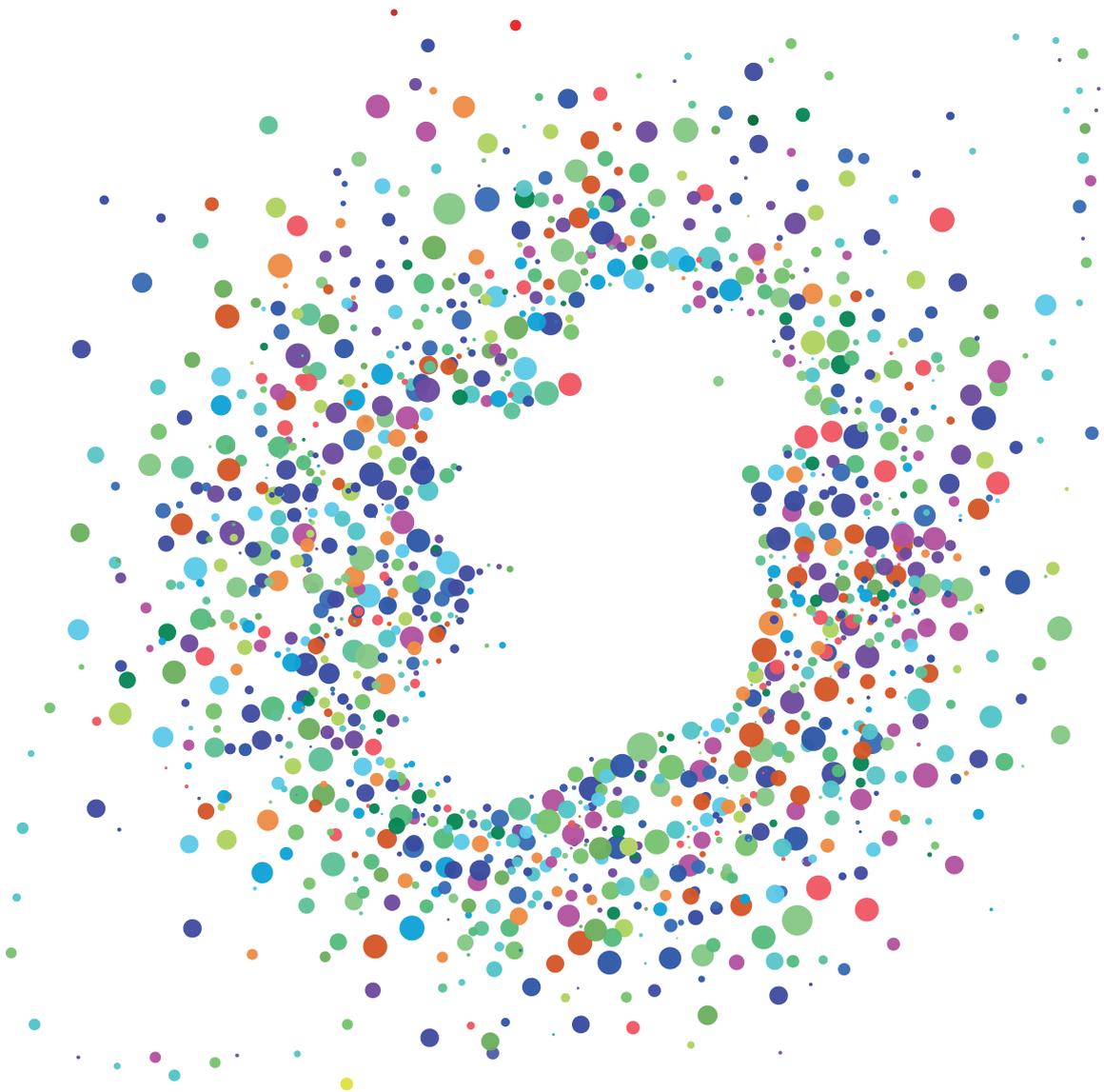




INNOVATION

2020



EXCELLENCE TALENT IMPACT

Ireland's strategy for research and development, science and technology

INNOVATION 2020

EXCELLENCE TALENT IMPACT

IRELAND'S STRATEGY FOR RESEARCH AND
DEVELOPMENT, SCIENCE AND TECHNOLOGY

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FOREWORD

An Taoiseach, Enda Kenny, T.D.



An Taoiseach,
Enda Kenny, T.D.

This Government has a plan to keep the recovery going by rebuilding a sustainable economy that can support full employment. Innovation has been central to securing the recovery to date. It has supported growth in the numbers at work with 135,000 more people in employment since 2012 and has seen unemployment fall from a peak of over 15% in that year to 8.9% in October 2015. This period has also seen Ireland continue to improve in international innovation rankings, most recently climbing from 10th place in 2013 to 8th place in 2015 in the EU Innovation Union Scoreboard.

We must continue to build on this success. This strategy's vision is for Ireland to become a *Global Innovation Leader* driving a strong sustainable economy and a better society. Research, development, science and technology will all contribute to this goal and this strategy sets out the roadmap to deliver on our vision focusing on **excellence, talent and impact** in research and development.

We remain committed to maintaining and improving standards in the **excellence** of our research. Since 2009, Ireland has been listed among the top 20 countries in global rankings for the quality of our scientific research with our ranking in citations moving up to 16th place in 2014.

People are our biggest asset. As the European country with the highest proportion of young people, we have the opportunity to nurture this **talent** to best serve the needs of our society and economy. We will increase enrolments in Masters and PhDs to meet growing demand for talent from enterprise.

We will continue to ensure that research is supported in strategically important areas that have **impact** for the economy and for society. This includes research that has direct relevance for the enterprise base, and meets the needs of society including improving the quality of our public services; protecting the environment, our natural resources and the climate; and ensuring food security and sustainability of energy supply.

In order to achieve our vision of becoming a Global Innovation Leader, we will continue to expand our international engagement in research through our participation in International Research Organisations and in Horizon 2020, the current European Framework Programme. We will work to deliver on our ambitious goal of securing €1.25bn funding from Horizon 2020 offering researchers and companies in Ireland the opportunity to collaborate with academia and enterprise across Europe.

Key to delivering our vision is a commitment to increasing public and private investment in research to reach Ireland's intensity target of 2.5% of GNP by 2020. Our ambition can only be achieved through a whole of government approach. This Innovation Strategy complements other government strategies, including the *Action Plan for Jobs and Enterprise 2025*, both of which have innovation as a central pillar. Working together with academia and enterprise we will deliver on our ambition.



*Minister for Jobs,
Enterprise and
Innovation,
Richard Bruton, T.D.*

INTRODUCTION

Minister for Jobs, Enterprise and Innovation, Richard Bruton, T.D., and Minister for Skills, Research and Innovation, Damien English, T.D.



*Minister for Skills,
Research and
Innovation,
Damien English, T.D.*

This strategy is based on a shared vision of Ireland becoming a *Global Innovation Leader*, driving a strong, sustainable, high employment economy and a better society enjoying a good quality of life. We have made significant progress in our national innovation system which started from a very low base by international comparisons. We have successfully built up research capacity and now we have a significant reputation for research excellence along with an increasing base of R&D active enterprises. This strategy will build on this progress.

Innovation plays a central role in driving productivity growth and fostering competitiveness in a global world where knowledge and innovation are critical factors for the advanced economies. Innovation contributes significantly to employment, export and investment growth; the competitiveness of indigenous enterprise; embedding the Foreign Direct Investment base in Ireland; and the creation and application of new knowledge and technology spillovers.

Our enterprise base must be resilient and internationally competitive, and innovation is central to ensuring that these aims are achieved. We are putting in place the supports to encourage greater engagement in R&D by both Irish and foreign owned enterprises and by both SMEs and large scale enterprises. We will continue to target our investment at strategically important areas of commercial opportunity for enterprise and achieve innovation leadership in key sectors where we can sustain a competitive edge. Manufacturing and Innovation in Services, of particular importance to the Irish economy, are given special attention in this strategy. The transfer of knowledge from our public research system to enterprise continues to be central to our strategy. That means a keen focus on delivering research outputs with commercial potential through licenses and spinouts and delivering talent.

Innovation is also crucial for social development. This strategy aims also to promote quality research in national and global challenges and to support rapid absorption of innovation into public policy and public service delivery.

Developing the talent of our population is an underlying aim of this strategy and will be critical to the successful realisation of our national vision, giving Ireland the capacity to exploit opportunities both established and emerging. Our success in delivering on the ambition in this strategy will depend on our people - undertaking the research, working in and creating successful enterprises, and contributing to the society in which we live. We will support the full continuum of talent development from primary level through to Postdoctoral research and from frontier research across all disciplines to the practical application and the successful deployment of that talent and research in driving innovation in enterprises and public services.

EXECUTIVE SUMMARY

VISION

Ireland – a Global Innovation Leader driving a strong sustainable economy and a better society underpinned by:

- **Excellent research** in strategically important areas that has relevance and impact for the economy and society
- A **strong innovative and internationally competitive enterprise base**, growing employment, sales and exports
- A renowned **pool of talent** both in Ireland’s public research system and in industry that maximises exchange of talent and knowledge
- A **coherent joined-up innovation ecosystem**, responsive to emerging opportunities, delivering enhanced impact through the creation and application of knowledge
- An **internationally competitive research system** that acts as a magnet and catalyst for talent and industry

We have built a strong research and innovation base in Ireland

Over recent years, Ireland has built an innovation-driven culture and is now firmly on the global map in terms of the excellence of our research. We are now among the leaders in generating and using new knowledge for economic and social progress. Ireland has succeeded in building a strong research capacity that has earned an international reputation. The base of enterprises engaging in research, development and innovation (RDI) activity is steadily increasing. Our investment in research and innovation has been instrumental in securing, diversifying and growing foreign direct investment, in licensing new technologies, in creating new companies, and in providing the highly educated workforce needed to grow the economy and contribute to society. Since 2012, a more focused approach has been adopted in the public funding of research and innovation activity. Research prioritisation has concentrated the majority of competitive funding on areas deemed likely to yield greatest economic and societal impact. In the strategy set out in this document, we aim to build on the significant progress of the past decade in developing Ireland’s research and innovation system, by **continuing to support excellent research across the full continuum and across all disciplines.**

We will become a Global Innovation Leader

This strategy reflects a whole-of-Government approach to innovation – it does not, however, stand alone. A number of related policies and strategies will have an important role in driving innovation. The Government’s *Spring Statement* and the annual *Action Plan for Jobs* (APJ) are the key instruments to support job creation, while the APJ has now been rolled out at regional level. This aims to see full employment of 2.1m people by 2020. The recently launched *Enterprise 2025* sets out a vision for Ireland to be the best place to succeed in business, delivering sustainable employment and higher standards of living for all. Full implementation of the *National Strategy for Higher Education to 2030* will encourage the best quality outcomes for students, the economy and society. The national *Policy Statement on Entrepreneurship* sets an ambition for Ireland to be among the most entrepreneurial nations in the world and to be acknowledged as a world-class environment in which to start and grow a business.

The forthcoming *National Skills Strategy* will determine the volume, type and mix of skills required to meet the Government's goal of full employment by 2020 and the challenges to be addressed in achieving this. Furthermore, a range of strategies across the broad spectrum of Government policy act as drivers in setting priorities for sectoral research and innovation agendas. The common thread running through all of these strategies is **innovation**, and this strategy has adopted a coherent systems approach to support our vision of becoming a Global Innovation Leader. This will mean:

- More enterprises engaged in RDI, including enterprises in the locally traded sectors, to drive productivity performance
- More enterprises progressing from early engagement with RDI to embedding innovation as a key part of their business model in a self-sustaining way
- Businesses across the enterprise base embracing new technologies to build successful business models
- Achieving innovation leadership in key sectors where we can sustain a competitive edge
- Greater utilisation by enterprises of the research assets of our Higher Education Institutes, by engaging with Research Centres and Technology Centres
- Greater success in translating intellectual property or new thinking into commercial products and services – by providing better supports for knowledge transfer and entrepreneurship, infrastructure for test-bedding, and access to funding
- Greater use of RDI to find solutions to pressing societal challenges in areas such as public health and energy
- Government departments using research to inform evidence-based policy and regulation, e.g. relating to the environment and
- Public services embracing an increased investment in RDI as a way of delivering higher productivity and service-user experience, including a greater openness to partnering with enterprise to fund solutions for difficult challenges.

We will increase public and private investment in research and development

Key to delivering our vision is a **commitment to increasing public and private investment in research**. Between 2008 and 2013, business investment in R&D grew by 31%, while public spending fell 22%. Over this difficult period, public funding was redesigned to improve its impact and incremental improvements to the R&D tax credit were introduced to support growth in business expenditure on R&D. In order to ensure that we are best placed to build on what we have already achieved, we present a path to obtaining an increase in public research investment and to thereby leverage greater private investment in order to bring Ireland's research and development intensity to 2.5% of GNP by 2020.

Increased investment will be targeted at:

- Increasing the number of research personnel in enterprise to 40,000.
- Researchers: increase annual research masters and PhD enrolments by 500 to 2,250.
- Supports for enterprise: Doubling private investment in R&D within the public research system.
- Research Centres: Further developing the network of Centres, building critical mass and addressing enterprise needs.
- Infrastructure: Introducing a successor to the Programme for Research in Third Level Institutions to provide investment in new facilities and equipment, and the maintenance and upgrading of existing ones.
- Expanding Ireland's participation in International Research Organisations, including CERN.

The impacts of innovation and research include:

- Increased competitiveness
- Maintaining high-value jobs
- Attracting foreign direct investment
- Developing human capital
- Ensuring a culture of evidence-based policy, processes and practices in both public and private sectors.

We are committed to maintaining a **focus on the impact and relevance of research**.

We will enhance the impact of research and innovation for enterprise

Research is fundamental to a strong, developed economy. In order for our enterprise base to thrive, it must be both resilient and internationally competitive. Innovation is central to ensuring that our enterprise base achieves these aims and a key goal is to increase enterprise engagement in R&D. Investment in research yields new, higher value-added products and services, and more efficient processes. This leads to growth in productivity, which is a determinant of long-term growth. We will support greater engagement in R&D in both indigenous and foreign-owned enterprises and in both SMEs and large-scale enterprises. Enterprises that are currently research performers will be supported including through direct supports, R&D tax credits, and the new Knowledge Development Box. We will also **increase enterprise engagement in RDI** throughout the economy. We will simplify and streamline supports and make them more easily accessible to industry. We will also continue to focus the majority of competitive funding on the 14 priority areas positioned within six broad enterprise themes

- ICT
- Manufacturing & materials
- Health & medical
- Food
- Energy
- Services & business processes

Of these, manufacturing & materials, and services & business processes, which cut across all sectors, are particularly important for the Irish economy and therefore receive special attention. Prior to the adoption of research prioritisation, public research activity in these areas was limited; we will introduce measures to boost national capacity further in these areas.

