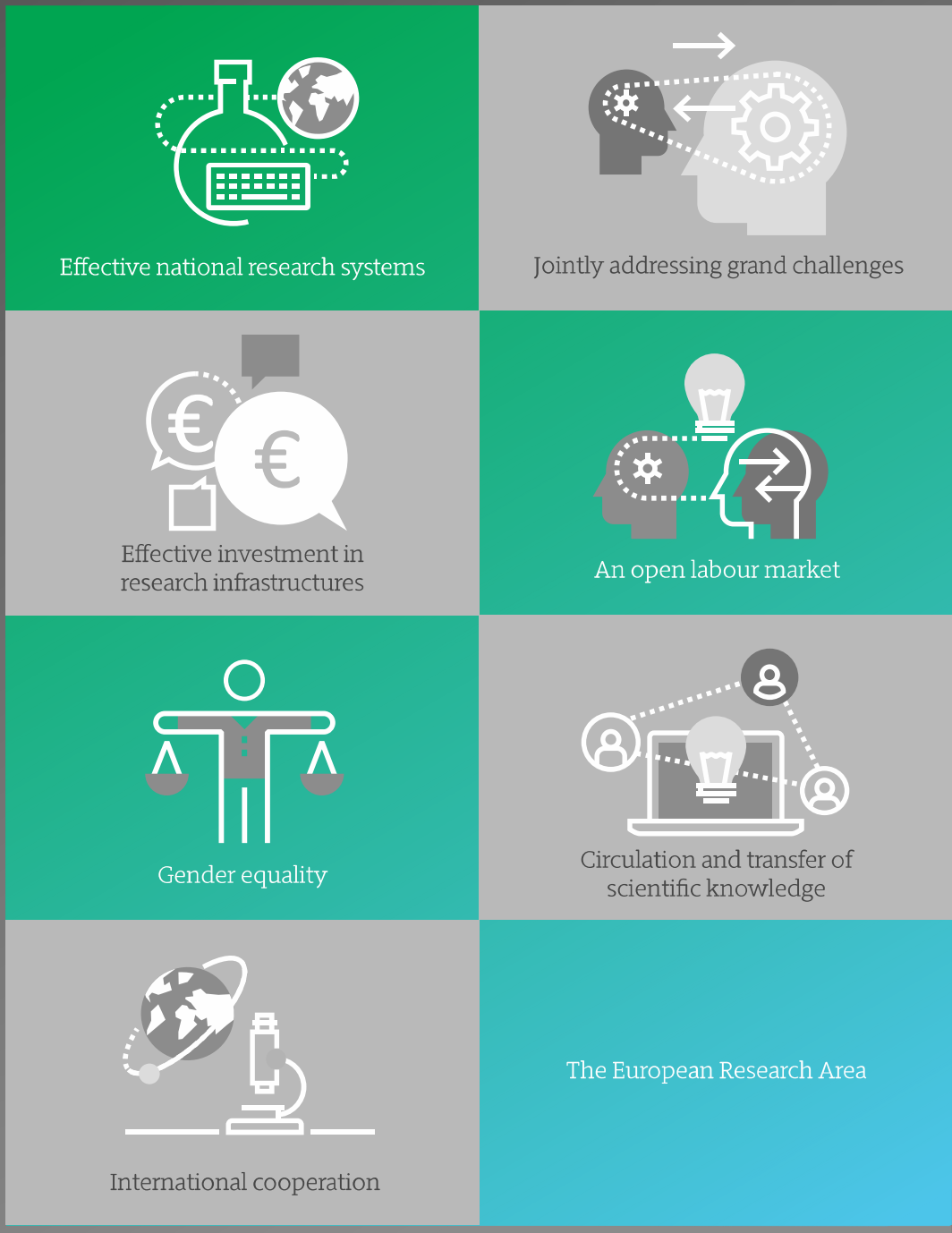
Danish Roadmap for the European Research Area 2016 – 2020



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1. Summary

Denmark is a small, open country competing on knowledge in a rapidly changing world, where research and innovation are increasingly being internationalised. Therefore, internationalisation of Danish research and the internal European market for knowledge – the European Research Area (ERA), where researchers, research institutions and enterprises move, compete and collaborate across national borders – is very important to Denmark. The further development of the ERA underpins the Government's ambition to ensure that Danish research communities are among the best in the world within select positions of strength, and that Denmark may contribute to – and benefit from – the opportunities created by globalisation for growth and job creation.

The Danish roadmap is based on the European roadmap for the further development of the ERA, which focuses on seven priorities. The Danish roadmap establishes a number of targets for the implementation of the ERA in a Danish context towards 2020, as well as actions and instruments for getting there. The roadmap is a living document, which can form a basis for dialogue on the ERA in research and innovation communities, and which will be revised concurrently with societal development and goals achieved along the way.

1. Effective national research systems
Over the past decades, a number of Danish reforms have been implemented with a view to developing a simple, transparent and coherent national research and innovation system that focusses on supporting the development of excellent research relevant to the challenges and needs of society. In the future, and thus also in 2020, Denmark must invest no less than 1 per cent of the country's GDP in publicly funded research. Within this framework, funds must be prioritised to ensure that they support Danish positions of strength and the needs of the private sector. Danish universities must be among the best in the world with, both in research and education. Denmark cannot be a leading player in all fields, but the Danish research communities must be first-rate within select fields and positions of strength.

2. Jointly addressing grand challenges
Grand transnational societal challenges are best handled together. Therefore, there must be a correlation between the research and innovation programmes – both as regards the Horizon 2020 framework programme and at national levels. It is in Denmark's interest that focus at European level is maintained on grand societal challenges, as the positions of strength of the Danish private sector and Danish knowledge institutions are to a large extent found in areas related to these challenges, including food, health, energy, climate and the environment. In 2020, Denmark must take active and focused part in strategically selected transnational research collaborations, which will increase Danish research excellence, create increased value for Danish research and innovation and favour both knowledge institutions and enterprises. Danish research and innovation must contribute to solving societal challenges and create growth, welfare and

jobs. Effective solutions presuppose the inclusion of multidisciplinary perspectives where relevant. This also applies within the framework of Horizon 2020. Denmark must therefore maintain a high level of involvement in Horizon 2020 and secure no less than 2.5 per cent of the total funds distributed.

3. Make optimal use of public investment in research infrastructure
It is vital that Danish and European researchers have access to state-of-the-art facilities to maintain their position among the best in the world. Research infrastructures also represent a competitive parameter as regards recruitment and retention of excellent foreign researchers. The Danish roadmap for research infrastructures 2015 sets out strategic guidelines for this future effort. In 2020, Denmark must participate in and have access to European research infrastructures that hold potential for and are relevant and of interest to Danish research and innovation communities, and there must be an increase in the level of Danish participation in projects under the Horizon 2020 programme for research infrastructures compared to current levels of participation. In 2020 the Danish Ministry of Higher Education and Science must act as a catalyst for investments in new Danish research infrastructures within all the main areas, as stipulated in the Danish Roadmap for Research Infrastructures, and compatibility with projects in the ESFRI Roadmap (European Strategy Forum for Research Infrastructures) will be a main evaluation criterion for the funding of new research infrastructures.

4. A free and open labour market for researchers
Increased mobility of researchers across national borders and sectors leads to increased research excellence. A common European labour market for researchers must be based on open, transparent and merit-based recruitment. In 2020, Denmark must continue to be among the European elite as regards the use of open, transparent and merit-based recruitment, and thus be attractive to foreign researchers. Vacant positions must be filled through fair competition between applicants and advertised in relevant fora, including the European job portal Euraxess, the aim of which must be to reach the European average number of advertisements. Students and young Danish researchers must, as a natural part of their studies or research employment, be mobile, and Danish universities must represent an attractive choice to foreign students and young researchers in line with the universities' own concrete goals.

5. Gender equality and gender mainstreaming in research
Better use of societal resources and better integration of the gender dimension within research contribute to promoting excellent research. Researchers must be recruited and promoted on the basis of their qualifications and the quality of their research. Everyone, regardless of gender, should have equal opportunities to pursue a career in research, if they so desire, and if they have the right qualifications. The existing recruitment imbalance within the research system should therefore be addressed, and in 2020 we should see a better use of all talents, regardless of gender. In line with the Equal Treatment Law, we should also see a more well-balanced gender distribution in the boards and managements of Danish research institutions.

The gender dimension should, to a relevant extent, be integrated into research and innovation policies, programmes and projects in line with the European ERA Roadmap.

6. Optimal circulation and transfer of scientific knowledge
In order to strengthen Europe's competitive position on knowledge and technology it is vital that new research-based knowledge is applied in society and in the private sector. Towards 2020, publicly funded innovation must be continually optimised through ongoing dialogue between

authorities and stakeholders within research and innovation, combined with systematic evaluation and documentation of efforts to circulate knowledge and technology. Investments in research and education must contribute positively to growth and development, also outside the university cities, and industrial development must be geographically well-balanced. The share of innovative enterprises, especially outside the large urban areas, must be increased, compared to the current level, through greater access to new knowledge and a highly educated work force. From 2022 and onwards, citizens must have unhindered, digital access to all Danish peer-reviewed research articles produced at Danish research institutions and published in 2021 and onwards. The research must be transparent in order to promote confidence in the results. Research integrity and responsible research conduct, including, among other things, documentation of the relevant data, should therefore be a main focus in the conduct of research at all Danish research institutions.

7. International cooperation

Internationalisation is a precondition for increasing the research production and for promoting excellent research and innovation. A main objective is therefore that the European Union and its Member States increasingly orientate themselves towards the wider world and open their research and innovation systems. This is in line with the existing internationalisation policy within education and research in Denmark. In 2020, the innovation centres must have created strong and well-established partnerships within research, higher education and business development with some of the world's leading innovation communities. New innovation centres may be established. Relevant Danish researchers, research institutions, Innovation Networks Denmark, the Advanced Technology Group (RTOs) etc. must be involved in concrete collaboration with global partners, and the efforts of growth consultants must result in improved framework conditions for research and innovation collaboration.

2. Introduction

Europe is currently facing large societal and economic challenges – possibly the biggest in the history of the European Union. Strong, new knowledge economies are growing rapidly, while climate change, poverty, disease, food shortages, conflict and migration are affecting the societal development at global level. Research, innovation and the utilisation of new technology are some of the methods for tackling societal challenges in a rapidly changing world, where the line between the digital and the physical dimensions is increasingly blurred, and where new knowledge is generated through global cooperation. To a small, open country like Denmark, which must compete on knowledge, internationalisation of research and innovation, the development of the European Research Area (ERA) is therefore central.

An internal knowledge market
The objective behind the ERA is to create an internal market for knowledge, research and innovation, where researchers, research institutions and enterprises move, compete and collaborate across national borders. This objective is at least as relevant and important to Denmark as when it was introduced alongside the Lisbon Strategy more than 15 years ago. The actualisation of the internal knowledge market will contribute to making Europe more dynamic and competitive, and is a precondition for fulfilling the political agenda introduced by the European Commission in the summer of 2015 under the headlines 'Open Innovation', 'Open Science' and 'Open to the World' – three strategic priorities for responding to three challenges:

- Research results are not to a sufficient extent being transferred to the market, and technologies developed in Europe are too often commercialised elsewhere.
- European research in some areas is falling behind, compared to the best international research – despite the fact that Europe is the global region with the largest research production.
- Europe's influence in an international context does not match the collective research strength and impact.

These are challenges that may best be solved through European cooperation.

