paulo. The innovation centres facilitate networks and partnerships between Danish and foreign researchers, educators and enterprises.

According to the JOREP project report, Denmark has participated in 22 joint programs in 2009 which corresponds to a total funding volume of 24m EUR or slightly more than one percent of GBAORD (JOREP Consortium, 2012). Denmark is found to have a stronger tradition of bilateral cooperation in comparison to European-level programs.

### **5.3 An open labour market for researchers**

Providing attractive employment and working conditions are priority areas in Denmark, since the employment system for public researchers generally displays a high level of flexibility (Steering group on human resources and mobility, 2009). When considering the cost of living, the level of remuneration for researchers in Denmark is high, but still below remuneration levels in the U.S. (European Commission, 2007). There are huge differences between the remuneration levels for the different levels of education in the public and the private business sector, both for employees with long-cycle higher education and for employees with PhDs.

The promotion of talent at higher education institutes is one of the priorities in the innovation strategy. A better framework for the development of a culture of talent shall be developed. Funding for increased enrolment in tertiary education programmes has been foreseen in the national budget for 2013. Denmark has attracted increasing numbers of researchers from EU-27 and third countries. The number of international PhD students has more than tripled since 2001. About 75% of the international PhD students take a grant in natural sciences or engineering. 18.5% of doctoral candidates come from outside Denmark, and here mostly from EU-27 and Asia, Middle East and Oceania (Mogu rou and Pietrogioacomo, 2007). The share of international PhDs who leave Denmark after getting their degree has increased from 7% in 2001 to 16% in 2010 (Universitets- og Bygningsstyrelsen, 2011).

### **5.4 Gender equality and gender mainstreaming in research**

The remuneration gap between men and women in Denmark is very small compared to other countries (below 5% after 15 years of working life). The difference in the annual average salary between men and women is 6%. However, there are differences between scientific domains in terms of remuneration gaps (European Commission 2007, table 65, based on Eurostat data). The 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.

In March 2013, the Danish Council for 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. In this context, the minister of science, innovation and higher education and the minister of gender equality discussed the introduction of special initiatives to enhance the chances of female researchers to access leading positions in research institutions.

Moreover, in 2013, the Danish Council for Independent Research commissioned a study on the role of gender in research and excellence (Det Frie Forskningsr d, 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.

An element in this conference was to follow up on the council's initiatives for female researchers in the last decade. The conference had two concrete outputs. Firstly, the council adopted a gender equality policy. This policy addresses issues such as transparency, the composition of the council, means and evaluation, and special initiatives. Secondly, the council proposed a concrete initiative to earmark funds targeted at female research leaders to continue the work that had previously been done in that area.

With the 2014 Finance Act the YDUN-programme (Younger women Devoted to a UNiversity career) has thus been allocated about €10 million. The Danish Council for Independent Research has allocated about €5 million of the own funds to the programme as well. YDUN is carried out in order to strengthen the utilisation of talent in Danish research by promoting a more balanced gender composition of the research environments in Denmark. The programme is operating through an exemption from the gender equality consolidation act; in case of equal qualifications between a male and female applicant, the application of the underrepresented sex is being prioritised.

It has to be noted that, despite the lack of more concrete measures, there is a very high degree of gender equality in Denmark which also extends into the research and innovation system.

## **5.5 Optimal circulation, access to and transfer of scientific knowledge including via digital ERA**

In 2007, the Danish Government approved the Council of the European Union's conclusions about scientific information in the digital age. As a result of this, in March 2011 an appointed Open Access Committee published its recommendations on how to implementing open Access in Denmark. In 2012, all the Danish public research councils and foundations implemented their joint Open Access policy. Based on the green model of Open Access, this policy requires grant holders to seek permission to archive their research articles in institutional or subject-specific repositories no later than 6-12 months after publication. Through dialogue and collaboration with relevant stakeholders DASTI has been monitoring and analysing the implementation of Open Access across Danish research institutions.

The Danish Ministry of Science, Innovation and Higher Education is currently analysing possible scenarios concerning the further implementation of Open Science in Denmark. As a result, in December 2013 a decision was taken to appoint the National Steering Group on Open Access. With representatives from all Danish universities, research councils and other relevant stakeholders the task of this group is to streamline the implementation of Open Access in Denmark. The National Steering Group on Open Access will commence its work in 2014.