We will ensure that education drives innovation

One of Ireland's greatest strengths is its people. Future growth depends on innovation and future innovation depends on people. Ireland's high proportion of young people, relative to other EU countries, presents us with a unique opportunity. In order to take advantage of this opportunity, the full continuum of talent development must be supported. This requires action at all levels, from encouraging greater engagement with science, technology, engineering and mathematics at primary level to ensuring the necessary supports for researchers at postdoctoral and Principal Investigator levels. As well as supporting the full continuum of talent development in order to ensure that the **quantity and quality of trained people** is sufficient, we also must support the full continuum of research, from *frontier research* at and beyond the frontiers of current understanding, to the creation and development of research-informed innovative products, processes and services. Support for excellent research across all disciplines (including arts, humanities and the social sciences as well as science, technology, engineering and maths) is essential, as is the provision of adequate research infrastructure to ensure that our researchers have access to the best possible equipment and facilities.

We will focus research and innovation activity on social and economic development

The full range of research activity includes research for both economic and societal benefit, and research in either of these often benefits both. Research in the public sector is crucial for underpinning a strong, developed economy and developing a progressive, sustainable society delivering modern public services efficiently to meet growing needs and expectations. We will adopt a **challenge-centric** approach by focusing on research that has the potential to address national and global challenges.

It is also vital that Government policy should have a sound scientific basis. As well as ensuring that **public sector policy is informed by research**, research can also ensure that the public sector embraces the most efficient systems for service delivery. This is a whole-of-Government strategy, and we will ensure that the public sector research system is **coherent** and that the benefits of collaboration in research across sectors, both public and private, are fully realised.

We will support Innovation through the protection and transfer of knowledge

A key to supporting an innovative enterprise sector is an **effective regulatory framework for protecting intellectual property**. This framework will encourage a competitive business environment, promote the commercialisation of products from publicly funded research and help ensure competitive advantage by assisting enterprises to use IP to increase their levels of innovation. We will also seek to **maximise the transfer of knowledge between Research Performing Organisations and enterprise to promote greater application of research results**.

We will engage with the rest of the world in becoming a Global Innovation Leader

As well as encouraging research at a national level, both in the public and private sectors, it is crucial for Ireland to participate in international collaborative research. The benefits of **international and EU collaboration in research and innovation** accrue not only to our researchers but also to our enterprise base and public policy makers. The benefits include access to shared infrastructure and facilities, and collaboration in addressing global societal challenges. By collaborating with international partners, we aim to secure €1.25bn from the current Framework Programme for Research and Innovation, Horizon 2020. We are committed to leveraging international and EU engagement to Ireland's advantage including through our membership of IROs and boosting our returns from EU programmes.

We will effectively implement this strategy to become a Global Innovation Leader

In order to maximise efficient use of State resources in driving and overseeing implementation of this strategy, a **streamlined governance structure** will underpin a whole of Government approach to its delivery.

1

IRELAND AS A GLOBAL INNOVATION LEADER

We will become a Global Innovation Leader

Innovation – whether it is the generation and introduction of a new idea, the invention of a new technology, the development of new or better products, processes and services – is about the constant drive for improvement. Innovation, whether it comes from advances in research and development, or science and technology, is about finding solutions that are original, more effective and, most importantly, deliver positive change. In *Enterprise 2025, Ireland's National Enterprise Policy*¹, innovation has been identified as a core focus and one of Ireland's key differentiators.

In the drive for constant improvement and positive change, the vision in this strategy is for Ireland to be a **Global Innovation Leader driving a strong sustainable economy and a better society**.

To enable Ireland to transition successfully from today's baseline to our future vision, we will innovate across the full spectrum – in the economy, in society and in delivery of our public services. We will focus directly on areas where we need to improve in order to stretch our performance. Meeting our ambition means we will:

- grow our research capability so that we become competitive, dynamic and knowledge-driven;
- maintain and enhance the capacity and capability of our people;
- support and build our talent pool to maximise the flow of skilled individuals into companies, creating new companies and working in the public research system;
- increase the number of innovative enterprises exporting to global markets and employing more people in our key areas of strength, namely ICT, manufacturing & materials, health & medical, food, energy, and services & business processes;
- address societal challenges and improve the quality of life of citizens; and
- design and deliver new and improved public services.

As a Global Innovation Leader Ireland will have:

- **Excellent** research performed in **strategically important areas** with relevance and impact for the economy and society
- A strong, innovative and internationally **competitive enterprise base**, growing employment, sales and exports
- A renowned **pool of talent** in Ireland's public research system and in industry, which maximises exchange of talent and knowledge between the two

¹ Enterprise 2025 – Ireland's National Enterprise Policy 2015-2025 Dept. Jobs, Enterprise & Innovation, 2015

- A **coherent, joined-up innovation ecosystem**, responsive to emerging opportunities, delivering enhanced impact through the creation and application of knowledge
- An **internationally competitive research system** that acts as a magnet and catalyst for talent and industry.

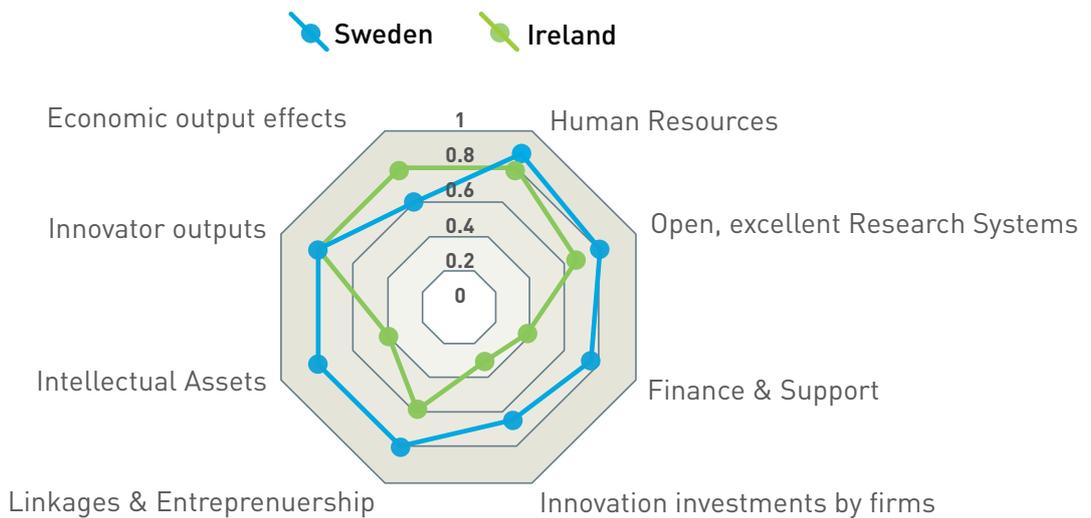
Ireland is firmly on the global map in terms of the excellence of our research, and is already generating and using new knowledge for economic and social progress within an innovation-driven culture. We have successfully built a strong research capacity, a significant reputation for research excellence, a maturing national knowledge transfer system with European recognition, an increasing base of enterprises engaging in innovation activity, and a cohort of spinout companies from the research system that have won significant commercial success.

Building on this significant progress, this whole-of-Government strategy sets out the roadmap for the next five years to set Ireland firmly on the path to becoming a Global Innovation Leader. Ireland has steadily improved its ranking in the Innovation Union Scoreboard², having moved from 10th place in 2013 to 8th place in 2015, and is currently in the group of ‘strong innovators’. Since 2009, Ireland has been listed among the top 20 countries in global rankings for the quality of our scientific research in terms of citations, moving up to 16th place in 2014³.

These successes demonstrate that the strategy to date of accelerating the economic and societal return on our investment in innovation and science is paying off. Many of the components of a complete innovation ecosystem are in place, and it is now timely for us to build on this foundation so that Ireland progresses from being a ‘strong innovator’ to a ‘Global Innovation Leader’.

Countries that are innovation leaders operate within a *balanced innovation ecosystem*, delivering high overall economic impact. This is illustrated in Figure 1.1 below, which compares Ireland’s performance in the EU Innovation Union Scoreboard to that of Sweden, which holds first place. The annual Scoreboard defines ‘innovation leaders’ as those that have an innovation performance of more than 20 percent above the EU average. Ireland scores strongly in terms of talent and impact of innovation, but lags behind in terms of the level of investment (both public and private), the linkages of research to enterprise, and the creation of patented intellectual assets.

Figure 1.1: Ireland’s innovation performance compared to Sweden in Innovation Union Scoreboard 2015:

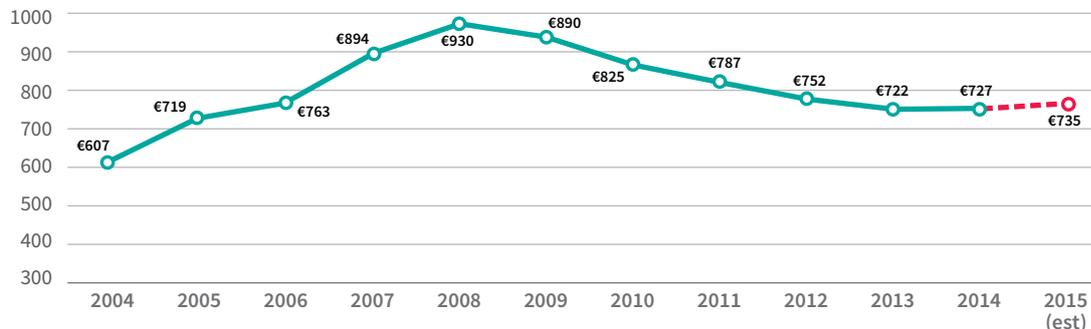


Innovation leaders, such as Denmark and Finland, have public investment in science, technology and innovation that (as a percentage of GDP) is twice that of Ireland.

2 Innovation Union Scoreboard is an instrument of the European Commission to provide a comparative assessment of the innovation performance of EU Member States
 3 Thomson Reuters: Essential Science Indicators

As shown in Figure 1.2 below, direct public spending on R&D in Ireland fell from a peak of €930m in 2008 to €722m in 2013 (a reduction of 22%), and although it is now slowly recovering, we are still behind leading international comparator countries.

Figure 1.2: Public investment trends (€m.) (current prices) 2004-2015



Private expenditure also fell by 6% from its peak of €1.86bn in 2009, but has since recovered – see Figure 1.3 on page 15. Between 2006 and 2013, the cost of the R&D tax credit grew from €75m to €420m and in fact supported 70% of business expenditure on R&D. The rate of growth in expenditure on R&D by the indigenous sector has been greater than that of the foreign-owned sector, albeit from a lower base.

Figure 1.3: Business Expenditure on R&D 2009 to 2013



A key metric for the assessment of innovative activity is R&D intensity (R&D expenditure as a percentage of GNP) which reflects the extent of research and innovation activities undertaken in a country in terms of resources input and includes **both private and public investment in R&D**. Ireland’s intensity rate in 2013 was 1.81% of GNP (1.54% of GDP). Israel – considered a world leader in innovation – has an intensity rate of 4.2% of GDP.

The *Europe 2020* strategy sets a 3% objective for R&D intensity. In the context of our National Reform Programme, Government adopted an R&D intensity target for Ireland of 2.5% of GNP (2.0% of GDP), to be achieved by 2020. Within this was a commitment to renewing the pattern of annually increasing public investment in R&D from 2014 onwards. **To become an innovation leader we will increase public investment in R&D, which will in turn leverage increased private investment in order to reach our target of 2.5% of GNP by 2020.**

Innovation is critical....

The primary rationale for Government investment in innovation is to develop a competitive knowledge-based economy and society and to drive innovation in enterprise, develop talent, and maximise the return on our investment for economic and social progress. Government intervenes to address market failures that hold back innovation. Investment in research and development increases economic productivity and competitiveness, and improves quality of life, health, and social and environmental outcomes. An essential component of supporting an innovative and enterprising economy, innovation investment is crucial to creating and maintaining high-value jobs and attracting, developing and nurturing business, scientists and talented people, ensuring Ireland is connected and respected internationally. Research is of vital importance to underpinning a strong, developed economy and a progressive, sustainable society. The OECD's view is supportive of public investment in science and innovation: *'Governments must continue to invest in future sources of growth, such as education, infrastructure and research. Cutting back public investment in support of innovation may provide short-term fiscal relief, but will damage the foundations of long-term growth.'*⁴

To our economic development and jobs....

The economic case for investing in research is that it supports and grows the enterprise base through, for example, the development of new or improved products, processes or services. Such research benefits business, enterprise and their customers, in the first instance. Innovation underpins the growth and dynamism of all economies. In many OECD countries, firms now invest as much in the knowledge-based assets that drive innovation – such as software, databases, research and development, firm-specific skills and organisational capital – as they do in physical capital, such as machinery, equipment or buildings.

Innovation, in its various forms, contributes to growth – for example:

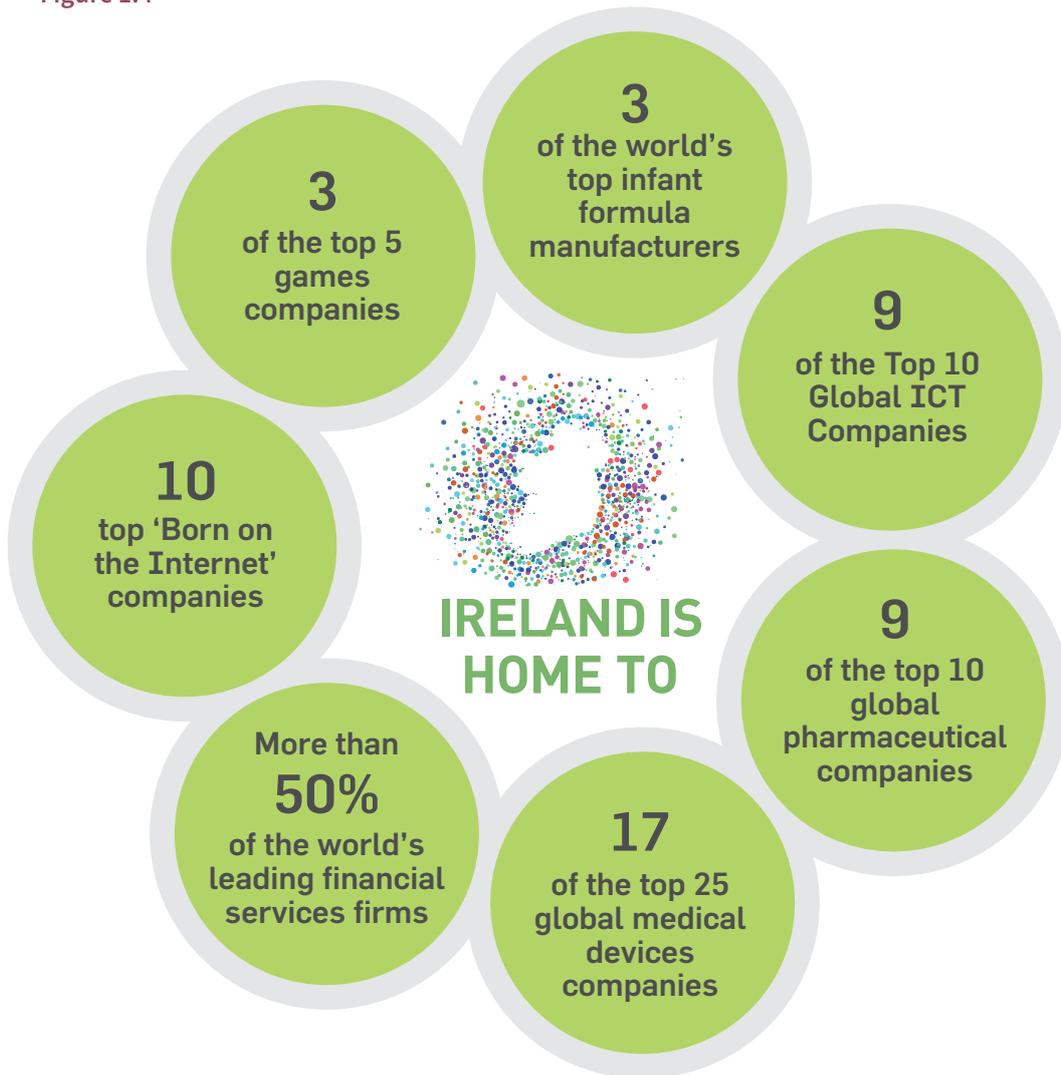
- The latest OECD figures show that about 0.25 percentage points of Ireland's annual average GDP growth between 1995 and 2013 can be attributed to investment in information and communications technology capital alone.
- Multi-factor productivity (reflecting increased efficiency in the use of labour and capital, a substantial part of which can be attributed to innovation, including process and organisational innovations) accounted for over 1.55 percentage points of Ireland's annual average GDP growth between 1995 and 2013.