The effect of investments
It has turned out to be particularly difficult to achieve the Barcelona objective of investing on average 3 per cent of the GDP in research and development. At the same time, evidence has shown that the countries that have managed to maintain a high level of investment in research and development are also the ones that have shown the best results in the wake of the global financial crisis. At European level, Horizon 2020 i.a. sets an ambitious target for European investment in research and innovation.

Focus will increasingly be on the impact of investments made over the coming years, where increasing pressure on public finances constitutes the foundation for the mid-term evaluation of the Multiannual Financial Framework (the MFF) and the framework programme for research and innovation, Horizon 2020. Denmark has a tradition for evaluating the instruments of the

research and innovation system and for being ready to introduce the required changes. Therefore, the Danish Government looks forward to the upcoming mid-term evaluations and expects them to generate a better understanding of how systems and instruments may be improved and optimised.

Seven political priorities

In 2014-2015 a European roadmap was produced, focusing on seven different areas[1]. Within each of these areas a top action priority, considered to be of special significance to the development of the ERA, has been identified. The priorities are:

- Effective national research systems
- Jointly addressing grand challenges
- Effective investment in and use of research infrastructures
- An open labour market for researchers
- Gender equality and gender mainstreaming in research
- Optimal circulation and transfer of scientific knowledge
- International cooperation

In 2015, the Council of Member States' ministers of research made a decision to translate the European roadmap into national roadmaps. The idea is for the national ERA roadmaps to constitute a framework, based on the seven priorities, for how individual Member States intend to promote these priorities at national level – while focusing on and acknowledging the great differences that exist between the research and innovation systems of the individual Member States.

The Danish roadmap is thus based on the seven select priorities. The priorities are to a large extent mutually reinforcing and cannot be pursued independently of each other. Thus, an effective national research system is vital to attracting the best foreign researchers; up-to-date infrastructures constitute significant venues for the transfer of scientific knowledge and are central to the creation of Open Access; and the transfer and greater use of scientific knowledge is linked to increased researcher mobility, also across sectors. At the same time, several cases reveal that an integrated approach to the priorities is necessary to fulfil the desired objectives.

World-class research – growth and job creation throughout Denmark

Implementing the ERA underpins the Government's ambition to ensure that Danish research communities are among the best in the world within select positions of strength, and that Denmark may contribute to – and benefit from – the opportunities created by globalisation for growth and job creation. The ERA will provide Danish research communities and enterprises with opportunities to be inspired by and get ideas from the wider world through strategic cooperation with the best foreign partners. Danish researchers will get opportunities to travel abroad and take home new, ground-breaking scientific knowledge, just as Danish research institutions will represent an attractive career choice to the best foreign researchers. Through better access to new knowledge the public and private sectors can develop more new products and services, and more innovative enterprises can be created, especially outside the large urban areas. This will create more knowledge-intensive jobs throughout the country.

[1] The European ERA roadmap was produced by the ERAC, which is a strategic advisory committee with official representatives from all the Member States. It advises the Council, the European Commission and the Member States on research and innovation.

Focus on Danish positions of strength
It will be a great advantage to Denmark that the European research cooperation maintains its focus on the grand societal challenges. The positions of strength of the Danish private sector and Danish research communities are to a large extent found in areas related to these challenges, including food, health, energy, climate and the environment. Incorporating these large societal challenges into efforts to prioritise public research funding creates a basis for solving future challenges.

A living document
The Danish roadmap will contribute to unfolding the ERA in a Danish context and render visible the priorities established, not least among actors in the research and innovation communities, which is a main setting for the implementation of the ERA. The development of the ERA will be an ongoing process, where the bar for goals to be fulfilled can always be raised and results achieved can create even higher ambitions. The Danish roadmap for the ERA will therefore be a living document, which forms a basis for dialogue on the ERA in research and innovation communities, and which must be revised concurrently with the societal development and the achieved goals. In this way, the roadmap may contribute to unfolding the political agenda on 'Open Innovation', 'Open Science' and 'Open to the World'.

3. Effective national research systems

Top action priority: Strengthening the evaluation of research and innovation policies and seeking complementarities between, and rationalisation of, instruments at EU and national levels.

Starting point

Over the past decades, the Danish research and innovation system has been strengthened and improved with a view to meeting the joint European and Danish goals for a more effective national system. A number of reforms have been implemented based on thorough analyses and reviews conducted by acknowledged international capacities. The objective of the reforms has been to develop a simple, transparent and coherent research and innovation system. Focus has been on promoting the development of excellent research through open postings, wide competition and excellence-promoting evaluation criteria. Concurrently, focus has been on promoting research that is more relevant in terms of the challenges and needs of society, and on translate research results into value creation and growth. The present Danish research and innovation system can be seen as an example of a well-functioning and well-calibrated system that matches the European Research Area and contributes positively to the objective of the ERA.

Research provides new knowledge and constitutes a main driver for the development of society. Denmark therefore gives priority to basic research as well as to application-oriented and challenge-based research. Publicly funded research creates a foundation for high-quality education and also provides access to new and useful knowledge that makes it possible to solve societal challenges. The results of the public research effort benefit all citizens and contribute to development in both the public and the private sector.

Where and how public research funding is invested is of great importance to society. To ensure that research investments secure the greatest possible value creation – not just in financial terms– requires ongoing development and calibration of the national research and innovation system. Among other things, the national research systems are structured in such a way that they interact with European and global research funding programmes, e.g. Horizon 2020, thus ensuring that Danish knowledge institutions as well as enterprises make optimal use of the total research funding programmes.

Relevant knowledge produced by Danish research and higher education institutions must facilitate growth and development within the Danish private sector. High-quality research contributes to the development of new products and services in the private sector, thus contributing to growth and job creation in Denmark. Therefore, the size of the investments is not the only signif-

icant factor; The capacity of the research and innovation system to promote excellent research of relevance to society and to translate research-based knowledge into innovative products and processes within the private sector, as well as new spin-off enterprises and thus growth and job creation, is also significant. Cooperation between knowledge institutions and small and medium-sized enterprises throughout the country is essential in this context. Relevant knowledge produced at Danish research and higher education institutions must also benefit the public sector, where, i.a., Danish universities and Danish university colleges play an important role in translating new knowledge and research into new solutions.

The Danish Ministry of Higher Education and Science is responsible for research, innovation, technology and higher education in Denmark and the ministry thus constitutes a main coordinating institution within the Danish research and innovation system. Several other ministries also contribute to the development of the overall Danish research and innovation system. Among these are the Ministry of Business and Growth, which is responsible for – amongst other things - regional innovation activities within the framework of the European structural funds, as well as the Danish Ministry of Energy, Utilities and Climate and the Ministry of Environment and Food of Denmark, which administers several funding schemes for development and demonstration projects, the so-called UDPs (Development and Demonstration Programmes).

The Ministry of Higher Education and Science undertakes institutional management and distribution of public, basic research funding among the eight universities, seven university colleges, nine academies of professional higher education and the maritime and artistic higher education institutions in Denmark. Likewise, the majority of the public competitive funding is distributed through the Danish Council for Independent Research, the Danish National Research Foundation and Innovation Fund Denmark. Furthermore, the ministry aims to strengthen the knowledge bridges between activities undertaken by Danish research and higher education institutions and small and medium-sized enterprises respectively, e.g. through Innovation Fund Denmark, the Advanced Technology Group (RTOs), Innovation Networks Denmark and the Innovation Incubators. An ongoing effort has been made to enable and encourage councils, foundations, institutions and networks to internationalise their activities in order to – among other things - give them the best possible opportunities to collaborate with relevant actors within the ERA. Also, law reforms have provided councils and foundations with greater authority to finance joint European research projects.

A main part of the implemented reforms has focused on Danish universities who receive the majority of Danish, public research funding. In 2004, a university reform was implemented with a view to strengthening university management and to secure greater interaction between the universities and the surrounding society. In 2007, a number of universities and governmental research institutions were merged and into forming a new structure consisting of the currently eight universities and three governmental research institutions. One aspect of the reforms has been to gear and encourage the universities to actively participate in research internationalisation and, in this connection, in the European Research Area.

In 2014, the university colleges also underwent a reform and in this context it was clearly stated that they are responsible for conducting practice-oriented and application-oriented research and development activities in close interaction with the labour market.[2]

[2] Act no. 936 of 25 August 2014

The establishment of Innovation Fund Denmark in 2014 has also played a main role in the Danish efforts to create a more effective innovation-promoting system. The objective of Innovation Fund Denmark is to financially support the development of knowledge and technology, including advanced technology, thus strengthening research and innovative solutions to create growth and jobs in Denmark. The fund was established to create a simpler and more flexible system consisting of fewer research funding bodies and was created through a merger between the Danish Council for Strategic Research, the Danish National Advanced Technology Foundation and parts of the Danish Council for Technology and Innovation. The ERAC peer review of the Danish research and innovation system, conducted in 2012, formed part of the reasons for establishing the fund.

The majority of Danish public research funding is distributed as basic funding to the universities, whom are free to decide how these are distributed internally between the individual research areas. Thus, basic funding is not targeted at specific subject or research areas. Basic funding enables the universities to conduct long-term planning and expand their capacities and it supports research-based teaching and contributes to supporting Danish research institutions' participation in international research programmes. A number of evaluations of, among others, the Danish Council for Independent Research[3], the Danish National Research Foundation[4] and the universities' knowledge cooperation[5] show that the Danish research- and innovation system is generally well-functioning. The evaluation reports conclude that there is no need for reform of the system, and that there is no need for altering the balance between basic funding and competitive funding.

Since 2007, the Ministry of Higher Education and Science has continuously analysed the effect of Danish research and innovation policies, and the ministry publishes a number of analyses and publications based on this work, including the annual science and innovation policy report, which in 2015 focused on the interplay between the private sector and publicly funded research with a special regional focus. In the future, effect analyses and evaluations will continue to represent a main tool in the continuous effort to create an effective research and innovation system in Denmark.

Status in Denmark

In 2016, public research funding constitutes approx. DKK 20.6 bn, or approx. 1 per cent of the country's GDP. It is therefore expected that Denmark continues to be one of the OECD member countries with the largest public research budget relative to the GDP. In 2014, Danish public research received DKK 2.3 bn from private and general foundations. This is a doubling since 2007.

In 2014, the Danish private sector invested DKK 36.3 bn in research and development in Denmark and, in addition, DKK 11.9 bn at international level. In 2014, the total research and development expenses of the private sector thus represented 1.89 per cent of the GDP.

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[3] UFM 2014, Evaluering af Det Frie Forskningsråd ('Evaluation of the Danish Council for Independent Research')

[4] UFM 2013, Evaluation of the Danish National Research Foundation

[5] UFM 2014, Vidensamarbejde under lup – evaluering af universiteternes erhvervssamarbejde og teknologioverførsel ('A study of knowledge cooperation – evaluation of the universities' cooperation with the private sector and technology transfer')

According to the 2015 Innovation Union Scoreboard, which compares the innovative capacity of EU Member States, Denmark comes in second after Sweden. And in 2014, 44.2 per cent of all Danish private companies were deemed innovative. [6]

Danish private companies and knowledge institutions have received more than DKK 2.7 bn from the EU framework programme for research and innovation, Horizon 2020. This corresponds to 2.6 per cent of the total funding distributed so far via Horizon 2020[7].

Over the past 15 years, the capacity of public research institutions for translating research into ideas and inventions applicable to the private sector has increased markedly. The number of inventions, patents and cooperation projects has increased, although recent years have seen an incipient tendency towards stagnation in commercialisation activities – though remaining at a historically high level.