Open Access to knowledge is an important issue for SMEs. In June 2011 a study was published on the levels of access to and use of research and technical information by knowledge-based SMEs in Denmark. The study revealed "barriers to access, access difficulties or gaps, and the costs and benefits involved in accessing research findings" (Houghton, Swan et al., 2011). The study was based on an online-survey and interviews and gave policy recommendations: "(i)

addressing information literacy and improving the capacity of SMEs to navigate the information landscape; (ii) addressing accessibility and affordability of access for SMEs; and (ii) responding to the expressed concerns and wishes” of SMEs.

Denmark also participates in the eduGAIN and eduROAM initiatives that are both aimed at easing the access to services and resources for the global research and education community. While eduGAIN enables the trustworthy exchange of information related to identity, authentication and authorisation by coordinating elements of the federations’ technical infrastructure and providing a policy framework that controls this information exchange, eduROAM provides both researchers and students at registered institutions with wireless internet access at all participating institutions. The Danish eID federation WAYF joined eduGAIN in July 2013.

## Annex 1. PERFORMANCE THE NATIONAL AND REGIONAL RESEARCH AND INNOVATION SYSTEM

Feature	Assessment	Latest developments
1. Importance of the research and innovation policy	(+) Innovation policy is a cornerstone in the Danish Government's ambition to foster competitiveness and growth.	(+) In connection with the new innovation strategy the Danish Government has started a process that led to the creation of the first INNO+ catalogue. Based on the involvement of a multitude of actors from the innovation system, INNO+ defines 21 concrete areas for research and innovation that are geared towards finding solutions to the grand societal challenges.
2. Design and implementation of research and innovation policies	(+) A well-developed funding infrastructure together with competent ministerial support ensure long-term commitment to innovation political aims.  (+) There is an innovation strategy in place ("Denmark – nation of solutions") that seeks to guide policy making in innovation related matters.	(+) The different research councils are to be merged into one entity from April 2014, Denmark's Innovation Fund.
3. Innovation policy	(+) Innovation policy is a cornerstone in the Danish Government's ambition to foster competitiveness and growth. It is actively promoted.	
4. Intensity and predictability of the public investment in research and innovation	(+) Denmark is among the countries with the highest GERD in the EU. Over the past couple of years, public investments into R&D have increased steadily.	
5. Excellence as a key criterion for research and education policy	(+) A substantial share of funding is allocated on a competitive basis.  (+) Bibliometric indicators are used in evaluations.  (+) Denmark offers attractive working conditions in scientific research. There is a special taxation scheme for researchers in place.	
6. Education and training systems	(+) The education system offers several different educational routes. Besides the university system, there are institutions such as Academies of Professional Higher Education ("Erhvervsakademier") and University colleges offering two to two and a half year long Academy Profession (AP) degree programmes and Professional Bachelor degree programmes.  (+) Entrepreneurship education is widely available.	
7. Partnerships between higher education institutes, research centres and	(+) 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	(+) The innovation strategy "Denmark – a national of solutions" contains 27 individual policy initiatives

<p>businesses, at regional, national and international level</p>	<p>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.</p> <p>(-) 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).</p> <p>(+) 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).</p> <p>(-) Nevertheless, the Danish business sector invests in R&amp;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&amp;D in collaboration with public research and the purchase of research results from public science.</p>	<p>to be implemented from the start of 2013. The individual initiatives can be grouped under the following headings (Danish Government, 2012c):</p> <p>(1) 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.</p> <p>(2) Integration of innovative competences and entrepreneurship in education programmes; closer coordination of education, research and innovation policy.</p> <p>(3) Active participation in the global knowledge and innovation network; better preparation of Danish companies and knowledge institutions for global development.</p> <p>(4) Securing better cohesion and impact in the innovation system; alignment of the innovation system with political priorities and the needs of users.</p>
<p>8. Framework conditions promote business investment in R&amp;D, entrepreneurship and innovation</p>	<p>(-) There is no favourable taxation regime for Venture Capital and/or business angels.</p> <p>(+) 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).</p>	<p>(+) A new system came into force that features a tax credit on R&amp;D expenditures. The tax credit amounts to 25 percent and is applied to the business expenses that relate to R&amp;D. A maximum of approximately €170,000 may be claimed per financial year.</p>
<p>9. Public support to research and innovation in businesses is simple, easy to access, and high quality</p>	<p>(+) National funding is allocated through international peer-review evaluation procedures and encourages trans-national cooperation.</p> <p>(+) There is an elaborate support infrastructure under the Ministry of Science, Innovation and Higher Education. The EuroCenter is located at DASTI and provides support for</p>	