Strategic investments have contributed significantly to:

- employment, export and investment growth;
- the competitiveness of indigenous enterprise;
- embedding the foreign direct investment base in Ireland;
- the creation and application of new knowledge and technology spillovers.

⁴ OECD Innovation Strategy: Getting a Head Start on Tomorrow

Figure 1.4



Innovation investment plays a central role in driving productivity growth and fostering competitiveness in a global world where knowledge and innovation are critical factors for the advanced economies.

A knowledge-based economy requires sustained investment in innovation to continue to ***maintain and attract high-quality foreign direct investment*** (FDI). Competition for FDI is intense: research, development and innovation (RDI) investments not only embed existing FDI operations and employment but pave the way for future investment, job creation and export growth. As the global battle for FDI intensifies, our investment in research and development will become even more critical to attracting and retaining FDI companies.

The increase in RDI investment since 2000 has improved our attractiveness as an FDI location. **60% (just under €60m) of IDA's total grant-aid budget is allocated to RDI projects each year.** This investment leverages RDI expenditure of €500m by IDA clients for these approved projects and an overall annual spend by MNCs of €1.4bn per annum on R&D. This has the effect of anchoring FDI clients and securing sustainable employment and related benefits to the Irish economy. A Forfás evaluation of IDA's RDI fund carried out in 2013 showed significant positive returns from the fund by 2009, with a 5:1 return to the economy on grants approved. Taking into account the time lag before the full economic impact of an RDI programme is felt, an eventual return of 25:1 was estimated.

IDA client companies are also key contributors to business expenditure on R&D (BERD), spending €1.4bn on R&D in 2013 (accounting for circa 70% of national spend by business on R&D). Over 11,500 people are engaged in R&D in IDA client companies. The challenge is to deepen the engagement of multinational companies in Ireland so that their activities move them up the value chain. IDA's strategy *Winning FDI 2015-2019* outlines a plan to support clients in creating 80,000 new jobs and to increase employment in the client portfolio to 209,000 by 2019 – within that, the aim is to win €3bn in new RDI investment projects, including in-house and collaborative RDI projects with companies and universities, and to encourage 120 additional companies across the FDI portfolio to engage in R&D.

The *availability of talent* will be the key differentiator for winning FDI in the future. The quality of our education system is therefore critical. International industry's view of Ireland's research capability and its linkages to the education system is an important determinant of our ability to attract FDI. In 2013, Science Foundation Ireland (SFI) had engagement with 41% of all IDA companies who announced new jobs. Ireland's economic renewal and development depends on our capacity to develop human capital, with the right mix of skills and expertise for the evolving labour market.

Indigenous companies contributed some €700m to BERD in 2013, accounting for circa 30% of national spend, with over 13,000 people engaged in R&D activity. For indigenous firms, innovation is at the heart of gaining competitive advantage and is central to their ability to compete and win in international markets. Enterprise Ireland's *Strategy to 2016* outlines a plan to support the creation of a further 40,000 new jobs in Irish companies by 2016. To deliver this, Enterprise Ireland provides supports both for companies and for researchers in Higher Education Institutes to develop new technologies and processes that lead to job creation and increased exports.

A comprehensive evaluation⁵ of the suite of enterprise support programmes provided by the enterprise development agencies points to:

- increased academic-industry links
- an increase in the industry relevance of the research conducted in research groups
- increased mobility of research staff into industry
- enhanced in-firm capabilities

Tangible evidence of commercial impact is the defining criterion underpinning the RDI instruments deployed by Enterprise Ireland. For example, commercialisation and technology transfer supports are directed at generating spinout companies and licensing into industry. A direct correlation has been found between collaboration activities (ranging from Innovation Vouchers and Innovation Partnerships to Technology Centres) and quantifiable increases in company turnover – these can be as much as seven times the investment in these instruments, as shown in the table below.

Figure 1.5: Enterprise Ireland Programmes stimulating additional growth in turnover

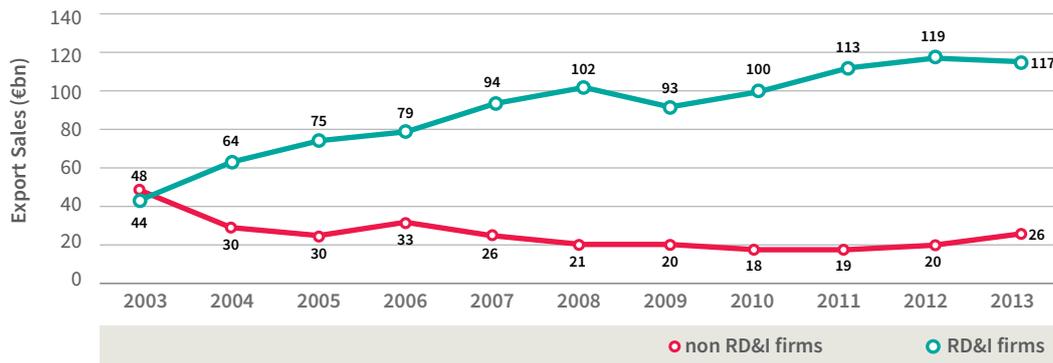
Enterprise Ireland Programmes stimulating additional growth in turnover	
• For every €1 invested in Innovation Vouchers,	company turnover increased by €7
• For every €1 invested in Innovation Partnerships,	company turnover increased by €6.70
• For every €1 invested in Technology Gateways,	company turnover increased by €5.85
• For every €1 invested in Campus Incubators,	company turnover increased by €3.61

Innovation-active companies provide high-quality employment and generate exports and tax receipts. RDI performers are gaining an increasing share of overall sales and export sales, and are accounting for increasing shares of employment. In addition, RDI performing firms better maintained employment during the challenging economic period. This can be seen in the direct correlation with exports from R&D performing companies increasing from €44bn in 2003 to €117bn in 2013, while for non-R&D performing companies, exports decreased from €48bn to €26bn over the same period⁶.

5 Forfás: Evaluation of Enterprise Supports for Research Development and Innovation

6 Source: Forfás analysis of ABSEI (Annual Business) survey

Figure 1.6: Export Sales of RDI and non RDI performers (€bn) 2003 – 2013:



Investment in RDI plays a crucial role in job creation- the evidence indicates that without continued investment by the enterprise development agencies in RDI, Science Foundation Ireland, Enterprise Ireland and IDA risk not fulfilling their contribution to the target of full employment as set out in the Action Plan for Jobs.

CASE STUDY:

EI-supported Dairymaster – delivering sustainable jobs

Dairymaster, based in Kerry, is a leading manufacturer of milking equipment, with customers in 40 countries. It has pioneered advances in such areas as milking parlour equipment, automatic scrapers, automatic cow feeding systems and farm management software. Dairymaster makes 95% of its parts in its highly automated site in Kerry, supporting 370 jobs and an average growth in sales of 20% per annum for over ten years. In order to sustain its global leadership and grow its markets, Dairymaster has consistently invested in R&D. This investment is at a multi-million euro level, both in-house, and through collaboration with higher education institutes. Through this collaboration, the company has accessed additional expertise and capability and has widened its product portfolio to improve market penetration to 10,000 farms worldwide. Dairymaster has collaborated with a number of higher education institutions on four Enterprise Ireland-funded Innovation Partnership projects, worth more than €1m over the past five years, and has also collaborated with Technology Gateways and Technology Centres. Dairymaster is also collaborating at a European level through a pan-EU research consortium dealing with robotics. This sustained investment in R&D, both in-house and through collaboration, has resulted in significant sales growth and in a 100% increase in sustainable and high added-value employment over the past six years.

CASE STUDY:

IDA-supported company Boston Scientific

Boston Scientific first established in Ireland in 1994, with the support of IDA Ireland, and has grown to be the largest medical device employer in Ireland, employing 4,500 people. Through its three Irish sites – located in Clonmel, Cork and Galway – the company exports around 10 million medical devices worldwide each year, valued at \$4.3bn, including stents, balloon catheters, platinum coils, inflation devices and pacemakers. IDA has worked closely with the company to identify areas for research in Ireland and provided R&D grant assistance towards several key projects which the company undertook in Ireland. These projects allowed the company to drive productivity improvement through process development and helped to diversify the site by bringing in new and improved products. In all this activity helped the site compete with sister sites within the Boston network and competitor sites on the global stage. Founded in 1979 and headquartered in Massachusetts in the US, Boston Scientific employs 25,000 people worldwide and is a global leader in the development and marketing of less invasive medical devices. The company is committed to continued investment in research, development and innovation, investing US\$1bn annually in new products and technologies.

CASE STUDY:

INFANT, an SFI Research Centre, and Metabolomics Diagnostics

The SFI Research Centre, INFANT, developed a diagnostic test for the early detection of pre-eclampsia - a significant health problems for mothers and their babies. IP was developed and licenced to a UCC spinout company, Metabolomics Diagnostics.

The discovery will lead to significant improvements in the health of mothers and babies. Metabolomics Diagnostics has grown significantly, providing hi-tech employment opportunities. It has done so primarily through its close association with the INFANT Research Centre.

CASE STUDY:

SFI Research Centre, the Alimentary Pharmabiotic Centre (APC)

The APC Microbiome Institute, hosted in University College Cork, was originally funded by SFI in 2003 and was recently designated an SFI Research Centre. In August 2015, it announced the creation of 50 additional hi-tech jobs. The new jobs have arisen largely from the ability of APC to attract new industrial partnerships. The APC Microbiome Institute currently partners with eight global corporations with a broad footprint in Ireland accounting for over 7,000 jobs. In addition, APC has established partnerships with nine other international companies that had no prior relationship with Ireland.

Innovation is critical to our social development...

The societal benefits of research are wide-ranging. Research has long played a role in addressing global and national challenges, and improving the quality of life through innovation in many areas. The outputs from the science base – which include new knowledge, skilled people, new methodologies and new networks – have contributed to improvements in areas as diverse as education, health, housing, environment, mobility, connectivity, culture, and policy formulation. For example:

- **Improving Health and Wellbeing:** Innovation is vital to address the sustainability of Ireland's health system, and to address health challenges, including the development of more effective treatments and strategies for disease prevention through behavioural and lifestyle change.
- **Meeting the forecast increase in global food demand:** Research into the complex relationship between the environment, both on land and at sea, and agricultural production is crucial to ensure sustainability and to improve yields without compromising environmental integrity or public health.
- **Climate change:** Addressing climate change and linked challenges, such as ocean acidification, will require major transitions in technologies, systems and practices across key sectors in Ireland and at global level, including in energy, agriculture, transport and the built environment. Achieving Ireland's 2020 greenhouse gas emissions reductions target and the longer-term goals to 2050 will require radical change, including radical technological, societal and organisational innovations. Adaption to future climate conditions will also be required. Deeper understanding of terrestrial, atmospheric and oceanic systems, the relationships between them, and human impacts on them is essential.
- **Reducing Ireland's energy dependency:** To reduce Ireland's energy dependency, we need to transition to a clean energy system built on wind and other renewables, using a smart grid that is integrated into an EU clean energy system.
- **Efficient and effective delivery of public services:** A national capacity for world-class research in support of policy and practice is a prerequisite for effective and sophisticated government. We need robust evidence to support policymaking and strategic investment decisions, to inform Ireland's position and engagement with EU and international processes, and to improve the administration and delivery of public services and practices. While the initial consumers of this research will be Government departments and State agencies, the ultimate beneficiaries will be those impacted by better policy and regulation. Similarly, we need capacity for research in support of practice and delivery of public services for efficient administration of high-quality public services.

The benefits of research can be felt across the socio-economic continuum, irrespective of the initial motivation. Research undertaken for economic motives yields societal benefits, and research undertaken to address societal issues can lead to commercial opportunities – for example, research in support of environmental policy may influence regulations (discharge of effluents, CO₂ emissions, oceanic carbon absorption) and present opportunities for enterprise to respond in innovative ways with new technologies and methods to address the environmental challenges. Similarly, research aimed at answering questions about, for example, the safety for human health and the environment of novel materials and technologies may provoke innovation in industry.

2

INNOVATION IN
ENTERPRISE**Innovation is critical for enterprise...**

A vibrant enterprise sector is a prerequisite for a strong, advanced economy, and a strong economy in turn provides the foundation for a progressive, sustainable and inclusive society. The enterprise sector provides quality employment which is important for our standard of living and inclusivity.

The national vision for the enterprise sector and the plan for realising this vision are set out in *Enterprise 2025*⁷. Innovation is central to this vision:

'We will be internationally renowned as being innovative in what we do and in how we do it, across all aspects of the business, including for example, business models, consumer engagement, channels to market, organisation structures, and modes of collaboration. We will strengthen our innovation system and will leverage our investments in [Research, Development & Innovation] to deliver impact. Our ambition is that our companies will derive competitive advantage from innovation.'

Productivity is the primary determinant of long-term growth. Investment in *knowledge-based capital*⁸, and innovation in particular, drives productivity through new, higher value-added products and services, and more efficient business processes. The value of services in the Irish economy exceeds that of manufacturing, and consequently investment in *knowledge-based capital* is increasingly important for driving future economic growth. This economic reality means that Ireland must be among the top-ranked nations for innovation if it is to realise its potential.

For individual firms, the key to market success and growth, particularly in international markets, is *competitiveness*. One element of competitiveness that can be directly influenced by a firm is its *productivity*. Recent work by the OECD⁹ has found that, since 2001, the most productive firms – that is, firms at the *global productivity frontier* have exhibited greater and more consistent growth in their productivity than non-frontier firms. In Ireland multinationals have demonstrated stronger productivity growth than indigenous SMEs¹⁰. The OECD identifies the fostering of innovation as one of the key policies to sustain productivity growth.

⁷ *Enterprise 2025 – Innovative Agile Connected*, Ireland's National Enterprise Policy 2015-2025 Dept. Jobs, Enterprise & Innovation, 2015.