Strategy and objectives towards 2020

In the future, and thus also in 2020, Denmark must invest no less than 1 per cent of the country's GDP in publicly funded research. Within this framework, funds must be prioritised to ensure that they support Danish positions of strength and the needs of the private sector.

Danish universities must be among the best in the world, both within research and education. Denmark cannot be a leading player in all fields, but the Danish research communities must be first-rate within select areas and positions of strength.

Closer cooperation must be established between universities and the private sector. The universities must organise their research activities to raise the current level of self-financing. Among the ways of doing so is via an increase in commercialisation or by attracting funding from enterprises or foundations.

Actions and instruments

In the spring of 2017, the Ministry of Higher Education and Science will publish the RESEARCH2025 catalogue, which will contain a list of highly promising fields of research for strategic investments, as seen from the perspective of the private sector, ministries, knowledge institutions etc. In the following five years, the catalogue will function as a knowledge basis for politicians and other actors in connection with the prioritisation and implementation of strategic research investments. Emphasis will be on incorporating the European dimension into the RESEARCH2025 catalogue.

An analysis will be conducted of the current Danish research efforts with a view to gaining knowledge on the effects of research investments. This work will begin during 2016 and will be conducted by an interdepartmental working group and international experts.

In 2016, the Ministry of Higher Education and Science will enter into dialogue with the higher education and research institutions and the local business promotion system - as well as regional incubators - on the dissemination of best practices in regional knowledge cooperation.

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[6] Statistics Denmark 2014, innovation is defined as the implementation of new products, production/work processes, marketing and organisation.

[7] As of 1 March 2016.

Innovation Fund Denmark must support research and innovation throughout the country and is therefore provided with better opportunities to improve its regional anchoring through physical presence. The Ministry of Higher Education and Science will thus ensure that Innovation Fund Denmark can place staff geographically close to the regional knowledge communities for a three-year period, beginning in 2016.

An evaluation of Innovation Fund Denmark must be undertaken by 2018. At the same time, an evaluation will be conducted of the Advanced Technology Group (RTOs), the Innovation Incubators and Innovation Networks Denmark in the Ministry of Higher Education and Science.

The Ministry of Higher Education and Science is currently developing evaluation frameworks and effect chains intended for future evaluations and impact measurements and as part of the ministry's ongoing supervision of the innovation actors.

In addition, work on a joint simplification package for all public Danish innovation systems will continue for the purpose of strengthening cooperation platforms, division of labour, coordination, administrative standardisation and simplification, as well as a shared evaluation system. In this context also, it will be considered how use of the 'Seal of Excellence' can benefit private companies.[8]

[8] The European Commission has launched the 'Seal of Excellence' - a European seal of approval for especially innovative enterprises. The seal will help enterprises find other potential sources of funding for the development of their ideas and make it possible for research funders to benefit from the international peer review that an enterprise has already received.

4. Jointly addressing grand challenges

Top action priority: Improving alignment within and across the Joint Programming Process and the resulting initiatives (e.g. Joint Programming Initiatives (JPIs)) and speeding up their implementation.

Starting point

In a time where the economic slowdown is putting budgets under pressure it is highly relevant to ensure that national and European research and innovation investments are used efficiently with a view to solving the grand societal challenges that cut across countries and regions and thus require a joint European, coordinated effort. Therefore it is vital to create alignment between the individual programmes – both within Horizon 2020 and at national levels. When national and European programmes and initiatives complement each other, Member States' positions of strength are used optimally, research excellence is increased, and better solutions are found in terms of the grand, societal challenges. The ERA-related group 'High Level Group for Joint Programming' (GPC) focusses specifically on alignment, and the objective behind establishing the European Joint Programming Initiatives (JPI) is precisely to align European research within select strategic areas, focusing on major, societal challenges. The JPIs were evaluated in 2016 and the evaluations generally suggest that the main challenge to making the JPIs function as intended is to ensure adequate involvement of member countries.

Transnational cooperation is of special interest to a small country like Denmark. Even though they maintain a high scientific level, attracting and maintaining the necessary knowledge and building the necessary capacity can be difficult for certain research communities. To develop the research within a given field it may be necessary to find international partners, and so transnational partnerships may be an effective tool. In addition, transnational partnerships promote internationalisation of research and innovation communities. Overall, transnational cooperation thus contributes to promoting research excellence in Danish research institutions. Therefore, a main priority of many research institutions and museums is to establish such international research networks.

It is in Denmark's interest that a focus is maintained at European level on grand, societal challenges, seeing as the positions of strength of the Danish private sector and Danish knowledge institutions are - to a large extent – linked to areas related to these challenges, including food, health, energy, climate and the environment. It is therefore important that Member States actively participate in identifying societal challenges and priorities in the creation of future framework programmes.

Since 2008, two catalogues, RESEARCH2015[9] and RESEARCH2020[10], have been produced in Denmark, containing suggestions for strategic research areas with a long-term focus on opportunities and challenges where Danish research and new scientific knowledge can be drivers for creating prosperity or may contribute to the realisation of key societal goals. Likewise, at European level, the transition from the EU's Seventh Framework Programme to Horizon 2020 has meant an increased focus on how research can contribute to solving the grand, societal challenges. RESEARCH2020 complements Horizon 2020 in a number of areas and has formed a basis for decisions regarding Danish participation in JPIs and ERA nets[11]. Likewise, a future RESEARCH2025 is expected to function as a point of orientation. In that connection, great emphasis will be placed on ensuring that the European dimension is incorporated into the RESEARCH2025 catalogue.

Status in Denmark

Several actions and instruments exist through which the European Commission and Member States aim to create alignment between national and European research and innovation programmes through joint strategic research agendas. A survey[12] from 2012 showed a large Danish commitment to a number of international programmes. These include e.g. JPIs, where Denmark currently participates in nine out of the existing 10; article 185 partnerships, where Denmark participates in all five initiatives; and the ERA net Cofund, where Denmark participates in 15 out of 27 ERA net Cofunds, launched under Horizon 2020. In addition, Denmark participates in three out of the existing five great European knowledge and innovation communities, the so-called KICs.

Denmark actively participates in a number of transnational research collaborations with other Nordic countries – mainly through the Nordic Council of Ministers. Denmark also takes an active part in European Cooperation in Science and Technology (COST), which is one of Europe's longest-running frameworks for cooperation in science and innovation. In the past five years, Danish researchers have participated in 84 per cent of all COST actions. The networks created through these collaborations often form a basis for other and more extensive transnational collaborations of various forms.

The majority of Danish research-funding organisations have the opportunity to support international cooperation between Danish and foreign partners. The Danish Council for Independent Research and Innovation Fund Denmark can direct up to 20 per cent of their funds to international activities, provided that the investment benefits Danish research. Innovation Fund Denmark thus plays a central role in Danish participation in transnational initiatives, and the foundation currently participates in a number of transnational initiatives. In addition, a number of ministries administer several development and demonstration project schemes, which provide an opportunity to co-finance Danish participation in co-financed EU partnerships.

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[9] UFM 2008, RESEARCH2015

[10] UFM 2012, RESEARCH2020

[11] The ERA net initiative is designed to, through network activities on research activities, increase cooperation and coordination of research activities at national and regional levels in the Member States.

[12] UFM 2012, Dansk deltagelse i Horizon 2020's samfinansierede initiativer – kortlægning og strategi ('Danish participation in co-financed initiatives under Horizon 2020 – survey and strategy').

In 2015, the Ministry of Higher Education and Science analysed the scientific impact of EU projects with Danish participation, as well as the long-term significance of EU projects to the participating companies[13]. One of the main results of the analysis is that scientific publications based on FP6 and FP7 research have greater citation impact than publications that result from support from the national public research councils and foundations. Also, companies that have participated in FP6 and FP7 research are prone to export more, grow faster and employ a large number of knowledge workers.

Danish research and innovation must contribute to solving societal challenges and deliver high-quality research. This also applies within the framework of Horizon 2020 where Denmark must continue to be a strong player and thus secure no less than 2.5 per cent of the total funds distributed through Horizon 2020. Creating successful research projects within the scope of Horizon 2020 presupposes great focus on the impact hereof. This requires close cross-disciplinary cooperation between research institutions and the private sector. A great and active commitment in European research and innovation programmes will be supported by a highly qualified and accessible information and counselling effort. In order to achieve synergy between the various national consultancies an EU-DK Support network has been established between the public Danish counselling and service offers within research, innovation and business promotion. The EU-DK Support network consists of 35 nationwide, regional and local institutions that advise Danish users about participation in EU programmes within research and innovation. Likewise, Danish applications for European research and innovation programmes receive support through a number of schemes, including the EUopSTART scheme, KIC funding and the 13 Horizon 2020 network projects supported by the network scheme, Horizon 2020-NET.

Strategy and objectives towards 2020
Towards 2020, Denmark will maintain its high level of commitment to Horizon 2020 and secure no less than 2.5 per cent of the total funds distributed.

In 2020, Denmark must take an active and focused part in strategically selected transnational research collaborations, which will increase Danish research excellence, create increased value for Danish research and innovation and favours both knowledge institutions and private enterprises.

Actions and instruments
Danish participation in the Horizon 2020 programme committees is supplemented by a number of so-called 'reference groups' with relevant experts. The Ministry of Higher Education and Science will establish a strategic reference group to discuss main strategic issues concerning Danish participation in Horizon 2020, including Danish participation in co-financed instruments.

In 2016-2017, the Ministry of Higher Education and Science will map the Danish participation in Horizon 2020, including in co-financed instruments. Based on this mapping a strategy and an action plan for future Danish participation in the EU Framework Programme for Research and Innovation will be developed.

In 2016, the Ministry of Higher Education and Science will establish a national ERFA network to support Danish participation in EU partnerships. The network will function as a platform for exchange of experiences and thus for building routine and capacity for Danish participation in

[13] UFM 2015, Effects of participation in EU framework programmes for research and technological development.

EU partnerships, debate about best practice and coordination at practical as well as strategic levels.

In 2016, the Ministry of Higher Education and Science will strengthen the EU-DK Support initiative, i.a. through targeted information activities and implementation of a funding scheme promoting outreach work targeted at new actors. In addition, support for the preparation of Horizon 2020 applications will continue through the EUopSTART scheme, just as the effort to promote Danish participation in KICs will continue.

In 2016, Innovation Fund Denmark will develop an international strategy establishing the priorities for its international cooperation. The fund's efforts include a targeted focus on international programmes, which will facilitate cooperation between Danish actors and strong international partners. This includes a specific focus on the programmes that are deemed to provide the best opportunities for creating growth, jobs and export.

5. Optimal use of public investment in research infrastructures

Top action priority: Making optimal use of public investments in RIs by setting national priorities compatible with the ESFRI priorities and criteria, taking full account of long term sustainability.

Starting point

It is vital that Danish and European researchers have access to state-of-the-art facilities to maintain their position among the best in the world. Research infrastructure is also a competitive parameter as regards recruitment and retention of excellent foreign students and researchers in Europe, just as research infrastructures constitute significant venues for the transfer of knowledge, innovation and technology between research and industry.

Traditionally, the national universities and research institutions have been responsible for the development and funding of research infrastructures and equipment. This will continue to be the case. However, a number of factors and development trends entail that part of the responsibility for research infrastructures is shifting towards national and European levels, demanding an active and coordinated effort by Member States.

First, research infrastructures have experienced marked growth because of new opportunities provided by information and communications technology. New and expensive supercomputers, advanced computer networks, digitalisation and the compilation of huge amounts of data have enabled scientists to handle large amounts of data and perform highly complex calculations. However, many existing research infrastructures require larger investments than was previously the case. One reason for this is that new research tools must often be tailor-made to fit the individual research project or community. In addition, research infrastructures are often so complex and advanced that new technological solutions are required for the facilities to work as intended. The consequence may be that the creation of new research infrastructures often exceeds the capacity of the individual institutions and instead requires national and European commitment.