	applications to EU programmes.	
10. The public sector itself is a driver of innovation	<p>(+) There has been an increased focus on easing the bureaucratic burden of the private sector by further digitalisation of public services.</p> <p>(+) Denmark has implemented policy initiatives related to public procurement of green innovations and in the health sector.</p>	<p>(+) 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 strategy can be expected to provide further innovation incentives to firms.</p>

## Annex 2. NATIONAL PROGRESS ON INNOVATION UNION COMMITMENTS

		Main changes	Brief assessment of progress / achievements
1	<b>Member States for Researchers' Training and Employment Conditions</b>	(+) First institution recognized in 2012 for being added to the list of HRS2R compliant institutions	<p>(+) All Danish universities have joined the 'Charter for Researchers' and the 'Code of Conduct for the Recruitment of Researchers'.</p> <p>(+) Denmark participates in international co-operation through the Europass Framework, and is active in implementing the Bologna Process on higher education, and the Lisbon Recognition Convention.</p> <p>(+) Universities Denmark and the Danish Agency for Universities and Internationalisation (UI) both argued that, overall, Danish universities met the European Commission's standards with regard to the Charter and the Code of Conduct. However, to date only one of the eight Danish universities, Copenhagen Business School (CBS), has been added to the list of "HRS4R Acknowledged Institutions". The recognition was awarded in 2012.</p> <p>(-) There is no systematic evaluation process in place yet with regard to the support instruments for researchers.</p>
4	<b>ERA Framework</b>	Covered by the ERA Communication Fiche	Covered by the ERA Communication Fiche
5	<b>Priority European Research Infrastructures</b>	n/a	<p>(+) The availability of high quality research infrastructures has been addressed in policy actions over several years. 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.</p> <p>(+) The Globalisation Fund includes funds earmarked to a comprehensive modernization of research infrastructure, including a green stimulus package and other measures.</p>
7	<b>SME Involvement</b>	n/a	n/a
11	<b>Venture Capital Funds</b>	n/a	<p>(-) No information is available on applications for EU Venture Capital funds passports.</p> <p>(-) There is no favourable taxation regime for Venture Capital and/or business angels.</p> <p>(+) 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</p>

			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).
13	<b>Review of the State Aid Framework</b>	n/a	n/a
14	<b>EU Patent</b>	n/a	(-) Denmark has not yet ratified the Unified Patent Court, which has received heavy criticism, particularly from the Danish Industry Association (DI).
15	<b>Screening of Regulatory Framework</b>	n/a	n/a
17	<b>Public Procurement</b>	(+) 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.	(+) 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 strategy can be expected to provide further innovation incentives to firms.
20	<b>Open Access</b>	n/a	(+) The implementation of Open Access is well under way among Danish universities and public research councils and foundations. As such, the public re-search 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.
21	<b>Knowledge Transfer</b>	(+) The innovation strategy “Denmark – a national of solutions” contains 27 individual policy initiatives to be implemented from the start of 2013. The individual initiatives can be grouped under the following headings (Danish Government, 2012c): (1) Increased cooperation between knowledge institutions, companies and other stakeholders to foster growth and employment; a higher	(-) 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).