⁸ 'Computerised information (software and databases); intellectual property (patents, copyrights, designs, trade marks); and economic competencies (including brand equity, firm-specific human capital, networks joining people and institutions, organisational know-how that increases enterprise efficiency, and aspects of advertising and marketing).' *New Sources of Growth – Knowledge-Based Capital Driving Investment and Productivity in the 21st Century*, OECD, 2013.

⁹ *The Future of Productivity*, OECD, 2015.

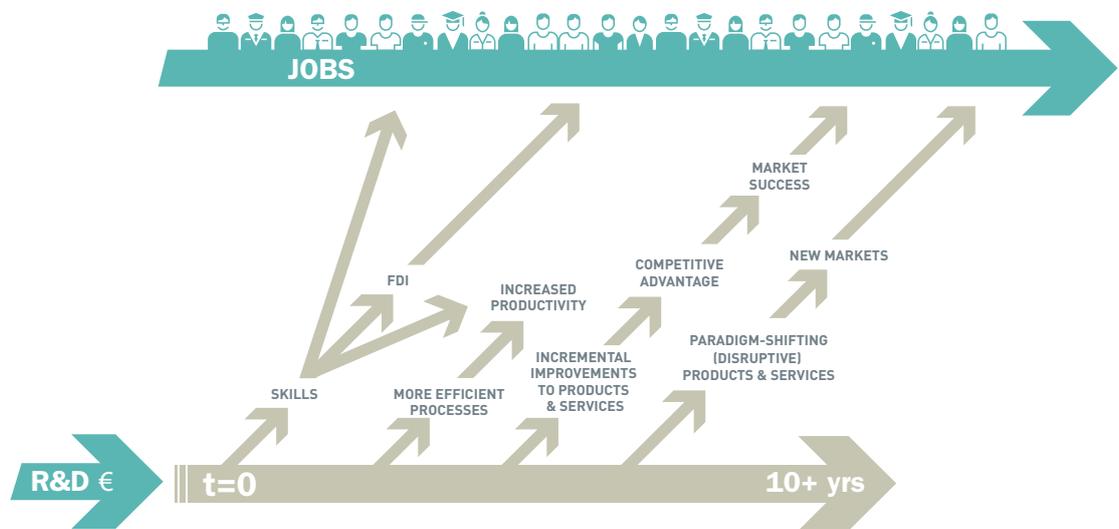
¹⁰ Ireland Policy Brief, OECD, 2015.

The OECD has also highlighted the important connection between innovation and *creative destruction* in driving competitiveness. At the heart of this process is the redeployment of creative and skilled people and resources from less competitive firms into firms that can be more successful in international markets, thereby providing more sustainable employment.

Despite the importance of research and innovation for firms, firms under-invest in research. At the lower Technology Readiness Levels (TRLs)¹¹ firms are concerned that they will not be the sole beneficiary of the research due to spill-over effects – that is, other firms can share in the rewards without bearing any of the cost. At the higher TRLs, firms can be reluctant to invest because such research must be conducted at scale in near real-world conditions and is consequently expensive. There is therefore a strong case for the State to co-invest in order to address these market failures.

Figure 2.1 provides an informal summary of the manifold ways in which public investment in R&D impacts on enterprise.

Figure 2.1: Flow of Enterprise Impacts over time from Public Investment in R&D



Given the importance of innovation for Ireland’s economic prosperity, we are committed to fostering innovation-led growth in the enterprise sector. Innovation must become a mainstream and essential business development activity for all firms, large and small, both indigenous and foreign-owned.

We will align innovation investment with enterprise opportunities

As a small country, Ireland cannot be a leader in all areas of enterprise research and innovation. We must therefore target our investment at areas of commercial opportunity that are strategically important. This is the underpinning rationale for *Research Prioritisation* (RP), Ireland’s Smart Specialisation Strategy, which was adopted by Government in 2012 as the guiding principle for competitive public investment in research in support of the enterprise sector. Government, in partnership with enterprise, identified 14 *Priority Areas* (see Fig 2.2) that presented particular market opportunities for Ireland. RP also identified the need to support relevant key enabling technologies to underpin the priority areas and, equally importantly, provide the foundation on which to develop capacity in new, emerging areas of opportunity. Examples of key enabling technologies include:

- Basic biomedical science
- Nanotechnology
- Advanced materials
- Microelectronics
- Photonics
- Software engineering

11 The nine level TRL scale indicates the maturity of a technology, ranging from basic principles observed (level 1), to proven in operational environment (level 9).

These, along with the 14 priority areas, form the basis for the current cycle of RP, which spans the period 2013 to 2017.

The rationale for adopting *Research Prioritisation* in 2012¹² remains valid today¹³. Government is committed to maintaining this approach as the central pillar of this strategy to support the enterprise sector and to reap the full benefits of the investment made to date.

In this strategy, the 14 priority areas are positioned within six broad enterprise themes, as illustrated in Figure 2.2:

- ICT
- Manufacturing & Materials
- Health and Medical
- Food
- Energy
- Services & Business Processes

This thematic presentation provides a more unified and accessible view of Ireland’s national strategy for public research in support of enterprise innovation.

Figure 2.2: Positioning of priority areas



12 Report of the Research Prioritisation Steering Group. DJEI, 2012.

13 Review of Progress in Implementing Research Prioritisation – Report of the Independent Panel. DJEI, 2015.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.1	Research Prioritisation (RP) as basis for research investment in support of enterprise	<p>a. Continue to target competitively-awarded research investment in support of enterprise towards the priority areas.</p> <p>b. Building on the accomplishments to date under RP, the 14 priority areas will be positioned within six themes: ICT, Manufacturing & Materials, Health and Medical, Food, Energy, and Services & Business Processes (Fig. 2.2).</p>	DJEI, EI, IDA, SFI, DAFM, MI, Teagasc, IRC, HRB, DCENR, SEAI and other research funders	2016 - 2020

The priority areas of *Manufacturing Competitiveness* and *Innovation in Services and Business Processes* are particularly important for the Irish economy.

In common with most OECD countries, Ireland is a highly services-intensive economy and competes for business in a growing global market. Services are increasingly delivered remotely and often digitally; business models are complex and centred on customer engagement. Remaining competitive in this market requires investment in research into new cutting-edge business concepts, models and platforms. Firms are also under competitive pressure to innovate continuously in their internal business processes in order to maintain productivity growth. Such research is likely to be conducted at the intersection of economics, business, technology and design / user experience, and will be highly collaborative and applied in nature, generating know-how that can be used and adapted by both Irish and foreign-owned businesses.

Ireland’s manufacturing base is a key pillar of the economy. Manufacturing firms supported by the development agencies¹⁴ directly employed 158,300 people and generated exports of €72bn in 2013¹⁵. These manufacturing operations are geographically distributed, providing employment across all regions of Ireland. In addition, manufacturing is a key driver of business R&D, with firms investing €863m in manufacturing R&D in 2013¹⁶.

However, prior to the adoption of RP, public research activity in these areas was limited, and they therefore warrant special measures to boost national capacity.

14 Enterprise Ireland, IDA Ireland and Údarás na Gaeltachta.

15 *Annual Business Survey of Economic Impact 2013*, DJEI, 2015.

16 *Business Expenditure on Research and Development 2013-2014*, CSO, 2015.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.2	Within the current cycle of RP, stimulate public research on <i>Services and Business Processes</i> and <i>Manufacturing Competitiveness</i>	a. Increase capacity in the higher education sector by appointing a number of ‘star’ researchers with proven track records of solutions-driven research in <i>Services and Business Processes</i> and <i>Manufacturing Competitiveness</i> , in collaboration with global leaders in enterprise.	HEIs, SFI	2016 - 2020
		b. Incorporate enterprise-relevant <i>services and business processes</i> challenges in the proposed new challenge-based funding system (see Action 4.3).	SFI, IRC	2016 - 2020

The current cycle of RP runs for the five-year period 2013 to 2017. While the rationale for focusing investment to support the enterprise sector will remain valid beyond this period, the specific areas of focus will need to be reviewed and revised in the light of changed circumstances.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.3	Put in place new cycle of Research Prioritisation	A market-led horizon-scanning exercise will be undertaken in order to identify strategic areas of commercial opportunity in global markets for Irish-based enterprises as the basis for the next cycle of RP, due in 2018. The exercise will take into consideration, inter alia, recent and likely future advances in science and technology, as well as the dynamics of international markets and global supply chains and policy developments.	DJEI, research funders, enterprise development agencies, key stakeholders	2017

We will tailor supports to meet enterprise needs...

Enterprise Ireland (EI) is the State agency responsible for supporting the start-up and growth of world-class Irish companies targeting global markets. In addition, EI has a central role in promoting foreign direct investment in natural resource sectors such as agri-food and wood processing. EI will continue to operate a range of programmes to foster entrepreneurship and drive innovation, including:

- supporting the commercialisation of research, new business creation and quality research spinouts
- promoting international research programmes (such as Horizon 2020, European Space Agency)
- providing direct support for ‘in company’ R&D, innovation and business process development
- building market-led enterprise collaborations that harness the talent in the Irish public research system

IDA Ireland has national responsibility for securing new investment from overseas in manufacturing and international services and for encouraging foreign enterprises already located here to expand their businesses. IDA focuses on R&D-intensive sectors, such as ICT, life sciences and industrial technologies, and on sectors such as financial services, where R&D is becoming increasingly important. The connectedness of the research landscape in Ireland – that is, the strong linkages between enterprise, research institutions and State agencies – is a major incentive for companies to invest here.

IDA will continue to actively encourage companies who have not yet established an R&D function in Ireland to do so through grant support for in-house R&D projects and promoting linkages to relevant research organisations with whom the company may collaborate.

The Foreign Direct Investment (FDI) sector and the indigenous sector in Ireland have differing RDI requirements. FDI companies can often access RDI expertise from within their wider group of affiliates rather than seeking external collaborators. Furthermore, FDI companies based here may not control decisions on RDI activities and may not have a local remit to engage in collaborative activities.

Irish-owned SMEs tend to be focused on wider innovation, aimed at improving management and business strategy changes, and on innovations that are ‘new to the firm’ as distinct from ‘new to the market’. While the FDI sector also has a keen interest in such process innovation, the SME sector faces a number of distinct challenges; in particular SMEs may not have any pre-existing R&D capability or the resources to employ specialist staff to undertake RDI.

Innovation is also key for reducing costs and enhancing the quality of services in the locally trading sectors of the economy. Costs in this sector have a direct bearing on the competitiveness of the internationally trading sectors. Enhancing the productivity and innovative capacity of locally trading enterprise is the focus of a specific action in *Enterprise 2025*.

Collectively, Government departments and State agencies operate a broad and sophisticated suite of instruments to support enterprise innovation directly and indirectly. Many of these instruments are designed to cater for firms with different needs and are tailored for firms of a particular type (size, sector, stage of development). A comprehensive evaluation¹⁷ of the suite of enterprise support programmes found that they contributed to increased academic-enterprise links, greater enterprise relevance of the research conducted in public research groups, increased mobility of research staff to industry, and enhanced in-firm capabilities.

A key objective of this strategy is to enhance coordination and coherence across the full suite of instruments so that they use public resources efficiently, and also that they are readily accessible by enterprise and aligned with enterprise needs. Additionally, it aims to ensure the comprehensiveness of the suite, so that there are no gaps for particular categories of firms. The OECD, in its *Economic Review of Ireland 2015*, noted that future innovation requires a stronger contribution by Ireland’s domestic firms and suggested that Government can help strengthen the indigenous sector by rebalancing its innovation policies towards more direct forms of support.

¹⁷ *Evaluation of Enterprise Supports for Research Development and Innovation*, Forfás, 2014.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.4	Optimising Enterprise RDI Supports	<p>a. We will review the full range of State financial aid for RDI, both <i>direct</i> and <i>indirect</i> (tax credits, Knowledge Development Box), in terms of the level of support available and eligibility rules, to ensure that the needs of small and young firms are being catered for as well as those of larger, established firm. The review will also assess the incentives available internationally to ensure that Ireland’s offering remains competitive.</p> <p>b. We will review and streamline enterprise RDI support programmes across departments and agencies to ensure their comprehensiveness and complementarity.</p> <p>c. We will explore how to increase the private investment that is leveraged by these RDI support programmes – that is, we will seek to increase the multiplier effect of public investment in these programmes.</p>	DJEI, EI, IDA Ireland and other relevant funders	2017
2.5	Accessibility of enterprise research, development & innovation supports	<p>A comprehensive and enterprise-friendly directory of all enterprise supports and programmes will be developed and disseminated.</p> <p>Allied with this, national and regional events will be organised periodically to showcase and promote these supports to enterprise.</p>	DJEI, EI/Knowledge Transfer Ireland, IDA, SFI, IRC, other stakeholders	2016 - 2020

We will develop our ecosystem of research and technology centres...

Market-focused research and technology centres are a vital part of the system of public support for enhancing the competitiveness of enterprise through innovation and the commercialisation of research. These centres provide a mechanism through which enterprise can access expertise and technology beyond what they have available in-house to enhance their products and services. They also provide a path to commercialisation for IP emerging from the public research system. Ireland currently has a sophisticated network of such centres providing research capacity across a broad range of technologies and at a various TRLs.

A recent study¹⁸ has identified an enterprise need for research support functions and capacity across a number of sectors at the higher TRLs – a need that is not being adequately met by the current configuration of centres. We will introduce a number of measures to optimise the network of centres in order to address this gap and to enhance their collective impact.

18 Strengthening Ireland’s market-focused research centre capacity, DJEI, 2015.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
<p>2.6</p>	<p>Optimise network of technology and research centres</p>	<p>a. The network of <i>Technology Centres</i> will be strengthened by increasing their critical mass and affording them greater operational flexibility so that they can provide a broader range of research functions, while maintaining strong links to the HEIs and other Research Performing Organisations.</p>	<p>EI, IDA, DES, HEA, HEIs</p>	<p>2016 - 2020</p>
		<p>b. The network of <i>Technology Gateways</i> will be strengthened to ensure good geographical and technological coverage and to maximise enterprise engagement.</p>	<p>EI, DES,HEA</p>	<p>2016 - 2020</p>
		<p>c. The network of Higher Education-based <i>Research Centres</i> will be developed to provide world-leading capacity in strategically important areas for the economy, while maintaining strong links to other RPOs.</p>	<p>SFI, DES,HEA</p>	<p>2016 - 2020</p>
		<p>d. The identified enterprise need for RTO support, particularly in the areas of <i>Advanced Manufacturing and Services & Business Processes</i>, will be addressed, building on the existing network of centres.</p>	<p>IDA, EI, SFI, HEIs</p>	<p>2016 - 2020</p>
		<p>e. We will develop standardised key performance indicators and associated targets for measuring and enhancing the impact of the <i>Technology Gateways, Technology Centres and Research Centres</i>, including enterprise co-funding and movement of researchers into enterprise.</p>	<p>EI, IDA, SFI, HEIs</p>	<p>2016</p>

We will develop Ireland as a test-bed location...