At the same time, science becomes increasingly transnational. Scientific breakthroughs, many of the grand, societal challenges and many research questions and areas require large, unique international facilities that cannot be managed or used effectively by one country alone - or that depend on transnational compilation and processing of data. This can e.g. be done by establishing international research infrastructures through the creation of research facilities at a specific geographical location, which are difficult for one country to create on its own. However, it can

also take the form of binding network collaborations that underpin the coordination of and access to nationally distributed data and facilities. This increases the need and demand for international facilities and cooperation on infrastructures.

With a view to promoting the establishment of national research infrastructures and strengthening Danish participation in international research infrastructures, the Ministry of Higher Education and Science has established a permanent National Council for Research Infrastructures. The council is a forum for creating the basis for making decisions and agreements about the prioritisation, creation, continuation and funding of national and international research infrastructures - as well as research-supporting activities related to the use of research infrastructures.

The productive impact of research infrastructures on innovation and growth is not necessarily natural or automatic. In connection with a number of existing research infrastructures it has been pointed out that cultural, professional, organisational and financial barriers can hinder frictionless and efficient transferability. A targeted, national effort must address these challenges and help research infrastructures live up to their full potential within the research and innovation system in order to ensure that the transfer of knowledge and technology benefits enterprises and society.

A number of factors and development trends thus entail that the responsibility for research infrastructures is increasingly being centralised, requiring an active Danish and European effort.

Status in Denmark
Denmark has given high priority to ensuring accessibility, development and implementation of advanced research infrastructures – both at national, European and global levels.

At national level, Denmark has added a scheme for research infrastructure funding to the National Budget, through which more than DKK 1 bn has so far been distributed. The scheme supports the creation of national research infrastructures selected by the Minister for Higher Education and Science from a list of suggestions provided in the national roadmap for research infrastructures.

In December 2015, the Ministry of Higher Education and Science introduced a second roadmap for research infrastructures. The first roadmap was introduced in 2011 and 10 out of the 19 proposed research infrastructures were implemented. Six of these were associated with ESFRI (The European Strategy Forum for Research Infrastructures). The roadmap outlines a number of strategic guidelines for the ministry's work in the next few years and presents a catalogue of 22 proposals for new research infrastructures, which will form the basis of the ministry's national investments. Several of the proposals are directly linked to the ESFRI roadmap, which was also the case with the previous Danish roadmap from 2011. Great emphasis is placed on national anchoring, maturity and implementability of the infrastructures, and each proposal is expected to meet a number of assessment criteria, including, where relevant, the ability to cooperate with international research infrastructures, e.g. research infrastructures mentioned in the ESFRI roadmaps.

At European level, the Ministry of Higher Education and Sciences participates actively in the European working fora, including ESFRI. Denmark participates in 17 ESFRI research infrastruc-

tures, and this participation is funded through the Danish roadmap. Four projects are included in the catalogue of the new roadmap but have so far not received funding.

For a number of years, Denmark has provided funding for Danish and typically convention based memberships of a number of large, international research infrastructures – the so-called 'big science' facilities.

Special emphasis must be given to the European Spallation Source (ESS), seeing as Denmark is one of the host countries, and seeing as ESS is one of the largest European research infrastructure projects and central to Danish as well as European research in a number of areas. The research facility will be located in Lund and a data management and software centre in Copenhagen. The construction work began in September 2014 and the ESS is expected to deliver the first neutrons for research purposes in 2019. The construction costs approx. DKK 14 bn of which approx. 50 per cent is provided by the host countries, Sweden and Denmark. In the years 2014-2022, Denmark will invest approx. DKK 2 bn in the ESS.

In 2015, the direct investments of the Ministry of Higher Education and Science in research infrastructures amounted to approx. DKK 787 m. Of this amount, 38 per cent went to conventional memberships, 42 per cent to other international memberships, 11 per cent to unique, Danish infrastructures, and the remaining nine per cent went to the scheme for research infrastructures and the implementation of projects in the national roadmap.

The total budget of Horizon 2020 for research infrastructures in the period 2014-2020 is just under 2.5 bn euros and also provides opportunities for funding European projects not exclusively related to ESFRI. However, this does not benefit Danish research communities to a sufficient extent. At the preliminary review in March 2016, the level of Danish participation in the first calls under the sub-programme for research infrastructures was considerably lower than for the total Danish participation in the entire framework programme.

Strategy and objectives towards 2020

In 2020 Denmark must participate in and have access to European research infrastructures that hold potential for and are relevant and of interest to Danish research and innovation communities, and there must be an increase – compared to the current level - in the level of Danish participation in projects that come under the Horizon 2020 programme for research infrastructures.

In 2020, the Ministry of Higher Education and Science must act as a catalyst for investments in new Danish research infrastructures within all the main areas c.f. the Danish Roadmap for Research Infrastructures, and compatibility with projects in ESFRI Roadmap (European Strategy Forum for Research Infrastructures) will be a main evaluation criterion for the funding of new research infrastructures.

Actions and instruments

In the coming years, investments will be made in no less than 15 of the roadmap's proposals for new research infrastructures and proposals for more ESFRI-relevant projects, pending the results of future national budget negotiations. Overall, emphasis will be on ensuring that all main fields of science in the long term receive funding. This will take place over a period of years through implementation of the Scheme for Research Infrastructures and/or private funds, and

by allowing the roadmap's catalogue of proposals to serve as inspiration for research foundations and other actors.

The aim is to sign three new agreements for Danish participation in new European research infrastructures (ERICs) within the next five years, giving Danish research and research infrastructures access to new data and strengthening Danish participation in European research communities.

Within the next five years, the Ministry of Higher Education and Science will strengthen counselling and guidance services for Danish research communities on the opportunities provided by research infrastructures at national as well as European levels.

New national investments in research infrastructures will require that explicit admission policies are drawn up and that a tailor-made policy for cooperation with the private sector is produced.

A dialogue will be initiated with the Advanced Technology Group (RTOs), focusing on their role in research infrastructures, and in the fall of 2016, a national conference will be held on research infrastructures' contribution to innovation and growth.

6. An open labour market for researchers

Top action priority: Using open, transparent and merit based recruitment practices with regard to research positions.

Starting point
The creation of a joint, open, European labour market for researchers was a key element in the ERA, when it was introduced alongside the Lisbon Strategy. The current level of transnational research cooperation within the EU is very different from the level 15 years ago, and mobility has to a large extent become a natural part of a research career. However, mobility can be further increased – both across national borders and between sectors.

Increased researcher mobility across national borders leads to increased cooperation and competition between research institutions. This contributes to increasing the critical mass and thus the basis for research excellence and for creating a framework for recruitment of the best candidate for a given research position. Open and merit-based recruitment also contributes to creating clearer carrier paths, making a research career an attractive choice and thus retaining the best researchers.

Mobility across sectors may also contribute to increasing research excellence. In Europe, relatively few researchers are employed in the private sector, while the number of newly qualified PhDs continues to rise. Although Danish PhDs, compared to PhDs from other countries, are generally successful in finding employment in the private sector[14] it is still possible to increase cooperation and knowledge sharing between research institutions and the wider society, including the private sector. From 2003 to 2010, the PhD intake doubled to approx. 2,400 new PhD students a year and this level has been retained. In the following years, the effect of the increased PhD intake has been subject to debate, including whether this high level should be maintained. In 2016, the Ministry of Higher Education and Science will undertake an analysis to create a solid and complete up-to-date analytical basis for assessing past efforts and any needs for adjustment.

One of the identified barriers to the creation of a joint, open, European labour market for researchers is that recruitment at European level is not sufficiently open, transparent and merit-based. Studies[15] suggest that European research positions are often targeted at national or internal candidates. Member States have agreed on the challenge of using open, transparent and merit-based recruitment as their top action priority in connection with the European ERA

[14] OECD 2014, Careers of Doctorate Holders 2014

[15] The European Commission 2013, MORE2 Study on Mobility Patterns and Career Paths of Researchers

roadmap, although the Member States do acknowledge that other challenges exist, such as different conditions for remuneration and employment and the opportunity to move retirement savings across Europe.

Status in Denmark

In Denmark, the past years' reforms of the higher education system have, among other things, given the universities a high degree of autonomy as regards the recruitment of researchers and other staff within the framework of national rules and legislation in the area. Conditions of employment in Denmark are perfectly aligned with the recommendations provided in the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers. To further create an attractive labour market for foreign researchers in Denmark a special tax system for researchers has been established under which foreign researchers in Denmark can get a tax reduction for a period of up to five years. It is also possible for foreign researchers in a temporary position of up to five years[16] to receive with their wages the part of their wages that is otherwise allocated to compulsory pension savings.

The Danish universities typically focus on educating, retaining and attracting the best researchers, and recruitment of researchers is generally based on open, transparent and merit-based processes. One example is that national and international recruitment of qualified PhD scholars is a main part of the effort to ensure quality of the PhD programmes. However, studies of the previous employment of newly appointed professors, associate professors and assisting professors indicate that candidates for positions at this level to a large extent are recruited from within the organisation, which means a potential for increasing mobility remains.

In Denmark inter-sectorial researcher mobility is supported, among other things, by the industrial PhD programme, which has existed in its current form since 2002. The programme facilitates combined employment in a university and a company to promote inter-sectorial knowledge sharing. In 2011, the programme was extended with an industrial postdoc programme.

Danish universities support the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers. Two universities (UCPH and CBS) have been certified by the European Commission for HR excellence in research, and all the universities are focusing actively on their HR strategies, including recruitment processes. In recent years, the universities have generally increased their HR efforts to attract foreign researchers, e.g. through the creation of special support units that offer guidance on practical matters in connection with recruitment, moving, retention etc. The Horizon 2020 mobility programme Marie Sklodowska-Curie Actions, where Denmark's total success rate is 3.7 per cent, supports the recruitment of foreign researchers to Denmark.

Danish universities are under obligation to publicly advertise vacant positions and to advertise positions at associate professor and professor levels internationally. Vacant positions are to a lesser extent advertised through the European job portal Euraxess, where only 13.0 positions per 1,000 public researchers were advertised in 2013. By comparison, the European average was 43.7. A Danish Euraxess steering committee has been established, where all the universities, among others, are represented, and where it is possible to discuss the barriers facing Danish

[16] Though up to six years, when agreed between the employment authority and the organisation authorised to negotiate.

institutions when using the Euraxess portal, as well as the time frame for advertising vacant positions.

The MORE2 Survey from 2012 showed that 65 per cent of the Danish researchers questioned found that vacant positions at their research institution were sufficiently advertised – which places Denmark among the most successful in Europe. The survey also showed that - according to the universities - essentially all positions are advertised. However, Danish figures (2013) showed that 24 per cent of the 1,903 positions at professor, associate professor and assistant professor levels filled in 2013 had not been externally advertised. The relatively high share of positions filled without external advertisement can, among other things, be explained by the opportunities given under Danish employment law for exemption from the rules on advertisement, e.g. in connection with short-term temporary positions.

65 per cent of the researchers appointed for positions at professor, associate professor and assisting professor levels in 2011-2013 were recruited internally, meaning that the researchers were already employed at the university where they found new employment. This applied to 74 per cent of the positions at professor level, 76 per cent of the positions at associate professor level and 56 per cent of the positions at assistant professor level, while 21 per cent came from positions abroad. The share of university researchers recruited from the private sector has been stable at four to five per cent since 2001.