		<p>focus on utilising research results, commercialisation and market maturation.</p> <p>(2) Integration of innovative competences and entrepreneurship in education programmes; closer coordination of education, research and innovation policy.</p> <p>(3) Active participation in the global knowledge and innovation network; better preparation of Danish companies and knowledge institutions for global development.</p> <p>(4) Securing better cohesion and impact in the innovation system; alignment of the innovation system with political priorities and the needs of users.</p>	<p>(-) 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&amp;D projects (Valentin and Jensen, 2007).</p> <p>(+) 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.</p> <p>(-) 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).</p> <p>(+) 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).</p> <p>(-) Nevertheless, the Danish business sector invests in R&amp;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&amp;D in collaboration with public research and the purchase of research results from public science.</p>
22	<b>European Knowledge Market for Patents and Licensing</b>	n/a	n/a
23	<b>Safeguarding Intellectual Property Rights</b>	n/a	n/a
24	<b>Structural Funds and Smart Specialisation</b>	<p>(+) Already since 2006, the Danish government has established the Danish Growth Council which advises the government on the growth policy and changes for Denmark in the global economy (Danmarks Vækstråd, 2013). Its primary purpose is to promote coordination between the</p>	<p>(+) Denmark and the Danish regions have been in the process of developing a strategy on smart specialisation. The information will be updated once the strategy has been officially communicated.</p>

		<p>national growth strategy and the regional business development strategies. The latter are set by the regional growth fora in order to contribute to an effective and continuous process enhancing growth and business development in all parts of Denmark. There are currently five regions in Denmark: the Capital region, Region Zealand, the North Denmark region, the Central Denmark region, and the Region of Southern Denmark. In order to stimulate both national and regional growth policy, the Danish Growth Council contributes with new knowledge and new ideas focused on about one to two themes per year. The Council has 20 members appointed by the Minister for Business and Growth. The chairman and the members are appointed for up to four years. They represent private firms, knowledge institutions, local authorities, the six regional growth fora, labour unions and the employers' organizations. The Council strives to ensure a global focus through the learning from international experiences and international best practices. For that reason, the Council also invites international experts to contribute to the Council's discussions.</p>	
25	<b>Post 2013 Structural Fund Programmes</b>	n/a	n/a
26	<b>European Social Innovation pilot</b>	n/a	n/a
27	<b>Public Sector Innovation</b>	n/a	n/a
29	<b>European Innovation Partnerships</b>	n/a	(+) Denmark is involved in numerous initiatives, among them in 60 initiatives within the pilot EIP on Active and Healthy Ageing. Only few of those initiatives are single-country initiatives, i.e. only comprise Denmark, while the vast majority

			comprises seven and more countries. There is no systematic information available yet on Danish participation in the other EIPs.
30	<b>Integrated Policies to Attract the Best Researchers</b>	(+) In the ongoing allocation of the globalisation funds, the Danish government aims at prioritising funds for Danish universities' participation in international university partnerships and networks. Priority will be given to the networks and partnerships where Danish universities gain access to cooperation with foreign universities that are among the world's leading universities.	<p>(+) The promotion of talent at higher education institutes is one of the priorities in the innovation strategy. A better framework for the development of a culture of talent shall be developed. Funding for increased enrolment in tertiary education programmes has been foreseen in the national budget for 2013.</p> <p>(+) Denmark has attracted increasing numbers of researchers from EU-27 and third countries. The number of international PhD students has more than tripled since 2001. About 75% of the international PhD students take a grant in natural sciences or engineering. 18.5% of doctoral candidates come from outside Denmark, and here mostly from EU-27 and Asia, Middle East and Oceania (Mogu�rou and Pietrogiacono, 2007).</p> <p>(-) The share of international PhDs who leave Denmark after getting their degree has increased from 7% in 2001 to 16% in 2010 (Universitets- og Bygningsstyrelsen, 2011).</p> <p>(+) 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.</p>
31	<b>Scientific Cooperation with Third Countries</b>	(+) In the ongoing allocation of the globalisation funds, the Danish government aims at prioritising funds for Danish universities' participation in international university partnerships and networks. Priority will be given to the networks and partnerships where Danish universities gain access to cooperation with foreign universities that are among the world's leading universities.	<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>(+) 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 New Delhi/Bangalore, Seoul and S�o Paulo.</p> <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 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</p>