Ireland is increasing becoming the locale of choice for multinational companies to test cutting-edge technologies and to conduct trials of new products, often in conjunction with public bodies. Ireland’s size – ‘small enough to trial, large enough to prove’ – its unique geographic and environmental characteristics, and the interconnected public sector makes Ireland ideal for testing and validating technologies in real-world conditions, before bringing them to a wider market. Ireland can use previous investment in research infrastructure (such as SmartBay Ireland, National Research Vessels, Moorepark Technology Ltd) for translational research and the provision of test-bed infrastructure to enterprise. Similarly, clinical networks such as ICORG¹⁹ support the trialling of novel medical therapies.

19 All Ireland Co-operative Oncology Research Group.

There is significant potential to expand this activity across many sectors. However, a single firm may be unable to make the large investment necessary. The State can mitigate this market failure by investing in a pilot plant or test-bed and thus help many companies to conduct research at the higher Technology Readiness Levels.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.7	Promote Ireland as a test-bed for innovative technologies and therapies	<p>a. A number of pilot test-beds will be established in conjunction with relevant research and technology centres operating at the higher TRLs, with Government and development agency support.</p> <p>b. Transparent protocols will be developed to facilitate and encourage enterprise access to the test-beds.</p>	Research funders, relevant Government departments and public bodies	2016 - 2020

We will promote interdisciplinary research...

Due to the complex dynamics of global markets (consumer and business), the sophistication of business models, and the multi-faceted nature of cutting-edge products and services, enterprise-oriented research must draw on multiple fields of science, technology, engineering and math and, increasingly, arts, humanities and social sciences. The relatively small size and highly interconnected nature of the Irish public research system means that Ireland is well placed to be a leader in interdisciplinary research. It is therefore important that appropriate instruments are in place to exploit this opportunity.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.8	Promote inter-disciplinary research	Research funders will review their programmes to ensure that they incentivise and reward interdisciplinary collaboration.	Research funders	2016 - 2020

We will promote innovation-driven entrepreneurship...

Entrepreneurship is a powerful driver of economic growth and job creation. It creates new companies and jobs, opens up new markets, and nurtures new skills and capabilities. Entrepreneurship and innovation go hand in hand: entrepreneurs need access to innovative ideas, products, processes and services, and, equally, innovative products, processes and services need entrepreneurs who are prepared to take risks and develop appropriate business strategies to bring them to market. The *National Policy Statement on Entrepreneurship in Ireland* sets out the Government’s plan to deliver an ambitious but realistic increase in the numbers of quality start-ups in Ireland over the next five years.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.9	Promote entrepreneurship	Progress the implementation of the actions in the <i>National Policy Statement on Entrepreneurship in Ireland</i>	DJEI, DES, HEA	2016 - 2020

We will enhance access to finance for innovation...

Access to finance is essential for all aspects of business development, including innovation, employment generation, and addressing new markets. *Enterprise 2025* sets out the Government’s ambition to establish a comprehensive and competitive funding environment for enterprises at all stages from pre-start-up to maturity, so that no viable business opportunity will falter due to lack of access to appropriate funding. Key elements in the response to this challenge include:

- The Strategic Bank Corporation of Ireland
- The Ireland Strategic Investment Fund
- The Development Capital Scheme
- The Seed and Venture Capital Scheme
- The Innovation Fund Ireland Scheme
- Micro Finance Ireland
- Schemes operating under the Credit Guarantee Act 2012
- The Credit Review Office
- The ‘Supporting SMEs’ online tool

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.10	Access to Finance	Implement the ‘Finance for Growth’ actions in <i>Enterprise 2025</i> to ensure the availability of a comprehensive and competitive range of financial services to meet the needs of innovative enterprises.	DJEI, DPER, DOF, EI	2016 - 2020

We will develop collaboration within the public research system and between it and enterprise...

In view of the comparatively small size of the Irish public research system, collaboration between institutions and centres is imperative in order to create the critical mass necessary for world-leading research in many areas of science, technology, engineering and maths (STEM). In recent years, significant progress has been made in consolidating the network of centres, and the focus is now on building critical mass around a smaller number of centres of scale. There is considerable scope for building on this consolidation by exploiting the synergies created by collaboration between centres with complementary research agendas.

Fruitful collaboration between the enterprise sector and the public research system is essential if the full value of investment in the public research system is to be realised. To this end, a concerted effort will be made by the enterprise development agencies and Knowledge Transfer Ireland to increase the breadth and depth of collaboration. This will require tailored supports for SMEs that, by virtue of their size, lack the in-house resources to initiate and manage collaborative arrangements. Additionally, foreign-owned multinational companies located here will be encouraged to deepen their engagement in Ireland from manufacturing to development to research.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.11	Increase collaboration within the public research system	a. Research funders will review their programmes to ensure that they incentivise and reward collaboration between researchers, institutions and centres.	All research funders	2016 - 2020
		b. Clusters of research centres with complementary research agendas will be identified and incentivised to collaborate for greater overall impact.	Technology Ireland	2016 - 2020
2.12	Increase collaboration between firms and the public research system	<p>a. Establish new enterprise liaison positions to promote collaboration between the enterprise sector and the public research system.</p> <p>b. Expand the <i>SFI Strategic Partnership and SFI Centres Spokes programme</i> for adding new industrial and academic partners to the SFI Research Centres.</p> <p>c. Increase the use of the EI Innovation Partnership scheme to drive market-led collaboration between firms and the public research system.</p>	EI/Knowledge Transfer Ireland, SFI, HEIs	2016 - 2020

We will promote design-driven innovation...

Design-driven innovation is an important dimension of the innovation ecosystem. User-centric design is a key business differentiator and source of international business competitiveness for a number of key sectors.

Design is important in product development (for example, in medical devices, electrical devices and food products) and is a key component in construction and consumer goods, as well as in architecture and engineering. Design also drives the emerging creative sectors such as graphics, film and animation, web interface and ICT design, costume and set design, organisational and service design and even food design, where future growth, exports and job creation are expected to be greatest.

Enhancing the management of design will help to address the lower innovation capability of SMEs.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.13	Promote design-driven innovation	Implement the Design Strategy ²⁰ to encourage more start-ups and SMEs to use design as a competitive differentiator, to develop the design sector in Ireland, and to promote Ireland’s creative economy and design excellence as part of our enterprise and innovation culture.	DJEI, EI, DCCOI ²¹	2016 - 2020

We will promote Standards and Regulations as a source of Competitive Advantage...

Standards and regulations are critical in many areas of enterprise innovation – for example, interoperability standards for ICT products, or regulations for health products. In order to minimise development costs and reduce time to market, Irish-based enterprises must embed standards and regulatory compliance in their research, development and testing processes. The National Standards Authority of Ireland (NSAI) plays a key role in supporting firms by providing information on current and future standards that can assist in bringing products to market and improving organisational performance. The 2015 European Innovation Management standards²², published by the NSAI, are another important development in this regard. The standards provide guidance for organisations, public and private, seeking to manage innovation and related issues by moving from an *ad hoc* to a more rigorous approach.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
2.14	Promote standards and regulations as a source of competitive advantage	Work with firms to stimulate and support the embedding of standards and regulatory compliance into their research and development processes.	NSAI	2016 - 2020

20 A strategy developed by DCCOI and DJEI as part of the Year of Irish Design initiative to ensure long term development of the design sector and to encourage business investment in design.

21 The Design & Crafts Council of Ireland fosters the growth and commercial strength of the design and craft industry in Ireland, stimulating innovation and competitiveness.

22 SR CEN TS 16555 Innovation Management Standards, parts 1-6.

3

EDUCATION FOR
INNOVATION**Innovation requires innovative people...**

It is globally accepted that talented people are a critical factor in innovation. In its *2015 Innovation Strategy*, the OECD stated 'human capital is the essence of innovation'. Angel Gurría, the OECD Secretary-General, elaborated:

'Skills have become the global currency of the 21st century. Without proper investment in skills, people languish on the margins of society, technological progress does not translate into economic growth, and countries can no longer compete in an increasingly knowledge-based global society.'

The development of a country's talent entails lifelong investment and commitment on the part of both the individual and the State. From pre-primary through to further and higher education and throughout an individual's career, skills and knowledge need to be continuously enhanced if individuals, employers and countries are to realise their potential.

Our success has always, and will always, depend on our people. It is people who undertake the research, create successful companies and work for our public services.

We have the potential to forge a clear international competitive advantage through our young population. Our 4.6m citizens include the highest proportion of those under 15 in the European Union. We offer an attractive location for mobile skilled labour. This presents a massive opportunity for Ireland by offering a reservoir of talent that has the capacity to transform our national economic and societal development into the future. The individuals who will help us achieve our innovation goals are not one homogenous cohort: they are researchers, employees, entrepreneurs, clinicians, educators, consumers and citizens.

We will continue to develop the pipeline of talent...

Talent development for innovation starts a long time before people start looking for jobs. Pre-primary education plays a key role in a person's development, and contributes to mitigating social inequalities. Its importance is recognised in Ireland, as illustrated in the 2015 report of the Interdepartmental Working Group on Future Investment in Early Years and School Age Care and Education Services.

Over half a million pupils are enrolled in primary level, within which science has been compulsory since 1999, and we have been working to improve teaching and learning in mathematics. The targets set out in the *National Literacy and Numeracy Strategy* relating to primary level attainment have been met well in advance of the 2020 target date.

At second level, the new Junior Cycle will enable students to use and analyse information in new and creative ways and to apply their learning to new challenges. 'Project Maths' has introduced new Junior Cycle and Leaving Certificate specifications and is an integral part of science, technology, engineering and maths promotion in the classroom. ICT integration is also equipping learners to live and work in today's digitally connected society.

The Smart Futures programme, coordinated and managed by SFI in partnership with Engineers Ireland, is aimed at promoting STEM careers to second-level students. Looking to 2020, the programme will continue to expand its number and range of industry partnerships and its reach nationally to allow targeted and diverse approaches – for example providing access to female role models to girls' schools, and ensuring all secondary schools throughout the country are provided with high-quality STEM career advice.

A new junior cycle specification for science was introduced in September 2015, and this will provide the foundation for the sciences at senior cycle. The introduction of coding into the curriculum is also a positive development and this will be an area for further action.

However, the development of talent relevant to research and innovation is not limited to STEM knowledge: it requires focus on complementary skills, such as critical thinking, creativity and entrepreneurship, and these will be essential to Ireland's continued success.

The education of Ireland's young people must be underpinned by a highly valued and highly skilled teaching profession. A unified continuous professional development strategy will ensure consistent teaching and learning in the various science subjects. The ongoing work of the Teaching Council in developing a National Framework for Teachers' Learning, and the Report of the STEM Education Review Group will inform developments in this area.

An individual's progress beyond second level is critical to their future prospects, and sound career guidance plays an important role here. Post-Leaving Certificate courses provide a valuable route for accredited education and skills training that can be useful in a variety of work environments. The major reforms that are currently underway in Ireland's further education and training system will see the provision of new apprenticeships and traineeships, developed in partnership with industry, and will ensure that the further education and training system plays an enhanced role in the achievement of Ireland's goals for research and innovation.

While recognising the importance of core educational provision and the imperative to maintain and enhance the student experience and the interconnectedness of all levels of mainstream provision, there remains a need to focus on growing the numbers and diversity of young people pursuing STEM studies and careers. This requires expansion of the initiatives to raise awareness and interest in STEM among the public and families in Ireland, which directly affect the attitudes of young people. In particular, informed by the SFI *Science in Ireland Barometer*, SFI public engagement funding will seek to influence the attitudes of families of girls and those from lower socio-economic backgrounds. By 2020, this will result in the number of Irish people who feel informed on STEM research and development increasing by over 350,000, from 49% to 60% of the population.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.1	Strengthen STEM teaching and learning at primary and post primary levels	Provide students with a wide range of STEM and related skills, supported by a programme of continuing professional development for science teachers at first and second level	DES	2016 - 2020
3.2	Further scale initiatives to encourage young people and the wider population to participate in STEM disciplines and engage the broader Irish public in STEM	<p>a. Increase support for the Smart Futures and SFI Discover programmes and build on success of initiatives including Student Enterprise Awards, CoderDojo, Science Week Ireland, BT Young Scientist.</p> <p>b. Increase Irish public awareness of STEM from 49% to 60% of the population (350,000 additional people)</p> <p>c. Increase the level of uptake of STEM at second level</p>	<p>SFI, DES, HEA, with other funders, stakeholders and co-sponsors</p> <p>SFI, DES, HEA</p> <p>SFI</p>	<p>2016 - 2020</p> <p>2020</p> <p>2020</p>
3.3	Launch new apprenticeships and traineeships	Launch, in partnership with industry, a range of new apprenticeships and traineeships to meet the needs of Ireland's most innovation-intensive sectors	DES, SOLAS, Skillnets with industry	2016 - 2020

We will ensure that the higher education sector drives innovation...

The expansion of higher education has been a key enabling factor in the growth of the Irish economy over the past four decades. The availability and quality of graduates is essential if we are to maintain our attractiveness as a location for investment and grow our reputation as a destination for a successful research career. Equally, increased participation in higher education has resulted in significant contributions to society and has played a critical role in enriching our cultural life. Our next generation of researchers and innovators require the best possible foundation from our higher education system.

National policy priorities for higher education are reflected in the *National Strategy for Higher Education to 2030* through which major system reforms are being progressed. The landscape of institutions is evolving with the introduction of Technological Universities and the development of higher education regional clusters. Through the Strategic Dialogue process between the Higher Education Authority and the institutions, the *Higher Education System Performance Framework 2014-16* is driving the coherence of the higher education system, while at the same time encouraging diversity in keeping with institutional strategic strengths. In 2016, the Department of Education & Skills will commence work with the HEA on updating the Higher Education System Performance Framework for the 2017-19 period.

The demographic certainty of increasing demand for higher education underpins the strategic imperative to ensure that the student experience offered by Ireland is of top international standing. The quality of our undergraduate formation is critical to the development of the national talent pool, which, in turn, is essential to our research and innovation success. The outputs of the Expert Group on the Future Funding of Higher Education will shape the future direction of institutional funding in Ireland and, given the critical importance of the institutional activities, will be pivotal to the success of this strategy.

Research performed in the higher education system relies on competitive funding awarded through Science Foundation Ireland, Enterprise Ireland, the Irish Research Council and other national and international funders. Since its establishment in 2000, SFI has become the largest national provider of competitive research funding across the higher education system. SFI funds oriented basic and applied research in the areas of science, technology, engineering and mathematics. It provides researchers with funding, helps link them with companies that are working on relevant projects, and provides the enabling environment that is essential for collaborative work.