Furthermore, it appears that even though the formal framework for open, transparent and merit-based recruitment is well-integrated at Danish universities, a certain number of the vacant positions are considered 'filled in advance'. In 2011-2012, 16 per cent of the advertised positions only attracted one applicant. This represents, however, an improvement compared to the years 2007-2009, where 27 per cent of the advertised positions only attracted one applicant.

The universities focus on attracting the best international candidates for PhD positions and on increasing their share of young researchers who - as part of their research training - spend time at foreign research institutions. According to the Danish PhD Order, PhD students must participate actively in research communities, and according to the guidelines this is best done through stays of some duration, e.g. three to six months, in other research institutions, mainly abroad[17]. In 2012-2013, approx. 33 per cent of the PhD students enrolled in Danish PhD programmes were international PhD students. The distribution of international PhD students across the subject areas is not uniform and is concentrated in the scientific and technical disciplines. Some Danish universities have made an effort to increase their share of international PhD students in the areas with the smallest representation of international PhD students.

There is some correlation between international student mobility and international researcher mobility, and Danish universities generally focus on promoting temporary studies or work placement abroad among their master students as part of their degree programme.

Strategy and objectives towards 2020

In 2020, Denmark must continue to be among the European elite as regards the use of open, transparent and merit-based recruitment, and thus be attractive to foreign researchers. Vacant positions must be filled through fair competition between applicants and advertised in relevant fora, including Euraxess, to reach the European average number of advertisements.

[17] Guidelines no. 9635 of 09/10/2013

Students and young Danish researchers must, as a natural part of their studies or research employment, be internationally mobile, just as Danish universities must represent an attractive choice to foreign students and young researchers in line with the universities' own concrete goals.

By 2020, the knowledge circulation between research institutions and the private sector must be optimised, which hinges, among other things, on well-functioning inter-sectorial researcher mobility.

Actions and instruments

In 2016, the Ministry of Higher Education and Science in cooperation with the think tank DEA will undertake an analysis of the impact of internationalisation on the quality of the research conducted in Danish research communities. Focus will be on international mobility and international recruitment. The analysis will be followed up with conferences and debates.

In 2016, the Ministry of Higher Education and Science will undertake a targeted communication effort and improve the opportunities for guidance on Marie Sklodowska-Curie for researchers as well as enterprises, e.g. through targeted events for small and medium-sized companies, with a view to increasing their participation in the programme.

The Danish Council for Research and Innovation Policy is currently surveying the barriers to increased inter-sectorial mobility. The survey will result in a number of recommendations for central as well as decentralised actors to be presented in 2016.

In 2016, the Ministry of Higher Education and Science will undertake a study of the effect of the increased PhD intake, including an analysis of the internationalisation of PhD students. Focus will be on examining the universities' current efforts – and possible future efforts – to recruit the best international talents. The study will also determine whether Denmark has the capacity to retain international PhD candidates after graduation, thereby benefitting from the significant knowledge capacity of this group.

In 2016 and the coming years, the Ministry of Higher Education and Science will actively involve the Euraxess steering committee in a survey of the barriers to using the Euraxess portal.

7. Gender equality and gender mainstreaming in research

Top action priority: Translating national equality legislation into effective action to address gender imbalances in research institutions and decision-making bodies and integrating the gender dimension better into research and innovation policies, programmes and projects.

Starting point

For many years, European research cooperation has focused on creating a better framework for utilising the European knowledge resources through increased gender equality and through better integration of the gender dimension in research. Sufficiently excellent research requires attraction and retention of the best talents, regardless of gender. Despite focus and actions to increase gender equality, Europe has still not managed to secure adequate participation of both men and women in European research. This was established by EU Member States' Ministers for Science who in their Council Conclusions from December 2015 once again highlighted that gender equality and integration of the gender dimension into research is necessary to secure sufficient quality, breadth and relevance of European research.

Recruitment and retention of the most competent research talents in Danish research institutions is a prerequisite for Denmark to continue to be among the leading research countries in Europe. This requires using the potential of the entire talent pool and thus also the increasing share of highly educated women.

The gender dimension should to a relevant extent be integrated into research and innovation policies, programmes and projects. For instance, physiological differences between men and women may entail the need for different treatment in connection with illness. Moreover, cultural and social differences can affect the norms, roles and patterns of behaviour of men and women, respectively. Failure to systematically consider the gender dimension in the design, evaluation and implementation of research may entail that important points are missed or, at worst, that erroneous conclusions are made.

Status in Denmark

In Denmark, more women than men complete a long-cycle higher education, and almost the same number of men and women complete a PhD programme. Nevertheless, only about one third of Danish researchers are female. The share of female professors in Denmark is just under

20 per cent, and women only represent 21 per cent of university management (rectors, pro-rectors, university directors, deans and heads of department).

The share of female researchers has increased in recent years and the share of female researchers has increased in all levels of employment and in all disciplines. Despite the positive development, Denmark is still below the EU average as regards the share of female researchers.

University management has a key responsibility in terms of securing good and equal conditions for recruitment and promotion of male and female researchers. Therefore, most Danish universities have created management strategies for increasing equality and some have integrated gender equality into general diversity strategies. Certain universities have also appointed gender equality or diversity committees.

The universities have launched a number of concrete activities to ensure that more talents, regardless of gender, wish to pursue a research career. Among other things, the question is how best to support the development of female research talent, how to secure equal conditions for competition for research positions, how to create a better work culture and a work environment to support this development, and how to make sure more women are part of research and university management. An increased focus on creating clearer career paths is also key to retaining more female talents.

These actions range from a focus on securing a high completion rate among PhD students, through transparency as regards career paths and demands on applicants, to easy access to statistics with gender-specific data. Some of the actions launched by the universities aim to ensure that assessment committees (in some cases appointment committees) consist of both male and female members, and that young researchers are offered guidance on career paths and mentoring.

Research-funding organisations focus on gender differences and have taken steps to prevent that application requirements etc. unintentionally give preferential treatment to male applicants. This includes allowing for periods of parental leaves of absence when dealing with applications with limits to applicants' age at the time of application. Also, the Danish research funding organisations continually monitor their funding practices, to make sure male and female applicants are faced with the same opportunities and conditions in practice, when they apply for and are granted research funding.

As state institutions the universities are subject to the Equal Treatment Act. This means that universities should strive towards achieving equal gender distribution vis-à-vis their boards and management bodies. All the universities, except for two, live up to the Equal Treatment Act's goal of equal gender distribution across their boards. An effort is also made to secure equal gender distribution in the research councils and boards of the foundations.

There is broad focus on integrating relevant gender aspects into research, and certain actions have been launched to deal with the issue on a systematic basis. The graduate schools of certain universities have launched actions to integrate relevant gender aspects into a given area, e.g. project planning and research funding applications. A few actions have also been introduced within the research funding system, e.g. specifying in various calls that applicants are expected to account for the gender dimension when applying for funding.

Horizon 2020 applications must account for relevant gender aspects, which are also taken into consideration in the evaluation process. Therefore, the Danish EuroCenter - under the Ministry of Higher Education and Science – has included advice on how to account for the gender dimension in its general guidance to applicants on Horizon 2020 applications and project design.

Strategy and objectives towards 2020
Researchers must be recruited and promoted on the basis of their qualifications and the quality of their research and teaching. All citizens, regardless of gender, should have equal opportunities to pursue a career in research if they so desire and if they have the right qualifications. The existing recruitment imbalance within the research system should therefore be addressed and in 2020 the use of talent, regardless of gender, should be improved.

In line with the Equal Treatment Law, the gender distribution vis-à-vis boards and management of Danish research institutions should be well-balanced.

The gender dimension should, to a relevant extent, be integrated into research and innovation policies, programmes and projects in line with the European ERA Roadmap.

Actions and instruments
Towards 2020, universities will continue to develop and implement equality action plans and to launch concrete actions tailored to the individual institution. Once a year, the universities must report the gender distribution of their boards and management to the Ministry of Higher Education and Science (cf. the Equal Treatment Law).

Some universities have in their three-year development contracts with the Ministry of Higher Education and Science set concrete goals for increasing the share of women in academic positions (SDU) or the share of female applicants for professor positions (CBS).

The research funding organisations will continue to focus on gender equality and to monitor the development with a view to securing equality of opportunities.

Once a year, the Ministry of Higher Education and Science will publish key figures on the share of male and female researchers respectively in Denmark – including data on applications and grants from Danish public research funding organisations as divided between male and female researchers.

The Ministry of Higher Education and Science will continue to advise potential Horizon 2020 applicants on the importance of integrating the gender dimension into their research.

8. Optimal circulation and transfer of scientific knowledge – A

Top action priority 1: Fully implementing knowledge transfer policies at national level in order to maximise the dissemination, uptake and utilisation of scientific results. Transfer of knowledge should be an integrated part of the day to day work of research institutions and research funding organisations.

Starting point

In order to strengthen the European countries' competitive position on knowledge and technology it is a main objective of the ERA that new research-based knowledge is applied in society and in the private sector. Member States are therefore encouraged to promote the dissemination and utilisation of scientific knowledge. Transfer of knowledge should be among the main objectives of public research institutions as well as national research- and innovation-funding organisations. A well-functioning ERA should be characterised by cooperation, knowledge sharing, networking and mobility between public and private research performers, and copyright should not prevent the circulation of knowledge. In addition, it should be easy to establish start-ups, and students should receive entrepreneurship training. In a well-functioning ERA, active knowledge sharing and its socioeconomic impact are monitored.

Status in Denmark

Denmark is at the forefront as regards meeting ERA goals for knowledge transfer. Since the launch of the current evaluation in 2005-2006, Denmark has been among the leading countries in the European Commission's annual Innovation Union Scoreboard. This position is to a large extent a result of Denmark's well-developed ecosystem of research-performing and research-funding organisations, which promotes public-private cooperation on research and innovation as well as circulation of new knowledge to small and medium-sized enterprises:

- Most universities have developed science parks and incubators that contribute to the creation of new knowledge-based start-ups.
- 22 professional innovation networks function as matchmakers and entrepreneurs on innovation projects between researchers and the private sector within select technology and business areas.
- Eight technological service institutes offer advanced technological services to private and public clients and assist companies in concrete development projects.

- Incubators have been established at regional level, advising smaller companies on relevant opportunities in the innovation system and on programmes that support industrial development at regional level.

Innovation Fund Denmark provides flexible funding of innovation projects in small and medium-sized enterprises, supports cooperation projects between public and private research and offers industrial scholarships at PhD and postdoc level. In addition, existing sector-specific programmes promote vocational research and innovation, especially in energy, environmental technology and food. Enterprises' access to venture capital is further supported by the Danish Growth Fund, while the Market Development Fund supports the introduction of new products in the market.

Denmark has an overall strategy for its cluster and network activities, identifying joint goals and creating coherence between state and regional efforts in the area. This has, among other things, meant that Denmark currently has seven clusters that have achieved the EU Gold Label for cluster excellence, making Denmark the European country with the most Gold clusters per capita.[18] The clusters are central to Denmark's participation in European research cooperation, including Horizon 2020.

Danish universities' statutory objectives include active exchange of knowledge with the wider world. Since 2000, national legislation has provided transparency on ownership of inventions, and encourages universities and other public research institutions to protect and utilise intellectual property rights and to establish professional units for technology transfer. During the phasing-in period, the professionalisation of this effort has been coupled with public funding for development and patenting of the institutions' inventions and further training of staff in technology transfer. At the same time, a national network for technology transfer, techtrans.dk, has been established, through which experts in the organisations can exchange experiences and cooperate with similar international organisations. Standard contracts for research and innovation cooperation have subsequently been developed and are available to public as well as private parties.