			<p>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>
32	<b>Global Research Infrastructures</b>	n/a	<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>
33	<b>National Reform Programmes</b>	<p>The Council recommends implementing measures to improve the cost-effectiveness of the education system, reducing drop-out rates, in particular within vocational education, and increasing the number of apprenticeships.</p> <p>(+) A major step in this direction has been the reform of the state education grant system (“SU”) and framework for higher education programmes in April 2013. The reform aims at limiting the duration of the grant while at the same time demanding evidence of progress from students. Among other changes, the reform also implements a bonus for faster completion of the study programme. The Danish Government expects the reform to yield €295 million in savings by 2020 that will be invested into strengthening the competitiveness of the Danish economy (Danish Government, 2013e).</p> <p>(+) Besides the reform of the study grant system, the government has also established a vocational education committee</p>	n/a

	<p>whose task it is to provide recommendations for a long-term solution of the training place challenge as well as to increase the overall quality of the vocational education system. In connection to this, the government has also reached an agreement on better vocational education and training programmes and a strengthened education guarantee with the Finance Act Agreement for 2013 (Danish Government, 2013e). The objective of the agreement is, among other things, to contribute to reducing drop out in the vocational education and training programmes and increasing the number of pupils who enter in-company practical work experience.</p>	
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## Annex 3. NATIONAL PROGRESS TOWARDS THE REALISATION OF ERA

ERA Priority	ERA Action	Recent changes	Assessment of progress in delivering ERA
<b>1. More effective national research systems</b>	Action 1: Introduce or enhance competitive funding through calls for proposals and institutional assessments	No recent changes	(+) Denmark has already realised a strong focus on competitive funding allocation.
	Action 2: Ensure that all public bodies responsible for allocating research funds apply the core principles of international peer review	No recent changes	(+) Research funds are allocated based on the principles of international peer review.
<b>2. Optimal transnational co-operation and competition</b>	Action 1: Step up efforts to implement joint research agendas addressing grand challenges, sharing information about activities in agreed priority areas, ensuring that adequate national funding is committed and strategically aligned at European level in these areas	No recent changes	(+) Denmark is actively cooperating with other Nordic countries in joint programmes and institutions within the Nordic Council of Ministers.
	Action 2: Ensure mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions	No information available regarding this action	No information available regarding this action.
	Action 3: Remove legal and other barriers to the cross-border interoperability of national programmes to permit joint financing of actions including cooperation with non-EU countries where relevant	No recent changes	(+) 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.  (+) Denmark has innovation centres in hotspots around the world, which facilitates networks and partnerships between Danish and foreign researchers et al. During 2013 Denmark has opened three new centres in New Delhi/Bangalore, Seoul and São Paulo.
	Action 4: Confirm financial commitments for the construction and operation of ESFRI, global, national and	No recent changes	(+) The availability of high quality research infrastructures has been addressed in policy actions over several years. Public

	<p>regional RIs of pan-European interest, particularly when developing national roadmaps and the next SF programmes</p>		<p>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).</p> <p>(+) The Globalisation Fund includes funds earmarked to a comprehensive modernization of research infrastructure, including a green stimulus package and other measures. A 'road map' for the development of research infrastructure was to be developed, based on a mapping of the short-term and long-term infrastructure needs.</p>
	<p>Action 5: Remove legal and other barriers to cross-border access to RIs</p>	<p>No recent changes</p>	<p>(+) In most programmes under the DCSR and the DCTI foreign participation and cooperation is encouraged, through higher rankings in the evaluation process and through the inclusion of foreign research institutes in project consortia.</p>
<p><b>ERA priority 3: An open labour market for researchers</b></p>	<p>Action 1: Remove legal and other barriers to the application of open, transparent and merit based recruitment of researchers</p>	<p>No recent changes</p>	<p>(+) Open and competition-based recruitment of researchers has been implemented at Danish higher education institutions and other public research organisations.</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>Action 2: Remove legal and other barriers which hamper cross-border access to and portability of national grants</p>	<p>No recent changes</p>	<p>(+) The Danish Council for Independent Research participate in the EUROHORCS initiative and its follow-up Science Europe, authorizing researchers moving to other countries to take the remainder of any awarded</p>