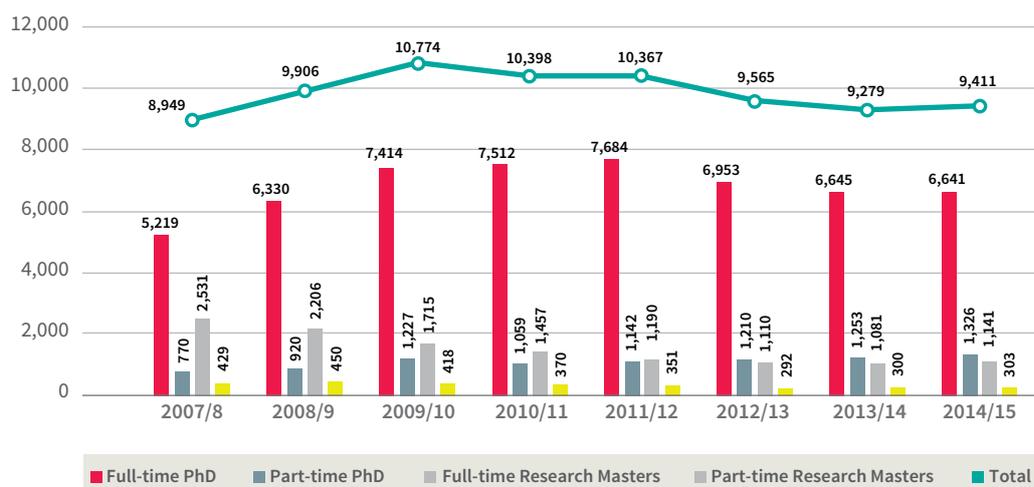
Embedded within the higher education system is a network of 12 Research Centres, funded by SFI, each built on a distributed hub and spoke model, and each with a specific research mission and competency. Each of these centres is at a scale to facilitate world-leading research and impact. These Research Centres are complemented by a network of 14 enterprise-led Technology Centres, also located for the most part on campus across the higher education system. The Research Centres and Technology Centres also involve other research performing organisations and are catalysts for linking the HEIs with the research capability in the public sector. These Centres form one element of a portfolio of schemes operated by SFI, Enterprise Ireland and other funders that provide the main dedicated funding channels for postgraduate researcher training, post-doctoral research, and the career development of researchers across our higher education system. Along with incubation centres, technology transfer offices and technology gateways supported by Enterprise Ireland, they collectively provide the mechanisms through which enterprise can access expertise and technology beyond what they have available in-house to enhance their products and services.

The quality of the postgraduate researcher education in our institutions is vital to the development of our human and knowledge capital. Graduate schools have been established and panel-based monitoring is now standard at review and progression points. In addition, there is a growing diversity of academic and professional routes to doctoral attainment. In the evolution towards structured provision across the sector, programmes aim to provide high-quality research experience and outcomes. They are also intended to imbue doctoral graduates with the transferable skills needed to advance their careers across a broad range of employment sectors and to make significant contributions to any field.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.4	Ensure that world-class standards apply to the quality of postgraduate researcher education and training	Advance and ensure quality postgraduate research education provision in Ireland through the implementation of the National Framework for Doctoral Education incorporating modules on entrepreneurship, IP management etc.	HEA & QQI with HEIs	2016 - 2020

We will increase the pipeline of Ph.D.s, post-doctoral researchers and principal investigators...

Postgraduate education delivered by higher education institutions is critical to Ireland’s research system. In addition to contributing to knowledge, postgraduate researcher education drives participants to develop their own research skills that can be applied in a range of environments, in academia or industry, at home or abroad. In 2014/15, enrolments at Research Masters and Ph.D. level dropped to 9,606 from a peak of 10,774 in 2009/10. Of those currently enrolled, 62% are in STEM areas and 38% in Arts, Humanities and Social Sciences or other areas.



There are now approximately 1,750 postgraduate students commencing their studies each year at research masters or Ph.D. level. The reduced enrolments witnessed in recent years will translate into fewer postgraduate researchers entering the labour market for a number of years. Given the strong signals of a growing gap between the output of researchers from our higher education system and the demand from employers for skilled researchers, this will need to be addressed. The enterprise agencies forecast that the number of R&D personnel needed in the enterprise sector will increase from 25,000 in 2013 to 40,000 in 2020. Not all of these R&D personnel will need to be qualified to Ph.D. level, but given the lead time required, there is an urgent need to increase enrolments of research masters and Ph.D. students in the areas most closely linked to enterprise demand, such as ICT, pharmachem, medical devices and business services.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.5	Increase enrolment of postgraduate researchers to address demand in the economy	Increase research masters and Ph.D. enrolments from 1,750 in 2015 to 2,250 in disciplines aligned to enterprise and other national needs.	IRC, SFI, other funding agencies as appropriate	2020

The emphasis on research centres of scale in identified priority areas has generated notable successes and has been an appropriate response to the need to build critical mass in the Irish research system. Funding limitations, however, have resulted in a shortage of post-doctoral opportunities outside of such research centres. Addressing this deficit will be critical to ensuring opportunity, attractiveness, success and succession in the Irish higher education and research base.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.6	Address gaps in the funding system for post-doctoral researchers through competitive support for excellent research across all disciplines and with a particular focus on inter-disciplinary research.	Deliver a 30% increase in the number of funded post-doctoral places in order to support the generation of future research talent and to maximise the take-up by industry of qualified researchers from the HE sector	SFI, IRC, Other Research Funders	2020

Success in innovation will come to pass only if researchers have the opportunity to enhance their own track record and reputation by, for example, leading their own team, managing a budget, or being the lead investigator named on grant applications. The sustainable advancement of Ireland’s research and innovation system requires investment across all stages of researcher development. Striking this balance will enable people to progress from learners to leaders, branching out into new fields of research and as yet unforeseen opportunities for innovation.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.7	Ensure continued opportunities for researcher career development in areas of strategic importance	a. Increase the number of early- and mid-career independent researcher awards by doubling the number of awards (Starting Investigator Research Grant and Career Development Award) from 20 to 40 per annum to enable formation of the next generation of Principal Investigators and ensure a vibrant research ecosystem	SFI	2020
		b. Develop metrics for scoring applicants who have successful industry linkages but lower numbers of publications/ citations than candidates with a purely academic track record.	DES, HEIs, HEA	2017

We will develop a clear career structure for researchers involved in innovation...

Clear career pathways for researchers help them to maximise their personal potential and, as a consequence, help to maximise the return on Ireland’s investment in innovation and research. They will lead to a variety of destinations – in academia, in existing industry, in entrepreneurial endeavours or in public service provision, such as health. They can help researchers to combine their research focus with their contribution to education and external engagement. Effective structured progression will also add up to more than the sum of its parts, with people being encouraged to grow their leadership as well as their research capabilities, and as they are given increased autonomy allied with increased responsibility for the delivery of outcomes. We will develop a coherent national policy on structured progression for researchers.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.10	Develop a coherent national policy on structured progression for researchers	Identify and tackle impediments to career progression and mobility of trained researchers and innovators in the publicly funded research system by developing a coherent national policy on structured progression for researchers	DES with DJEI and relevant stakeholders	2016 - 2020
3.11	Ensure career support for Ph.D.s and post docs	Provide detailed advice, mentoring, internships and placements to ensure that the full spectrum of career possibilities – industry, academia, public service – is known from an early stage.	HEA, IRC, SFI and all research funders	2016 - 2020

We will create opportunities for improved researcher mobility...

Mobility is a vital element of a researcher’s development. As well as international mobility between research institutions, intersectoral mobility between industry and academia forges important linkages between research and innovation performers. In order to encourage cutting edge research and the further growth of Ireland’s competitive advantage, there must be strategic links between our research community and our industry base. Intersectoral mobility provides researchers with the opportunity to gain first-hand experience in a commercial research environment while also providing industry with access to highly specialised trained researchers from the academic institutions. We will expand existing schemes to facilitate mobility and knowledge transfer in order to increase the number of researchers from public research programmes being placed in industry.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.12	Ensure the mobility of researchers between academia and industry	a. Enhance existing support for the bilateral flow of researchers between academia and industry by increasing awards including under the SFI Industry Fellowship Programme, the IRC Employment-based Postgraduate Programme and the IRC Enterprise Partnership Programme	SFI, IRC, other funders	2016 - 2020
		b. Increase the share of PhD researchers transferring from SFI research teams to industry from 25% in 2014 to 35% by 2020	SFI	2020
		c. Establish improved system-wide tracking of researcher mobility into industry	HEA, research funders	2017
		d. Continue support for the EURAXESS Ireland Office	DJEI, IUA	2016 - 2020
3.13	Enhance innovation and entrepreneurship related skills	Establish a new initiative to encourage a culture change and enable the structured progression of early-career stage researchers to careers in entrepreneurship.	SFI, EI	2017
3.14	Address barriers to pension portability that can restrict researcher mobility	Explore possibility of higher education institution and other RPO participation in the EU RESAVER pension scheme	DES, HEA, HEIs, RPOs	2016

We will promote gender equality in researcher careers...

Ireland has the opportunity to build its international reputation for gender equality through improved participation of women in research and innovation activities. A number of specific initiatives are currently under way – for example, Aurora and Project Juno – with one of the more significant recent developments being the extension of the Athena Swan Awards to Ireland. In addition, a major review of gender equality in higher education is being undertaken under the direction of the HEA.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.15	Address gender issues relating to career progression in research and innovation	Engage fully with the Athena Swan initiative. Implement the relevant recommendations emerging from the HEA National Review of Gender Equality in Irish Higher Education.	DES, HEA, funding agencies	2016 - 2020

We will further develop our research infrastructure...

Complementing our investment in people, we will continue to ensure that researchers have access to the best possible equipment and facilities in order to pursue their research.

The Programme for Research in Third Level Institutions (PRTLTI) has been a core instrument in our research capability-building. It has put in place research infrastructure, built basic research capability and helped to drive a strategic approach to research activity in institutions. It has provided the platform for the research activities of other funders (such as SFI, IRC, EI, Department of Agriculture, Food and the Marine and the HRB). An independent report to the HEA in 2011 confirmed that the programme was pivotal in stimulating the development of research performance in Ireland. There have been five cycles of funding through it, with total investment between 1998 and 2015 of €1.2bn. This has been invested across the sciences (biosciences and biomedical, environment and marine, platform technology and materials), technologies (ICT and Advanced Communications) and social sciences and humanities.

A range of actions supported by Government departments and agencies provide additional infrastructure supports to the research and innovation agenda.

Continued support for a well-equipped research environment is an investment in the tools that will keep us at the cutting edge of research and innovation. In making future investment decisions, the following guiding principles will apply:

- Excellence with impact will be the core funding driver. Funding for infrastructure will be awarded via a competitive process and will include the potential for co-funding with industry and other private sources.
- Coherent campus development: research investment and facilities must align – and drive synergies – with Ireland’s talent development at higher education level.
- The infrastructural needs of the wider research base must be recognised in order to tackle global challenges and to be internationally competitive, including the growing importance of big data/ data analytics and other associated e-infrastructures.
- The importance of international links, such as the European Strategy Forum on Research Infrastructures, must be acknowledged through the funding of large-scale research infrastructure.
- There must be long-term commitment to the maintenance, operational and upgrade costs of facilities to ensure their future viability, including implementation of access charges for all large pieces of research infrastructure by all national funders of research.
- System efficiencies must be continuously sought, for instance through shared access to equipment through inter- and intra-institutional collaboration, and through the provision to industry of access to infrastructure promoted through online resources such as the HEA’s Large Items of Research Equipment (LIRE) database.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
3.16	Ensure a strategic approach to the development of existing and new research infrastructure programmes	a. Scope out and develop a successor to PRTLTI to support new investment in research infrastructure in the wider research base and to allow for maintenance and upgrading of existing facilities and equipment. b. Review and optimise roll out of policies for accessing research infrastructure including policies to maximise enterprise use of, and partnerships in, research infrastructure.	DJEI, DES, SFI, HEA with other departments and funders, HEIs, enterprise agencies and other stakeholders HEA, HEIs, Research Funders	2016 2016 - 2020

4

INNOVATION
FOR SOCIAL
PROGRESS AND
THE ECONOMY**Innovation is key to our social development...**

Becoming a **Global Innovation Leader** will result in key benefits for Irish society. Over the coming decades, we will face profound challenges, and innovation and research will be centre-stage in developing our national responses. There will be growing demand for energy and food security, health services, education, protection of the environment, understanding the ocean, and combatting poverty and social exclusion. To address these challenges, coherence in policy development and implementation across all national agendas, including research and innovation, will be essential. Public good research (that is, research associated with public health and safety, and environmental protection and resource management) is a key element in the research ecosystem. We must foster a broad-based research capacity to support national and international policy goals, characterised by excellence in all areas and world-leading in a number of strategically important ones. Research programmes designed to inform the policy process play a vital role in translating important findings in relation to health, education, the terrestrial and ocean environments, social and societal development, and other research domains into effective public services.

Public service reform and innovation have been central elements in responding to the crisis that the public service has faced in recent years. The Government's two public service reform plans emphasised the development of innovative approaches to service delivery and to achieving efficiencies. This includes a particular focus on digital government, improving customer service, new delivery models and shared services, to name just some areas. Innovation is key in driving continuous improvement in the way public services are delivered. It is a crucial element in improving the efficiency and effectiveness of service delivery, while also improving the quality and reducing the costs involved in providing those services.

Innovation will help us address the grand challenges of our time...

How we respond to the **grand challenges** that we face will be the major determinant of economic and societal development in the years ahead. Challenge-led innovation is an increasingly important concept. Stimulating solutions-driven collaboration will foster interdisciplinary consortia of enterprises, higher education institutions and public service delivery bodies to address major societal challenges. Interdisciplinary research is key to addressing such challenges, and incorporating the 'human factor' is also vital. Societal challenges are typically highly complex, and the engagement of researchers from both Arts, Humanities and Social Sciences, and Science, Technology, Engineering and Maths can often generate more innovative solutions and new ways of approaching and thinking about problems. Targeted initiatives of different scales are required to cultivate and grow quality interdisciplinary research that can deliver optimal impact.

These challenges are recognised in the selection of the 14 priority areas under Research Prioritisation and under Horizon 2020. Our nationally-funded research has the potential to further address national and global challenges and to simultaneously provide economic opportunities as recognised in the Independent Review of the Research Prioritisation Exercise.

In September 2015, Ireland signed up to a new international UN Agreement on Sustainable Development, the 2030 Agenda, based on a challenging series of explicit goals and targets across the economic, social and environmental agendas.

We will fully recognise the importance of **citizens** in the innovation and research processes. For many citizens, their contribution to the research agenda is purely altruistic. Citizen engagement in research is essential in some instances and increases the richness and applicability of the findings. For example, the *Growing Up in Ireland* longitudinal study follows the progress of almost 20,000 children across Ireland as they grow, with the aim of improving our understanding of all aspects of children and their development, and the *Irish Longitudinal Study on Ageing* (TILDA) is a large-scale, nationally representative, longitudinal study on ageing in Ireland, collecting data on the health, economic and social circumstances of 8,000 people aged 50 and over. Neither of these important policy instruments would be possible without the engagement and commitment of participants. Another area where citizen engagement is critical is in clinical research and in the design and testing of healthcare interventions.

SFI's *Science in Ireland Barometer* found that the public places a high societal value on science and believes it is important for Ireland's future prosperity, with 87% of the Irish public agreeing that research in STEM will lead to an improvement in the quality of life in Ireland in the next 20 years. The Irish Research Council has developed a Research for Policy and Society initiative, engaging with a range of Government departments and – in partnership with the Wheel²³ – with civic society and citizens. This has the objective of establishing a 'Social Innovation Community' of researchers, social innovators, end-users (citizens) and policy-makers. And in its *Strategic Plan 2016-2020*, the Health Research Board has explicitly recognised the importance of public and patient involvement, and has set out plans to incorporate this into many of its future programmes.

We will create a coordinated innovation and public research system...