The achieved progress within commercialisation of research results is continually monitored through annual statistics that observe relevant international standards. Furthermore, in 2014, a joint evaluation was conducted of the universities' cooperation with the private sector and technology transfer. The evaluation[19] concludes a marked increase in knowledge exchange between universities and the private sector over the past 10-15 years. The main body of rules and laws regulating the area functions as intended, and the universities' top management bodies are committed to opening up the institutions towards the private sector. In addition, many researchers have experience with external cooperation and indicate that it contributes positively to their research and teaching activities. The evaluation further suggests that the achieved results vary between institutions, and that there is unrealised potential for providing research-based

[18] Ministry of Higher Education and Science (on behalf of Cluster Forum), 2016: Cluster Strategy 2.0.

[19] UFM 2014, Vidensamarbejde under lup – evaluering af universiteternes erhvervssamarbejde og teknologioverførsel ('A study of knowledge cooperation – evaluation of the universities' cooperation with the private sector and technology transfer')

knowledge services[20] to small and medium-sized enterprises in cooperation with other organisations, which already cooperate closely with the private sector.

Since 2009, a targeted effort has been undertaken to promote entrepreneurship among students at Danish higher education institutions. This effort is implemented by, among others, the Danish Foundation for Entrepreneurship, which serves to promote entrepreneurship training from primary school to higher education. The Danish Foundation for Entrepreneurship offers funding for course development, continuing training of teachers and micro grants for students who wish to start their own business etc. Furthermore, the foundation annually outlines the spread and impact of entrepreneurship training in the Danish education system.

Strategy and objectives towards 2020
Towards 2020, publicly funded innovation must be continually optimised through ongoing dialogue between authorities and stakeholders within research and innovation, combined with systematic evaluation and documentation of knowledge and technology circulation efforts.

Investments in research and education must contribute positively to growth and development, also outside the university cities, and industrial development must be geographically well-balanced. The share of innovative enterprises, especially outside the large urban areas, must be increased compared to the current level through greater access to new knowledge and highly educated workers.

Actions and instruments
The universities' multiannual development contracts will have increased focus on the universities' knowledge exchange with the local community and their contribution to regional development and growth. In 2016-2017, the Ministry of Higher Education and Science will further develop the concept of the annual commercialisation statistics to produce broader knowledge cooperation statistics.

To strengthen its function as a bridge-builder between higher education and research institutions and smaller enterprises throughout the country, the Ministry of Higher Education and Science will, starting from 2016, form three-year contracts with the technological service institutes that occupy a key position in the circulation of new scientific knowledge and technology.

To offer better services to applicants, Innovation Fund Denmark must in the future be physically present in several locations throughout the country and the Fund will offer a new programme for so-called rural growth promoters through which enterprises located outside the large urban areas can apply for government support for hiring highly educated staff to undertake concrete innovation projects.

To strengthen and extend the technology transfer and commercialisation effort, the Ministry of Higher Education and Science will extend existing commercialisation statistics to include socio-economic impact indicators as well as a wider range of cooperative relationships and more channels for knowledge exchange between the research institutions and society and the private sector.

[20] Knowledge services: services and counselling provided by the universities based on concrete challenges found in the private sector. Research-based knowledge is applied to create solutions based on concrete demands in one or more enterprises.

9. Optimal circulation and transfer of scientific knowledge – B

Top action priority 2: Promoting Open Access to scientific publications.

Starting point
Part of the ERA Roadmap's priority of optimal circulation and transfer of scientific knowledge focusses on the need for Open Access to scientific publications and data – which represents a main precondition for the creation of more open, scientific systems widely available to the public in line with the Open Science policy. Open Access can maximise the utilisation of public investments in research and development, increasing opportunities of researchers, research communities and private enterprises to contribute to innovation and societal growth through wider utilisation of research results. Open Access will e.g. facilitate better knowledge sharing by securing easy access for all, especially small and medium-sized enterprises, to publicly financed research results.

A top action priority of the ERA Roadmap is to promote Open Access to scientific publications at national level. The roadmap encourages Member States to undertake the following concrete actions:

- Promote Open Access to research articles – green or gold.
- Facilitate the development of certified repositories/archives for green Open Access.
- Encourage their research funding organisations to exchange information and good practices during the transition to Open Access.
- Consider coordinating and aligning their negotiations with scientific publishers with other countries.
- Explore the conditions under which Open Access may be further implemented at national level.

Status in Denmark
By the end of June 2014, the Minister for Higher Education and Science issued a National Strategy for Open Access with a view to maximising the impact of the research effort through greater access for all citizens to scientific results – focusing especially on the transfer of scientific knowledge from universities to enterprises. The strategy comprises a national political framework for the Open Access effort and is not based on legislation, but on support from management and researchers at the research institutions, as well as publishers' willingness to allow for Open Access.

A National Steering Committee for Open Access with representation from all universities has been appointed for a period of three years (2014-2017) to coordinate the implementation and further development of the strategy.

The National Open Access Indicator, as introduced by the National Steering Committee in 2015, shows that in 2014 only 18 per cent of the research articles produced at Danish research institutions were freely available online. The review further points to a great unrealised potential for green Open Access of 61 per cent. It is not immediately possible to provide Open Access to the remaining 21 per cent via self-archiving.

The first results of the indicator thus point to a need for greater motivation among Danish researchers and universities to make their publications freely available online, and for a continued targeted negotiation effort directed at the scientific publishers. However, the lack of certified repositories addressed in the ERA Roadmap does not constitute a barrier to green Open Access in Denmark. All the Danish universities use a research registration system (PURE) through which the researchers can record as well as upload their publications. The repositories provide free online access to the articles for all citizens, if the publishers allow it.

In 2012, the public research councils took action to publish a joint green Open Access policy. Denmark's Electronic Research Library (DEFF) is an organisational and technological collaboration between the Danish academic, research and education libraries. DEFF undertakes negotiations with the scientific publishers on behalf of the universities and closely monitors international developments, e.g. through knowledge exchange, with a view to gaining knowledge on and experience with new economically sustainable business models for promoting more and better Open Access at a cost that does not exceed the total expenses of the institutions for journal subscriptions and publication expenses (e.g. article processing charge (APC)).

Like many other Member States, Denmark does not have an existing national strategy for open research data, partly due to the fact that Open Access to all research data is complicated and raises a number of significant technical, legal and financial questions. In 2015, the Ministry of Higher Education and Science participated actively in the ERAC taskforce on open research data, which has provided a number of recommendations that address several of the challenges of open research data. The taskforce expects Member States, the European research councils and foundations and universities to apply the recommendations as inspiration in their further work with open research data.

In Denmark, the National Forum for Research Data Management is currently implementing the research data management strategy adopted by the DEFF and the DEIC (Danish e-Infrastructure Cooperation). The National Forum for Research Data Management consists of representatives from all Danish universities, and the strategy aims to facilitate better and more competitive research in Denmark through efficient compilation, protection, dissemination and recycling of relevant research data.

In 2014, the Ministry of Higher Education and Science together with Universities Denmark implemented a Danish Code of Conduct for Research Integrity. The objective behind the code is to promote high-quality research through increased focus on research integrity and accountability with a view to securing greater research transparency and documentability etc.

The code contains three main principles of research integrity (honesty, transparency and accountability) and six basic standards for conducting responsible research within e.g. data management. The recommendations of the code are currently being implemented in the Danish research communities.

The activities of the National Forum for Research Data Management and the Danish Code of Conduct for Research Integrity represent the first step towards open research data in Denmark.

Strategy and objectives towards 2020
By 2022 and onwards, all citizens must have unhindered, digital access to all Danish peer-reviewed research articles produced at Danish research institutions and published in 2021 and onwards.

To promote confidence in results, research must be transparent. Research integrity and responsible research conduct, including, among other things, documentation of data on which results are based, should therefore be a focus area in the research processes in all Danish research institutions.

Actions and instruments
Each year, the Ministry of Higher Education and Science will, through the National Open Access Indicator, monitor the progress within Open Access in Denmark. The next review will be published in the beginning of 2017.

The National Strategy for Open Access will be regularly updated based on the acquired experiences.

The National Steering Committee for Open Access will on a regularly basis discuss the status of Open Access in Denmark and, if required, launch motivating actions to increase the share of freely accessible research articles.

In 2016, the Ministry of Higher Education and Science will enter into dialogue with the Danish Council for Independent Research, Innovation Fund Denmark and the Danish National Research Foundation with a view to 1) gaining more knowledge on the impact of their Open Access policy, and identifying measures for following up on its implementation in relation to the grant recipients, and 2) discussing the recommendations provided by the ERAC taskforce in the report on Open Research Data.

At national level, the DEFF will, within the framework of the national Open Access strategy and the consortium's negotiating mandate, focus on including as many contractual parameters relating to Open Access as possible, including the best possible opportunities for self-archiving and the shortest possible waiting periods.

The Ministry of Higher Education and Science will continue its dialogue with the research institutions on promoting research integrity through implementation of the Danish Code of Conduct for Research Integrity in the institutions.

10. International cooperation

Top action priority: Development and implementation of appropriate joint, strategic actions and instruments for international cooperation on the basis of Member States' national priorities.

Starting point
One of the main European challenges is fully utilising the excellent research and innovation produced in Europe. Research results are not to a sufficient degree being transferred to the market, and technologies developed in Europe are too often commercialised elsewhere. Competition on knowledge and talent has increased, and regions and countries outside the European Union have in recent years invested heavily in research and innovation.

The aim of the European Commission's priority 'Open to the World' is to ensure that the EU and its Member States increasingly orientate themselves towards the wider world and open up their research and innovation systems. This is fully in line with the existing internationalisation policy within education and research in Denmark, which is continually revised at government level and by the individual universities, research institutions and foundations.

Denmark gives high priority to research internationalisation, as research conducted in cooperation with international partners is generally of a higher quality. Therefore, strong international cooperation and greater researcher mobility not only facilitates greater research production and innovation - it also helps Danish researchers to gain access to highly specialised research facilities abroad and the latest knowledge within a given field. In addition, international cooperation within research and innovation increases the potential for commercial activities and gearing of national investments.

Status in Denmark
Generally, the conditions for internationalisation of research and innovation in Denmark are good.

One of the main actions undertaken to promote internationalisation of Danish research, education and innovation is the creation of so-called innovation centres. Since 2006, the Ministry of Higher Education and Science together with the Ministry of Foreign Affairs of Denmark have created seven Danish innovation centres in Silicon Valley, Shanghai, Munich, São Paulo, New Delhi/Bangalore and Seoul, and another innovation centre will be established in Tel Aviv in 2016. The main objective of the centres is to assist Danish research and higher education institutions and enterprises in gaining access to knowledge and science, establishing connections to possible foreign collaborators, developing business cases with an international perspective as well as producing and attracting new knowledge, talents, investments and transforming knowledge into growth. In 2015, approximately DKK 24 m have been allocated to running the centres. In addition, the centres also generate income from their commercial activities.

Also, the Ministry of Higher Education and Science have entered into bilateral agreements with Brazil, India, Israel, China, Japan, the Republic of Korea and the USA. Formal Memorandums of Understanding (MoUs) have been signed with most of the countries to highlight specific fields of research in which the countries at government level have a mutual interest, which may contribute to creating more opportunities for cooperation. The MoUs promote transnational contact between researchers and high technological businesses. Concrete actions include researcher exchange, workshops, matchmaking and joint project calls between e.g. Innovation Fund Denmark, ministries and research councils in Brazil, India, China and the Republic of Korea respectively. In 2015, the foundation granted a total of approx. DKK 40 m for joint projects between these countries.