			grant with them, while the DCSR has not signed the letter of intent 'Money follows researchers' (SGHRM, 2009).
	Action 3: Support implementation of the Declaration of Commitment to provide coordinated personalised information and services to researchers through the pan-European EURAXESS3 network	No recent changes	(+) 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, and is active in implementing the Bologna Process on higher education, and the Lisbon Recognition Convention. Recognising academic and professional qualifications from other countries is a prerequisite for foreign researchers to be able to apply for researcher positions in Denmark.
	Action 4: Support the setting up and running of structured innovative doctoral training programmes applying the Principles for Innovative Doctoral Training.	No recent changes	(+) Doctoral training in Denmark features both the "traditional" model of PhD education oriented towards internationally competitive education standards and a path referred to as the Industrial PhD Programme. The Industrial PhD Programme was established in Denmark in 1970 and has been a growing success ever since. It is internationally recognised for its combination of industrial experience and academic research.
	Action 5: Create an enabling framework for the implementation of the HR Strategy for Researchers incorporating the Charter & Code	No recent changes	(+) Danish universities met the European Commission's standards with regard to the Charter and the Code of Conduct.
<b>ERA priority 4: Gender equality and gender mainstreaming in research</b>	Action 1: Create a legal and policy environment and provide incentives	No recent changes	(+) With the 2014 Finance Act the YDUN-programme (Younger women Devoted to a UNiversity career) has been allocated €10 million. The Danish Council for Independent Research has allocated €5 million of the own funds to the programme as well. YDUN is carried out in order to strengthen the utilization of talent in Danish research by

			promoting a more balanced gender composition of the research environments in Denmark. The programme is operating through an exemption from the gender equality consolidation act; in case of equal qualifications between a male and female applicant, the application the underrepresented sex is being prioritised.
	Action 2: Engage in partnerships with funding agencies, research organisations and universities to foster cultural and institutional change on gender	No recent changes	(+) With the 2014 Finance Act the YDUN-programme (Younger women Devoted to a UNiversity career) has been allocated €10 million. The Danish Council for Independent Research has allocated €5 million of the own funds to the programme as well. YDUN is carried out in order to strengthen the utilization of talent in Danish research by promoting a more balanced gender composition of the research environments in Denmark. The programme is operating through an exemption from the gender equality consolidation act; in case of equal qualifications between a male and female applicant, the application the underrepresented sex is being prioritised.
	Action 3: Ensure that at least 40% of the under-represented sex participate in committees involved in recruitment/career progression and in establishing and evaluating	No recent changes	(-) No special initiatives have been developed yet.
<b>ERA priority 5: Optimal circulation, access to and transfer of scientific knowledge including via digital ERA</b>	Action 1: Define and coordinate their policies on access to and preservation of scientific information	No recent changes	(+) 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. In December 2013, a decision was taken to appoint the National Steering Group on Open

		<p>Access. With representatives from all Danish universities, research councils and other relevant stakeholders the task of this group is to streamline the implementation of Open Access in Denmark. The National Steering Group on Open Access will commence its work in 2014.</p>
<p>Action 2: Ensure that public research contributes to Open Innovation and foster knowledge transfer between public and private sectors through national knowledge transfer strategies</p>	No recent changes	<p>(+) There are several funding instruments which are targeted at increasing R&amp;D co-operation between the business sector and public research organisations. 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. In 2010, the Danish Council for Strategic Research and the Danish Council for Technology and Innovation launched a new initiative, inviting proposals for Strategic Platforms for Innovation and Research (SPRI). This policy measure targets inter-sectoral R&amp;D co-operation and improved linkages between research and innovation. The platforms will be funded for 5-7 years.</p>
<p>Action 3: Harmonise access and usage policies for research and education-related public e-infrastructures and for associated digital research services enabling consortia of different types of public and private partners</p>	No recent changes	<p>(+) In April 2012, the Danish e-Infrastructure Cooperation (DeIC) was created. The objective of DeIC is to support Danish science by making e-infrastructure such as computing, data storage and networks available to research and research-based teaching.</p>
<p>Action 4: Adopt and implement national strategies for electronic identity for researchers giving them transnational access to digital research services</p>	No recent changes	<p>(-) No special initiatives have been developed yet.</p>

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## LIST OF ABBREVIATIONS

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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 Council 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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