The Irish public research system is made up of multiple actors with various roles in research funding and performance. As a result of investment to date, we now have a sophisticated but potentially complex public research landscape. Public research funders have been working closely together to ensure complementarity and the removal of overlaps and gaps in the funding architecture. This has been evident particularly in implementation of research prioritisation, and research funders are now working cohesively to support the 14 priority areas. We will continue to build the key components of a successful innovation ecosystem to ensure that interactions within the system are working effectively and efficiently.

We will promote innovation in the public sector...

Public procurement can be used to stimulate the take-up of new technologies. For example, our Green Public Procurement Action Plan, Green Tenders, sets out a range of measures to drive innovation and thus provide industry with real incentives for developing green products and services – particularly where public purchases represent a large share of the market, such as in construction, health services and public transport. The Department of Public Expenditure & Reform's circular Initiatives to assist *SMEs in Public Procurement* recognises that innovation can also assist procurement solutions.

Small Business Innovation Research (SBIR) enables public sector bodies to address challenges by connecting with businesses to procure research and development on innovative solutions. For example, in 2014, Enterprise Ireland in collaboration with the Sustainable Energy Authority of Ireland and the ESB launched the first SBIR programme seeking smart solutions for charging electric vehicles in communal parking. Over the coming years, we will explore the potential for extending this approach to other areas, including health.

23 A leading support and representative network for the community and voluntary sector in Ireland.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.1	Address public policy needs and optimal use of research	Government departments will: <ul style="list-style-type: none"> a. ensure that they are making best use of scientific evidence in the execution of their mission and address gaps where they arise. b. evaluate all funding programmes to ensure continued relevance and clarity of purpose. 	All Government departments	2016 - 2020
4.2	Ensure R&D expenditure is afforded a sufficiently high priority in Government department budgets	Make business case through annual Estimates process to secure funding and report to the Cabinet Committee (through 2020 Implementation Group) on increased investment levels to contribute to impact and the 2.5% target for investment.	All Government departments	2016 - 2020
4.3	Address global and national societal challenges	Explore potential for competitive funding mechanism aimed at stimulating solutions-driven collaborations; engage the civic community and enterprise in identifying the grand challenges.	All Government departments and agencies	2016 - 2020
4.4	Strengthen public policy and societal impact	Target supports to cultivate interdisciplinary research; increase the engagement of public entities and civic society in public policy and societal challenge-based research.	IRC, HRB	2016 - 2020
4.5	Support collaboration across sectors (public and private) to deliver social policy objectives	Examine potential areas for collaboration across Government departments and agencies. Explore SBIR potential in relevant sectors including health.	Research funding Government departments and agencies	2016 - 2020
4.6	Use public service innovation to deliver better outcomes for users of public services	Realise the full potential of public service innovation to provide better and more efficient public services.	DPER and other Government departments and agencies across all sectors	2016 - 2020

CASE STUDY:

The Social Protection Research Innovation Awards

The Social Protection Research Innovation Awards (SPRIA) aim to promote innovative, policy-relevant research on poverty and social inclusion (including active inclusion) that complements the ESRI poverty research programme and contributes to the Department of Social Protection’s understanding of key policy questions. It is funded through and managed by the Irish Research Council (IRC) as part of its Research for Policy and Society initiative. A recent output from SPRIA was the report, *‘Playing Social Roulette: The Impact of Gambling on Individuals and Society in Ireland?’*

We will facilitate open access to scientific publications/research...

Open access to scientific publications adds value to research, to the economy and to society. The outputs from publicly-funded research should be publicly available to researchers, and also to potential users in education, business, charitable and public sectors, and the general public. Peer reviewed journal articles and other research outputs resulting in whole or in part from publicly-funded research should be deposited in an open access repository and made publicly discoverable, accessible and reusable as soon as possible and on an ongoing basis. Research data should be deposited whenever this is feasible, and linked to associated publications where this is appropriate. These principles were recognised in the *National Open Access Statement*, which was launched in 2012²⁴. *Rian* is a web-based portal that collects the content of the repositories of the universities, other institutions and agencies (such as Teagasc and the Marine Institute) in order to make Irish research material more freely accessible, and to enhance the research profiles of individual researchers and their institutions.

CASE STUDY:

Ireland’s Open Data Roadmap and Portal

Open data is a core element in Ireland’s first Open Government Partnership National Action Plan, coordinated by the Department of Public Expenditure & Reform. Studies show that publication of official non-personal data in open format has the potential to drive more effective decision-making and efficient service delivery, to spur economic growth, and to empower citizens to take an active role in improving their own communities. The Open Data Roadmap and Portal developed by INSIGHT at NUI Galway is a great example of leveraging research results and expertise funded by SFI and Enterprise Ireland for the good of society and, along with civil society, it facilitates the use of public data assets for economic and societal benefit.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.7	Support national and European open access policies and principles	Integrate and support open access repositories, the national research classification system (see Action 7.6), HEI research information systems, research funders’ grant management systems, and expertise locator systems (such as KTI’s <i>Find a Research Expert</i>).	HEA, KTI, SFI, HRB, DRI	2016 - 2020

We will promote innovation in health...

Public investment in science and research for health is an investment in our future, ensuring that we have a healthier society and a more productive economy. Knowledge arising from research is paramount in providing the evidence-base for better health policies, practices, products and systems. This evidence is essential to the creation of a fairer, more efficient health system and for the delivery of better health outcomes. Health research provides us with the evidence to address key challenges in our society – radical demographic change, an ageing population, increases in the number of people living with chronic diseases, the spiralling cost of healthcare services and medication, greater demand from citizens for higher quality and more personalised care, and the need to shift investment from acute to primary, community and self-managed care. Research activity attracts and retains high-quality health professionals in the system. With global shortages of health professionals, we need a vibrant research-active delivery system to attract and retain skilled personnel. The highest performing healthcare systems have research embedded in service delivery and produce innovation and outcomes that are of benefit to patients, enterprise, the nation's health and the tax payer as funder.

Spending on health services constitutes almost 10% of total GDP and, as in many developed countries, by far the largest proportion of this expenditure is publicly financed. Health research delivers economic benefits to the exchequer through direct and indirect savings and through reallocation of resources within the health system. The health services can also be a source of innovation, producing new, marketable products and services that can be sold globally. The strong presence in Ireland of multinational and indigenous lifescience and connected health companies provides a potentially rich source for collaboration between enterprise, academia and the health services. Investment in health research also underpins economic growth, by ensuring a healthier workforce and by providing hi-tech employment opportunities. It creates an attractive environment for R&D investment by pharmaceutical, medical devices and biotechnology industries. Internationally, macroeconomic analyses have found very high returns on investment in health research.

The mandate of the Department of Health influences the research and innovation that it supports. The Health Research Board's *Strategic Plan 2016–2020* builds on the recommendations of the Health Research Action Plan, and both will continue to guide actions in health research in the coming years.

CASE STUDY:

Health Innovation Hub Ireland

Improving innovation capacity and enhancing operational excellence are crucial requirements for the health, lifesciences and ICT sectors in Ireland. A unique characteristic of the health sector is that collaboration between industry and the healthcare system can deliver economic growth, improved patient outcomes and lower healthcare services costs. Health Innovation Hub Ireland is a joint initiative of the Department of Jobs, Enterprise & Innovation and the Department of Health to drive collaboration between the health system and commercial enterprises, leading to the development and commercialisation of new healthcare technologies, products and services, emerging from within the health system and/or enterprise. It will establish Ireland as a leading location for enabling start-up and expanding medtech/healthcare companies to interface easily with hospitals and primary care centres. It will also facilitate the health system to find efficiencies and improvements by engaging with innovative companies creating solutions to problems (reducing cost, increasing service efficiency, improving patient outcomes). A pilot project, implemented in University College Cork in 2012 to test the Hub model, provided access to test-bed infrastructure enabling companies to optimise their approaches to technology performance and testing in complex real-world environments. On the basis of a positive evaluation of this pilot, Government decided to scale the initiative to national level.

CASE STUDY:

The Oncotype DX diagnostic test

Some women with early-stage breast cancers have a reduced risk of cancer recurrence following chemotherapy, while some do not. Inability to distinguish these sub-groups up front has been a clinical problem. As a result, there was no option but to administer chemotherapy to many women without certainty that this would reduce recurrent disease, despite its side effects for the individual and costs for the healthcare system. A new diagnostic test (Oncotype DX), which analyses the expression pattern of 21 genes in breast tumours, promised to address this problem by guiding the clinical decision as to whether or not to give chemotherapy. Due to limited industry interest in research seeking to reduce the number of women receiving chemotherapy, the clinical trial investigating the validity of this diagnostic test was sponsored by the National Cancer Institute (USA), using public funding. Irish participation in this international trial was funded by the HRB through the cancer clinical trials network ICORG. Ireland was the largest recruitment centre outside the US, with approximately 700 women participating. While some of these women are still being followed up until 2017, the trial has already proved very successful in providing clinicians with a tool to help decide on the best treatment. The results have already spared many women unnecessary treatment and the associated side effects. Over the four-year clinical trial, there was an estimated cost saving to the Irish health system of €5m (€3m in avoided chemotherapy and €2m in free Oncotype DX tests for the participating patients). Based on these positive outcomes, Ireland became the first country in the world to reimburse the use of Oncotype DX as a diagnostic for routine cases.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.8	Support a conducive environment for health research in Ireland	Continue the development of a coordinated approach to research management in the health system.	Department of Health	2016 - 2020
4.9	Support exceptional researchers, talent and leadership in health research and build a strong enabling environment for Irish health research, nationally and internationally.	<ul style="list-style-type: none"> a. Support innovative, investigator-led and internationally competitive research to address major health challenges b. Support the conduct and evaluation of healthcare intervention studies in order to improve health outcomes and health service delivery c. Support partnership-driven research, information and evidence that meet the needs of the Irish health and social care system. d. Support exceptional research, talent and leadership in health research. e. Build a strong enabling environment for Irish health research nationally and internationally 	Health Research Board	2016 - 2020
4.10	Support collaboration between the health system and enterprise leading to development and commercialisation of new healthcare technologies and to facilitate the health system to find efficiencies and improvements.	<ul style="list-style-type: none"> a. Establish a national Health Innovation Hub Ireland (HIHI). b. Explore and develop collaborations in the context of the eHealth Strategy for Ireland²⁵ and the Knowledge & Information Strategy.²⁶ 	<p>DJEI, Department of Health</p> <p>Department of Health and HSE</p>	<p>2016</p> <p>2016 - 2020</p>

We will promote innovation in agri-food...

The sustainable development of the agri-food sector and the optimisation of its contribution to national economic development and the natural environment is a key national goal. The agri-food sector represents our largest and most important indigenous sector, providing direct employment for 170,000, with a gross annual output of €26bn and €10.5bn of exports to more than 170 countries.

25 eHealth Strategy: Bringing improved population wellbeing, health service efficiencies and economic opportunity through the use of technology enabled solutions, Dept of Health Dec 2013

26 Knowledge and Information Strategy: Delivering the Benefits of eHealth in Ireland, HSE May 2015

The major priorities facing the Irish agri-food sector include:

- progressing the economic development and enhancing the competitiveness of the sector, focusing on efficiency and profitability;
- becoming a recognised world leader in sustainable, scientifically verified food production, and capturing new market opportunities;
- promoting and enhancing the already high standards of food safety, consumer protection, animal health and welfare, and plant health; and
- becoming a consumer/citizen orientated industry, with incremental and significant innovations in food.

Research and innovation play crucial roles in delivering on these priorities. The Department of Agriculture, Food & the Marine and its agencies (including Teagasc) play the lead role in advancing these priorities, and Teagasc is the independent Government agency with a statutory role in the provision of research, education, training and advisory services for the Irish agri-food sector.

The Department of Agriculture, Food & the Marine's *SHARP – Sustainable Healthy Agri-Food Research Plan*, provides the blueprint to guide the future direction of research funding in the Research Prioritisation areas of Sustainable Food Production & Processing and Food for Health. The Department's Strategic Research Agenda in relation to forestry, *Forest Research Ireland (FORI)* outlines our ambition for policy, knowledge and production-focused forestry. *Food Wise 2025 – A 10-year vision for the Irish agri-food industry* sets out ways in which the aspiration for growth in this sector can be realised. It sees research, development and innovation as key drivers of competitiveness.

Teagasc seeks to improve the competitiveness of agriculture, food and the wider bio-economy, to support sustainable farming and the environment, and to encourage diversification of the rural economy and enhance the quality of life in rural areas. Teagasc is currently engaged in a foresight exercise to identify the key technologies that will drive growth and innovation in the agri-food sector over the coming decades.

The bio-economy addresses the production of renewable biological resources and their conversion into products and bio-energy. In 2013, the EU published a bio-economy strategy for Europe, dealing with production, consumption, processing, storage, recycling and disposal of biological resources. The Department of Agriculture, Food & the Marine has funded the BIO-ÉIRE project, which aims to identify and assess national and international bio-economy opportunities over the medium and longer term.

CASE STUDY:

Cattle breeding

In recent years, genome-based selection algorithms have caused a paradigm shift in how animal and plant breeding programmes operate, and Ireland is at the forefront in the development and deployment of this technology in cattle. Selection of elite animals as candidate parents of the next generation is no longer just based on the observed performance of the animal and its relatives, but also takes into account the unique DNA or genomic characteristics of the animal. With funding support from DAFM, Teagasc, the Irish Cattle Breeding Federation and industry, Teagasc research resulted in Ireland being the second country in the world (after the USA) to introduce genome-wide enabled selection into its national dairy cattle breeding programme. This has resulted in an increase of more than 50% in the rate of genetic gain in the dairy herd. More recently, Ireland has embarked on the most ambitious beef cow genotyping project in the world, with over 1 million beef cows to be genotyped in the coming years. This will make Ireland a global leader in research to enhance genomic selection of beef cattle, and will provide Ireland with possibly the largest database globally of genomic information for any species, including humans.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.11	Future agri-food research to be informed by consumer insights to improve translation of research output into commercial products on market.	Explore with industry the potential for developing a Centre for Consumer Insight to inform future investment in research and development by Irish agri-food research bodies.	DAFM, Bord Bia	2016 - 2020
4.12	At producer level, prioritise research and innovation investment in processes and technologies which improve productivity and sustainability of production.	Progress research investment areas identified in SHARP.	DAFM	2016 - 2020
4.13	Improve coordination between industry, State agencies and research institutions to support the delivery of research that will deliver commercial outputs and products.	Review agri-food sector innovation capacity; review coordination of agri-food research technology centres.	DAFM, Teagasc	2016 - 2020
4.14	Improve capacity of agri-food companies to absorb research and innovation output from research bodies.	<ul style="list-style-type: none"> a. Develop proposals for a Food Innovation Hub at its Moorepark campus. b. Lead research in collaboration with other research institutions and industry to derive applications from the significant investment in foods for health. c. Complete the €10m upgrade of Moorepark Technology Limited pilot plant. d. DAFM to continue to partner with the Irish Research Council's employment based Research Programme to facilitate the placement of post-graduate research students in agri-food enterprises. Develop further joint research / funding initiatives in Precision Agriculture e. DAFM funded Agri-Food Graduate Development Programme to continue to upskill agri-food graduates for employment 	<p>Teagasc</p> <p>Teagasc</p> <p>Teagasc</p> <p>DAFM, IRC</p> <p>SFI, Teagasc, DAFM</p>	2016 - 2020

<p>4.15</p>	<p>Invest strategically in the bio-based economy, rural development and along the food chain</p>	<p>Identify and progress research, development and innovation investments in the bio-based economy, in rural development and in reducing losses along the food chain.</p>	<p>DAFM</p>	<p>2016 - 2020</p>
<p>4.16</p>	<p>Develop a national bio-economy strategy</p>	<p>Develop a bio-economy strategy to identify opportunities for Ireland to build innovative enterprises to address the global requirement for replacing fossil-derived consumer goods with bio-based alternatives.</p>	<p>DAFM, DCENR, DECLG, relevant funders</p>	<p>2017</p>

We will promote innovation in marine...