The Danish research institutions also enter into bilateral agreements on various levels. One example is the strategic alliance between the Technical University of Denmark (DTU) and the Korean Advanced Institute of Science and Technology (KAIST) with the aim of creating joint study as well as research projects.

Danish growth counsellors have been stationed in Turkey and South Africa to establish and implement strategic sector cooperation within research and innovation. The growth counsellors focus on sectors and actions where Denmark has unique competences, knowledge and technology, and which may pave the way for Danish exports and commercial internationalisation activities. Denmark currently has a growth counsellor on energy and the environment in Turkey and a growth counsellor on water issues in South Africa.

Denmark participates in EUREKA, which is an international collaboration that strives to support science and innovation in all sectors and to give enterprises access to public as well as private funding across the approx. 40 member countries. Each year, Innovation Fund Denmark supports Danish enterprises' and research institutions' participation in projects with international partners within the framework of the EUREKA Eurostars programme. In 2015, 206 Eurostars projects received funding, 32 of which had Danish participation. The total public budget for the 32 projects with Danish participation is DKK 316 m, of which the Danish public and private share is DKK 136 m.

A study[21] indicates that Danish enterprises that have participated in EUREKA projects show greater growth rates in export, employment and company growth than comparable enterprises that have participated in similar, purely national projects or which have not participated in cooperation projects.

Denmark participates in the cluster policy cooperation - Innovation Express - within the framework of the EU Strategy for the Baltic Sea Region. The aim is to establish new, transnational collaborations, among other things through international cluster alliances. Each year, a number of transnational cluster-to-cluster cooperation projects are launched within fields where small and medium-sized enterprises in the participating countries are believed to hold great growth and innovation potential.

Together, the Danish universities and the Ministry of Higher Education and Science have established the Sino-Danish Center for Education and Research (SDC) in Beijing with the objective to support the strong bilateral research cooperation, improve Danish students' opportunities to

[21] FI 2011, Economic Impact of International Research and Innovation Cooperation

complete a study programme in China and to facilitate recruitment of talented Chinese researchers and students to Danish enterprises and knowledge communities. The centre's seven master's programmes can accommodate approx. 400 students. Furthermore, approx. 75 PhD students and 100 researchers are affiliated with the centre – half of which are Danish and half of which are Chinese. 50 per cent of the funding for the programmes comes from Denmark and 50 per cent from China.

In addition to the SDC, a small group of Danish universities have formed a consortium for the creation of a Nordic centre at Fudan University in China, which - according to Times Higher Education - is ranked as one of the best universities in Asia. 25 universities from the Nordic countries participate in the consortium.

Strategy and objectives towards 2020
By 2020, the innovation centres must have created strong and well-established partnerships within research, higher education and business development with some of the world's leading innovation communities. New innovation centres may possibly be established.

Relevant Danish researchers, research institutions, Innovation Networks Denmark, the Advanced Technology Group (RTOs) etc. must be involved in concrete cooperation with global partners, and based on the work of the growth consultants, the existing framework conditions for research and innovation collaboration must be improved.

In 2020, the EUREKA initiatives will represent a main platform for internationalisation of Danish innovation. Action will be taken to increase cooperation with countries outside EUREKA, and to raise the level of Danish participation in EUREKA programmes, including Eurostars.

In 2020, cluster cooperation based on the Innovation Express concept must be expanded to include the other European countries, the US and other high-growth countries with which Denmark cooperates on research and innovation.

By 2020, the SDC must have established and strengthened its cooperation with Danish enterprises operating in China, focusing on research and development projects as well as internships.

Actions and instruments
The Ministry of Higher Education and Science will strive towards making the European research and innovation systems more open, among other things by ensuring that the Horizon 2020 programmes specify when international cooperation is key to solving grand, societal challenges.

In 2016, the Ministry of Higher Education and Science will present an Arctic strategy focusing on research, education and innovation.

In 2016, the Ministry of Higher Education and the Ministry of Foreign Affairs of Denmark will follow up on the evaluation of the innovation centres made in 2015, with a view to strengthening the centres' focus and resources to a relevant extent.

In 2016, the Ministry of Higher Education and Science will conduct an evaluation of the international network programme, which has been established with the countries with which Denmark cooperates bilaterally. The programme will subsequently be adjusted and improved where relevant.

In 2016 and onwards, the Ministry of Higher Education and Science will monitor the development of the new EUREKA initiative “Global Stars”, targeted at countries that are not currently members of EUREKA. In addition, Innovation Fund Denmark will strive to ensure that a targeted programme is launched within the framework of EUREKA to support large public-private consortia.

Together with relevant partners the Ministry of Higher Education and Science will strive to expand the cluster cooperation and the Innovation Express concept, focusing especially on the other European countries and, eventually, the US and other high-growth countries with which Denmark cooperates on research and innovation.

The Ministry of Higher Education and Science will contribute to a taskforce within the framework of the so-called Policy Area Innovation under the EU Strategy for the Baltic Sea Region, which will draw up a strategic action plan focusing on innovation policy priorities in the period 2016-2020.

In connection with the creation of the Sino-Danish Center for Education and Research, the Danish Industry Foundation donated DKK 100 m for the construction of a building which for hosting SDC activities. The building is expected to be ready for use in 2017. In addition to constituting a venue for research and education activities, the building will also host conferences, seminars, exhibitions and other events to achieve synergy between the Danish/Chinese private sector and research and education.

11. Appendix: Outline of objectives and actions

At European level, the development of the ERA has for a number of years been monitored through the so-called ERA monitoring mechanism. In connection with the ERA roadmaps, one indicator for providing a snapshot of the development for each focus area, has been chosen at EU level. In the future, these indicators will be integrated into the ERA monitoring mechanism, which contains a number of supplementary indicators and thus provides a more comprehensive overview. The European Commission is expected to release the next ERA progress report by the end of 2016 and, subsequently, every two years. In addition, a review of current Danish actions and instruments will be undertaken each year at national level to continually revise the Danish ERA Roadmap towards 2020. The first national review will be conducted in the beginning of 2017.

Effective national research systems

Snapshot indicator
Adjusted Research Excellence Indicator
Status
Preliminary calculations by the European Commission show that Denmark ranks in the top 5 in Europe by using this indicator.

Strategy and objectives towards 2020
In the future, and thus also in 2020, Denmark must invest no less than 1 per cent of its GDP in publicly funded research. Within this framework, funds must be prioritised to ensure support for Danish positions of strength and the needs of the private sector.
Danish universities must be among the best in the world, both within research and education. Denmark cannot be a leading player in all fields, but the Danish research communities must be first-rate within select areas and positions of strength.
Closer cooperation must be established between the universities and the private sector. The universities must organise their research activities to raise the current level of self-financing. This may be done e.g. through increasing commercialisation or attraction of funding from enterprises or foundations.

Actions and instruments
In the spring of 2017, the Ministry of Higher Education and Science will publish the RESEARCH2025 catalogue, which will contain a list of highly promising fields of research for strategic investments from the perspective of the private sector, ministries, knowledge institutions etc. In the following five years, the catalogue will function as a knowledge basis for politicians and other actors in connection with the prioritisation and implementation of strategic research investments. Emphasis will be on incorporating the European dimension into the RESEARCH2025 catalogue.
An analysis of the current Danish research effort will be conducted with a view to gaining

knowledge on the effects of research investments. This work will begin during 2016 and will be conducted by an interdepartmental working group and international experts.
In 2016, the Ministry of Higher Education and Science will enter into dialogue with the higher education and research institutions and the local business promotion system - as well as regional incubators - on the dissemination of best practice of regional knowledge cooperation.
Innovation Fund Denmark must support research and innovation throughout the country and is therefore given better opportunities to improve its regional anchoring through physical presence. The Ministry of Higher Education and Science will thus ensure that Innovation Fund Denmark in a three-year period beginning in 2016 can place staff geographically close to the regional knowledge communities.
An evaluation of Innovation Fund Denmark must be undertaken by 2018. At the same time, an evaluation will be conducted of the Advanced Technology Group (RTOs), the Innovation Incubators and Innovation Networks Denmark in the Ministry of Higher Education and Science.
The Ministry of Higher Education and Science is currently developing evaluation frameworks and effect chains intended for future evaluations and impact measurements and as part of the ministry's ongoing supervision of the innovation actors.
In addition, work on a joint simplification package for all public Danish innovation systems will continue for the purpose of strengthening cooperation platforms, division of labour, coordination, administrative standardisation and simplification as well as a shared evaluation system. In this context, it will also be considered how use of the "Seal of Excellence" can benefit private companies.

Jointly addressing grand, societal challenges

Snapshot indicator
National GBARD allocated to Europe-wide, bilateral or multilateral transnational public R&D programmes.
Status
Reported numbers from 2007-2013 ranks Denmark in the middle range of the European countries. However, these numbers do not constitute a completely accurate picture, since they do not account for funds spent on international cooperation related to research and innovation, which are not accounted for separately in the budget. For instance, funds from Innovation Fund Denmark for international cooperation are not included in the statistics. Also, an increased number of researchers funded from private foundations will distort the outcome.

Strategy and objectives towards 2020
Towards 2020, Denmark will maintain its high level of commitment in Horizon 2020 and secure no less than 2.5 per cent of the total funds distributed.
In 2020, Denmark must take an active and focused part in strategically selected transnational research collaborations, which will increase Danish research excellence, create increased value for Danish research and innovation and equally favour knowledge institutions and enterprises.

Actions and instruments
Danish participation in the Horizon 2020 programme committees is supplemented by a number of so-called 'reference groups' with relevant experts. The Ministry of Higher Education and Science will establish a strategic reference group to discuss main strategic issues concerning Danish participation in Horizon2020, including Danish participation in co-financed instruments.
In 2016-2017, the Ministry of Higher Education and Science will map the Danish participation in Horizon 2020, including in co-financed instruments. Based on this mapping, a strategy and an action plan for the future Danish participation in the EU Framework Programme for Research and Innovation will be developed.
In 2016, the Ministry of Higher Education and Science will establish a national ERFA network to support Danish participation in EU partnerships. The network will function as a platform for exchange of experience, and thus for building routine and capacity for Danish participation in EU partnerships, for debate about best practice and coordination at practical as well as strategic levels.
In 2016, the Ministry of Higher Education and Science will strengthen the EU-DK Support initiative, among other things through targeted information activities and implementation of a funding scheme promoting outreach work targeted at new actors. In addition, support for the preparation of Horizon 2020 applications will continue through the EUopSTART scheme, just as the effort to promote Danish participation in KICs will continue.
In 2016, Innovation Fund Denmark will draw up an international strategy establishing the priorities for its international cooperation. The Fund's efforts include a targeted focus on international programmes, which will facilitate cooperation between Danish actors and strong international partners. This includes a specific focus on the programmes that are deemed to provide the best opportunities for creating growth, jobs and export.

Make optimal use of public investment in research infrastructure

Snapshot indicator
Availability of national roadmaps with identified ESFRI projects and corresponding investment needs.
Status
In view of the existing Danish research infrastructure roadmap and the fact that links to the ESFRI roadmap are included as a positive evaluation criterion, it is expected that Denmark will be ranked in the European top.

Strategy and objectives towards 2020
In 2020, Denmark must participate in and have access to European research infrastructures that hold potential for and are relevant and of interest to Danish research and innovation communities, and there must be an increase in the level of Danish participation in projects that come under the Horizon 2020 programme for research infrastructures compared to the current level.
In 2020, the Ministry of Higher Education and Science must act as a catalyst for investments in new Danish research infrastructures within all the main areas, as stipulated in the Danish Roadmap for Research Infrastructures. Compatibility with projects in the ESFRI Roadmap will be a main evaluation criterion for the funding of new research infrastructures.

Actions and instruments
In the coming years, investments will be made in no less than 15 of the roadmap's proposals for new research infrastructures and proposals for more ESFRI-relevant projects, pending the results of future national budget negotiations. Overall, emphasis will be on ensuring that all main fields of science receive funding in the long term. This will take place over a period of years through implementation of the scheme for Research Infrastructures and/or private funds, and by allowing the roadmap's catalogue of proposals to serve as inspiration for research foundations and other actors.
Denmark aims to sign three new agreements for Danish participation in new European research infrastructures (ERICs) within the next five years, giving Danish research and research infrastructures access to new data and strengthening Danish participation in European research communities.
Within the next five years, the Ministry of Higher Education and Science will strengthen counselling and guidance services for Danish research communities regarding opportunities provided by research infrastructures at national as well as European levels.
New national investments in research infrastructures will require that explicit admission policies are drawn up, and that a tailor-made policy for cooperation with the private sector is produced.
A dialogue will be initiated with the Advanced Technology Group (RTOs), focusing on their role in research infrastructures, and in the fall of 2016 a national conference on research infrastructures' contribution to innovation and growth will be held.

An open labour market for researchers

Snapshot indicator
Researchers' posts advertised through the EURAXESS job portal per thousand researchers in the public sector per year.
Status
In 2013 Denmark posted 13.0 positions Euraxess per 1,000 public research. In comparison, the European average is 43.7.

Strategy and objectives towards 2020
In 2020, Denmark must continue to be among the European elite as regards the use of open, transparent and merit-based recruitment, and thus be attractive to foreign researchers. Vacant positions must be filled through fair competition between applicants and advertised in relevant fora, including Euraxess, to reach the European average number of advertisements.
Students and young Danish researchers must, as a natural part of their studies or research employment, be internationally mobile, just as Danish universities must represent an attractive choice to foreign students and young researchers in line with the universities' own concrete goals.
By 2020 the knowledge circulation between research institutions and the private sector must be optimised and, among other things, based on well-functioning inter-sectorial researcher mobility.

Actions and instruments
In 2016, the Ministry of Higher Education and Science - in cooperation with the think tank DEA - will undertake an analysis of the impact of internationalisation on the quality of the research conducted in Danish research communities. Focus will be on international mobility and international recruitment. The analysis will be followed up with conferences and debates.
In 2016, the Ministry of Higher Education and Science will undertake a targeted communication effort and improve the opportunities for guidance on Marie Sklodowska-Curie for researchers as well as enterprises, e.g. through targeted events for small and medium-sized companies, with a view to increasing their participation in the programme.
The Danish Council for Research and Innovation Policy is currently surveying the barriers to increased inter-sectorial mobility. The survey will result in a number of recommendations for central as well as decentralised actors to be presented in 2016.
In 2016, the Ministry of Higher Education and Science will undertake a study of the effect of the increased PhD intake, including an analysis of the internationalisation of PhD students. Focus will be on examining the universities' current efforts – and possible future efforts – to recruit the best international talents. The study will also determine whether Denmark has the capacity to retain international PhD candidates after graduation and thus benefit from the significant knowledge capacity of this group.
In 2016, and the coming years the Ministry of Higher Education and Science will actively involve the Euraxess steering committee in a survey of the barriers to using the Euraxess portal.

Gender equality and gender mainstreaming in research

Snapshot indicator
Percentage of women in A grade in HES.
Status
Reports by the European Commission shows that Denmark will be positioned below the European average by using this indicator.

Strategy and objectives towards 2020
Researchers must be recruited and promoted on the basis of their qualifications and the quality of their research and teaching. All citizens, regardless of gender, should have equal opportunities to pursue a career in research if they so desire and if they have the right qualifications. The existing recruitment imbalance within the research system should therefore be addressed and in 2020 the use of talent, regardless of gender, should be improved.
In line with the Equal Treatment Law, the gender distribution vis-à-vis boards and management of Danish research institutions should be well-balanced.
The gender dimension should, to a relevant extent, be integrated in research and innovation policies, programmes and projects in line with the European ERA Roadmap.

Actions and instruments
Towards 2020, universities will continue to develop and implement equality action plans and to launch concrete actions tailored to the individual institution. Once a year, the universities must report the gender distribution of their boards and management to the Ministry of Higher Education and Science (cf. the Equal Treatment Law).
Some universities have in their three-year development contracts with the Ministry of Higher Education and Science set concrete goals for increasing the share of women in academic positions (SDU) or the share of female applicants for professor positions (CBS).
The research funding organisations will continue to focus on gender equality and to monitor the development with a view to securing equality of opportunities.
Once a year, the Ministry of Higher Education and Science will publish key figures on the share of male and female researchers respectively in Denmark – including data on applications and grants from Danish public research-funding organisations as divided between male and female researchers.
The Ministry of Higher Education and Science will continue to advise potential Horizon 2020 applicants on the importance of integrating the gender dimension into their research.

Optimal circulation and transfer of scientific knowledge – A

Snapshot indicator
Percentage of product or process innovative firms cooperating with higher education institutions or public research institutions for their innovation activities.
Status
In reported numbers from 2010-2012 Denmark ranks among Europe's top 10 countries.

Strategy and objectives towards 2020
Towards 2020, publicly funded innovation must be continually optimised through ongoing dialogue between authorities and stakeholders within research and innovation, combined with systematic evaluation and documentation of knowledge and technology circulation efforts.
Investments in research and education must contribute positively to growth and development, also outside the university cities, and industrial development must be geographically well-balanced. The share of innovative enterprises, especially outside the large urban areas, must be increased compared to the current level through greater access to new knowledge and a highly educated work force.

Actions and instruments
The universities' multiannual development contracts have increased focus on the universities' knowledge exchange with the local community and their contribution to regional development and growth. In 2016-2017, the Ministry of Higher Education and Science will further develop the concept of the annual commercialisation statistics to produce broader knowledge cooperation statistics.
To strengthen its function as a bridge-builder between higher education and research institutions and smaller enterprises throughout the country the Ministry of Higher Education and Science will in 2016 and coming years form three-year contracts with the technological service institutes that occupy a key position in the circulation of new scientific knowledge and technology.
To offer better services to applicants Innovation Fund Denmark must in the future be physically present in several locations throughout the country, and the foundation will offer a new programme for so-called rural growth promoters through which enterprises located outside the large urban areas can apply for government support for hiring highly educated staff to undertake concrete innovation projects.
To strengthen and extend the technology transfer and commercialisation effort the Ministry of Higher Education and Science will extend existing commercialisation statistics to include socio-economic impact indicators as well as a wider range of cooperative relationships and more channels for knowledge exchange between the research institutions and society and the private sector.

Optimal circulation and transfer of scientific knowledge – B

Snapshot indicator
Percentage of Open Access papers (gold and green only) per country.
Status
In reported numbers from 2008-2013 Denmark will be just above the European average.

Strategy and objectives towards 2020
By 2022 and onwards, all citizens must have unhindered, digital access to all Danish peer-reviewed research articles produced at Danish research institutions and published in 2021 and onwards.
To promote confidence in results, research must be transparent. Research integrity and responsible research conduct, including, among other things, documentation of data on which results are based, should therefore be a focus area in the research processes in all Danish research institutions.

Actions and instruments
Each year, the Ministry of Higher Education and Science will, through the National Open Access Indicator, monitor the progress within Open Access in Denmark. The next review will be published in the beginning of 2017.
The National Strategy for Open Access will be regularly updated based on the acquired experiences.
The National Steering Committee for Open Access will regularly discuss the status of Open Access in Denmark and, if required, launch motivating actions to increase the share of freely accessible research articles.
In 2016, the Ministry of Higher Education and Science will enter into dialogue with the Danish Council for Independent Research, Innovation Fund Denmark and the Danish National Research Foundation with a view to 1) gaining more knowledge on the impact of their Open Access policy and identifying measures for following up on its implementation in relation to the grant recipients, and 2) discussing the recommendations provided by the ERAC taskforce in the report on Open Research Data.
At national level, the DEFF will, within the framework of the national Open Access strategy and the consortium's negotiating mandate, focus on including as many contractual parameters relating to Open Access as possible, including the best possible opportunities for self-archiving and the shortest possible waiting periods.
The Ministry of Higher Education and Science will continue its dialogue with the research institutions on promoting research integrity through implementation of the Danish Code of Conduct for Research Integrity in the institutions.

International cooperation

Snapshot indicator
International scientific co-publications with non-ERA countries per 1000 of researchers in the public sector.
Status
Preliminary calculations by the European Commission show that Denmark will position itself in the European top 10, using this indicator.

Strategy and objectives towards 2020
In 2020, the innovation centres must have created strong and well-established partnerships within research, higher education and business development with some of the world's leading innovation communities. New innovation centres may possibly be established.
Relevant Danish researchers, research institutions, Innovation Networks Denmark, the Advanced Technology Group (RTOs) etc. must be involved in concrete cooperation with global partners, and - based on the work of the growth consultants - existing framework conditions for research and innovation collaboration must be improved.
In 2020, the EUREKA initiatives will represent a main platform for internationalisation of Danish innovation. Action will be taken to increase cooperation with countries outside EUREKA, and to raise the level of Danish participation in EUREKA programmes, including Eurostars.
In 2020, cluster cooperation based on the Innovation Express concept must be expanded to include the other European countries, the US and other high-growth countries with which Denmark cooperates on research and innovation.
By 2020, the SDC must have established and strengthened its cooperation with Danish enterprises operating in China, focusing on research and development projects as well as internships.

Actions and instruments
The Ministry of Higher Education and Science will strive towards making the European research and innovation systems more open, e.g. by ensuring that the Horizon 2020 programmes specify when international cooperation is key to solving the grand, societal challenges.
In 2016, the Ministry of Higher Education and Science will present an Arctic strategy focusing on research, education and innovation.
In 2016, the Ministry of Higher Education and the Ministry of Foreign Affairs of Denmark will follow up on the evaluation of the innovation centres made in 2015, with a view to strengthening the centres' focus and resources to a relevant extent.
In 2016, the Ministry of Higher Education and Science will conduct an evaluation of the international network programme, which has been established with the countries with which Denmark cooperates bilaterally. The programme will subsequently be adjusted and improved where relevant.
In 2016 and onwards, the Ministry of Higher Education and Science will monitor the develop-

ment of the new EUREKA initiative “Global Stars” targeted at countries that are not currently members of EUREKA. In addition, Innovation Fund Denmark will strive to ensure that a targeted programme is launched within the framework of EUREKA to support large public-private consortia.
Together with relevant partners the Ministry of Higher Education and Science will strive to expand the cluster cooperation and the Innovation Express concept, focusing especially on the other European countries and, eventually, the US and other high-growth countries with which Denmark cooperates on research and innovation.
The Ministry of Higher Education and Science will contribute to a taskforce within the framework of the so-called Policy Area Innovation under the EU Strategy for the Baltic Sea Region, which will draw up a strategic action plan focusing on innovation policy priorities in the period 2016-2020.
In connection with the creation of the Sino-Danish Center for Education and Research the Danish Industry Foundation donated DKK 100 m for the construction of a building, which will host SDC activities. The building is expected to be ready for use in 2017. In addition to constituting a venue for research and education activities, the building will also host conferences, seminars, exhibitions and other events to achieve synergy between the Danish/Chinese private sector and research and education.