The marine sector contributed an estimated €1.4bn to Ireland’s GDP in 2014. With an estimated turnover of €4.5bn, the sector employs approximately 18,500 people and a further 13,000 are indirectly employed across the wider economy, providing an additional €3.3bn in turnover.

Enabling our marine potential to be realised is a key national objective. Our targets are to double the value of our ocean wealth to 2.4% of GDP by 2030 and to increase the turnover from our ocean economy to exceed €6.4bn by 2020. Ireland’s integrated marine plan, *Harnessing Our Ocean Wealth*, includes research, knowledge, technology and innovation as core enablers in realising the potential of our marine sector.

The Marine Institute is the State agency responsible for marine research, technology development and innovation in Ireland, and it provides independent scientific and technical advice to Government to help inform policy and to support the sustainable development of Ireland’s marine sector. The Institute engages in and supports RDI programmes that promote the sustainable use of Ireland’s extensive marine resource, supports and informs public policy, and promotes Ireland as a leader in marine research. The Marine Institute will produce a national marine research and innovation strategy which will focus on a number of research topic areas under three broad cross-connected themes:

- A thriving marine economy
- Healthy marine ecosystems
- Engagement with the sea.

CASE STUDY:

Marine energy research, development and innovation facilities

Ireland has a unique wave, tidal and offshore wind energy resource. This provides a unique opportunity to develop an indigenous ocean energy industry and to become an international destination for testing and demonstrating ocean energy devices and marine sensors. Since the publication of the *Offshore Renewable Energy Development Plan (ORED)* by Government in 2014, several State agencies have worked together to create a national network of facilities that cover all Technology Readiness Levels along the Atlantic coast.

TRL 1- 4: The Lir National Ocean Test Facility, co-located with the headquarters of the SFI-funded MaREI research centre at University College Cork’s Beaufort Building, has provision for 135 researchers and support staff in offices and across a suite of start-of-the-art test tanks and dedicated workshops.

TRL 4- 6: The Smart Bay Marine & Renewable Energy Test Site in Galway Bay supports the translation of technology research from a laboratory environment to a real-world environment for ocean sensing and marine energy products and services. The facility is supported by the Marine Institute and SEAI, with initial funding under HEA PRTL Cycle V. With funding from SFI, it recently installed a fibre-optic and power subsea cable, which has given it the ability, unique in Europe, to deploy devices underwater. The site facilitates the testing of quarter-scale ocean energy devices.

TRL 7- 9: The Atlantic Energy Test Site (AMETS) off the coast of Belmullet, Co. Mayo is being developed by SEAI, with technical support from the Marine Institute, to facilitate testing of full-scale wave energy converters in an open-ocean environment.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.17	Support progress towards the <i>Harnessing Our Ocean Wealth</i> targets through coordinated marine research and development strategies	<ul style="list-style-type: none"> a. Publish and implement a National Marine Research & Innovation Strategy to 2020. b. Implement the recommendations of the Interdepartmental Marine Coordination Group, Development Task Force focused on research translation and development. 	<p>Marine Institute</p> <p>Funding departments and agencies</p>	2016 - 2020

We will promote innovation in environment...

In relation to the environment, Ireland's goal is to ensure that our development is sustainable environmentally, socially and economically. Policies underpinning this goal are set at international, EU and national level. At EU level, key strategies such as the 7th Environment Action Programme and Europe 2020 are important drivers for the research agendas at both national and EU levels. Ireland's *Framework for Sustainable Development* provides an integrated cross-Government framework for transitioning to a resource-efficient, low-carbon and climate-resilient future and for driving a major reorientation of public and private investment, including in innovation, research and development, with a focus on the green economy.

The Government's policy statement on growth and employment in the green economy, *Delivering our Green Potential*, identifies significant opportunities for economic growth and employment. The Expert Group on Future Skills Needs estimated that some 18,750 people were employed in the green economy.

Research, development and innovation are central to sustainable development. Living well within ecological limits will require fundamental transitions in the systems of production and consumption that are the root cause of environmental and climate pressures. By increasing understanding of the environment and the environmental consequences of human activities, and changing attitudes towards environmental issues, environmental research can have a profound and long-lasting effect on our society and economy.

Through its research programme, the Environmental Protection Agency (EPA) plays a key role in providing the evidence base for policy actions to achieve short- and long-term improvements in our environment, health and economic prosperity. The *EPA Research Strategy 2014-2020* is organised around three pillars: climate, water and environmental sustainability. It aims to identify pressures, inform policy and develop solutions to facilitate and inform a credible knowledge base underpinned by evidence-based research. The strategy recognises that the environment must be protected and proactively managed to ensure it forms the basis for a healthy society and economic well-being. Key priorities of the EPA research programme include:

- developing integrated approaches to addressing the challenges that arise from climate change, air and water quality and other environmental issues, and identifying growth opportunities arising from them
- deepening our understanding of the role of the natural environment in sustaining well-being and the economy
- reducing waste generation and treating waste as a resource
- identifying and informing cost-effective transition pathways to a carbon-neutral and climate-resilient Ireland, and understanding how individual and collective behaviour can influence this transition.

The outcomes of the research programme will help support effective and efficient policy development and decision-making (for example, significant infrastructure investment may be required for climate change adaptation and river basin management). The will also inform our position in EU and international processes. Research to identify pressures on the environment (air, water, soil quality) is essential to preserve and enhance the ecosystem upon which public well-being and economic development depends.

CASE STUDY:

Soil quality and carbon content

EPA funding has been central to development of the new national soil map which provides insights into the structure of Ireland’s soil and the processes that enable it to sustain agriculture and other essential ecosystems and resources, such as fresh water. It provides key information for determining the options for better management of soil and land resources.

EPA-funded research has also been at the forefront of studying carbon uptake in key ecosystems, such as grass and peatlands. This research, along with analysis of non-forest biomass pools, has enabled Ireland to elect these areas, along with forestry, as part of our commitments under the 2nd Commitment Period of the Kyoto Protocol and supported Ireland’s engagement with EU on future actions on climate change, as well as contributing to longer-term national policy. EPA funded researchers have also contributed to the development of the reports of the Intergovernmental Panel on Climate Change.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.18	Implement the actions identified in EPA Research Strategy 2014–2020	Support and inform transformation of Ireland’s economy and society to a sustainable base with reduced environmental damage and adverse impacts on human health, by generating evidence and building models to inform policy development and implementation, and developing solutions through novel technologies and methods that address global and regional challenges.	EPA	2016 - 2020

We will promote innovation in the digital society...

Ireland’s ICT sector is world-renowned and continues to flourish. Nine of the world’s top ten ICT companies are located here. The industry employs over 37,000 people and generates €35bn in exports annually. New technologies can deliver major transformative impacts and we can see this particularly in the way information and communications technologies have changed how we live and work. The priorities for an action-oriented approach to innovation outlined in the *OECD Innovation Strategy*²⁷ include ‘seize the benefits of the digital economy.’

The vision set out in *Doing more with Digital – the National Digital Strategy for Ireland* is one of an inclusive knowledge society. Specific research priorities to underpin this vision include:

- data analytics
- mobility
- cyber security
- identity
- digital financial transactions
- platform interoperability
- telemedicine
- telepresence
- autonomous transport

27 OECD Innovation Strategy 2015: An Agenda for Policy Action

The importance of data analytics is recognised in the “Big Data” Disruptive Reform in the *Action Plan for Jobs*, which seeks to strengthen Ireland’s position as a global leader in the data and analytics space, and enable businesses and public sector organisations to benefit from the insights provided by data analytics for the achievement of their respective objectives. The significance of the digital society is also reflected in the three ICT-related priority areas under Research Prioritisation:

- Future networks and communications
- Data analytics, management, security and privacy
- Digital platforms, content and applications

The National Digital Research Centre is an early-stage investor in tech companies and works side-by-side with researchers, entrepreneurs and venture teams to turn ideas into successful new ventures by providing the resources including people, time, space and investment at the earliest stages of company creation.

Healthcare, and specifically the area of eHealth, also has significant potential for development with social and economic benefit, with convergence of opportunities around technology including software, hardware, smart devices, sensor technologies and data analytics. Governments across the world are engaged in healthcare reform that will be underpinned by digital transformation thus providing a world market for health technology products and new services. This presents significant global opportunities and job creation potential for industries in Ireland.

CASE STUDY:

Internet of Things (IoT)

The Internet of Things (IoT) refers to the network of physical objects or ‘things’ that are embedded with electronics that enable connectivity to the Internet via a WiFi or mobile network. Machine-to-machine control, smart cities, smart agriculture, and connected health are all potential applications that require IoT services. A joint industry and Government Task Force on Big Data has been established to develop the high-growth sectors of big data and data analytics in Ireland. Ireland is currently poised to be the leader in the generation of business and enterprise solutions around IoT, with available spectrum, supportive communications regulators, and multinationals and SMEs that have IoT as a key feature of their development roadmaps. The Irish State has also invested in research in IoT through a range of SFI Research Centres and EI/IDA Technology Centres.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.19	Create high-impact ventures out of opportunities in the research base and accelerate business model innovations	Continue to support the National Digital Research Centre (NDRC)	DCENR	Ongoing

We will promote innovation in energy...

The recent *Green Paper on Energy Policy in Ireland*²⁸ set out six priorities for policy:

- Empowering energy citizens
- Markets and regulation
- Planning and implementing essential energy infrastructure
- Ensuring a balanced and secure energy mix
- Putting the energy system on a sustainable pathway
- Driving economic opportunity

²⁸ *Green Paper on Energy Policy in Ireland*, Department of Communications, Energy & Natural Resources, 2014.

National goals for energy over the period to 2030 will be set out in the forthcoming *Energy White Paper*. The theme of the White Paper will be one of transition: the continued decarbonisation of the energy fuel mix, the development of indigenous energy supplies, and the move towards sustainability. The last priority area listed above – driving economic opportunity – is reflected in one of the Disruptive Reforms in the *Action Plan for Jobs 2015*. This Disruptive Reform aims to establish Ireland as Europe’s Energy Innovation Hub by 2020 through targeted and coordinated action by a new research and industry partnership.

Energy research is an integral part of Ireland’s energy policy, and a new energy research strategy is being developed in tandem with the White Paper. A productive research environment will help to develop the tools for transitioning to a sustainable low-carbon environment and to make Ireland a world leader in the energy transition. It can also help to create economic opportunities and to provide long-term societal and environmental benefits. The importance of energy research is reflected in the selection of marine renewable energy as a priority area under Research Prioritisation, as is the selection of smart grids and smart cities, which have the potential to deliver greater resource efficiency.

CASE STUDY:

The Energy Systems Integration Partnership Programme

Energy Systems Integration (ESI) is a multidisciplinary area spanning science, engineering, technology, policy, economics, regulation and human behaviour. It is coming to the fore in the planning, design and operation of the global energy system. It seeks to optimise the energy system and other large-scale infrastructures, in particular water, by leveraging the synergies across all scales and pathways (electricity, fuel and heat).

The Energy Systems Integration Partnership Programme is conducting research in this important area. It has been funded under SFI’s Strategic Partnership Programme to a value of more than €11m, supplemented with a philanthropic cash contribution. It includes lead academics from UCD, five industry partners (AIB, EirGrid, Ervia, Glen Dimplex and ESB), and 17 industry collaborators.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.20	Implement research-related actions in the forthcoming <i>Energy White Paper</i> and <i>Energy Research Strategy</i>	Build on the integration of energy research, development and commercialisation support activities to further develop a coherent energy innovation process and to ensure maximum impact from our investment in energy research.	DCENR	2016 - 2020

We will promote innovation in natural resources...

Sustainable and efficient natural resource management is particularly important in the context of global shortages of raw materials, minerals and energy, and the environmental/geoscience impacts (e.g. radon, health risks, environmental damage) of resource exploitation. To manage our resources responsibly, we need to improve our knowledge of the Earth and its resources, build strong collaboration with researchers, and connect to other key sectors, such as technology development, energy, health, digital data and agri-food.

The Geological Survey of Ireland (GSI) provides geological advice and information and acts as a knowledge centre and project partner in all aspects of Irish geology. GSI’s INFOMAR marine mapping programme and the geological mapping and TELLUS (geochemistry and geophysical) mapping programmes contribute directly to the marine, agri-food, and raw materials and minerals industries. In addition, an average of 25% of water used in Ireland (up to 100% in some counties) comes from groundwater sources; in light of increased focus on FDI and water resource characterisation, it is essential that we continue to improve our understanding of the solid Earth and our groundwater resources. The high-quality data produced and managed by the GSI is used by industry, academia and other agencies in a wide range of research and development areas. The GSI’s *Geoscience Research Strategy 2015–2020* sets out a roadmap for geoscience research towards 2020 including:

- structured funding of Irish geoscience research
- securing further, non-exchequer funding for geoscience research
- establishing new collaborations and strengthening existing links with external researchers, both nationally and internationally
- raising Ireland’s international profile as a location for geoscience excellence

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.21	Implement <i>Geoscience Research Strategy</i>	Implement actions identified in <i>Geoscience Research Strategy 2015–2020</i>	DCENR, GSI	2020
4.22	Develop a network to support researchers and business partners in addressing economic and societal challenges in geoscience	Establish and strengthen networks for geoscience collaborators to increase impact of research outputs and to help secure non-exchequer funding	DCENR, GSI	2017
4.23	Complete INFOMAR, National Marine Mapping Programme	Implement Phase 2 of INFOMAR, 2016-2026 to complete mapping of all Irish waters	DCENR, GSI and MI	2026
4.24	Complete TELLUS Programme	Complete TELLUS, national coverage of airborne geophysics and ground geochemistry as national environmental baseline	DCENR, GSI	2023

We will promote innovation in defence...

The Government’s *White Paper on Defence*²⁹, sets out the defence organisation’s goals for research. Well-funded research is a driver of enhanced capability and opportunities arising from EU funding for research are being assessed by the Department of Defence. We will continue to progress opportunities for cooperative-collaborative engagement between the Defence Forces and Irish-based enterprise and research institutes, including third-level colleges, through the Defence Enterprise Initiative, a joint initiative of the Department of Defence and Enterprise Ireland. This includes information exchange and supporting indigenous industry in product/service development and evaluation where this contributes to the Defence Forces’ capabilities. The primary purpose of these activities is to support the development of the Defence Forces’ capability for crisis management, while leveraging the opportunities that may arise for innovation, growth and jobs in Ireland-based industry and thus contributing to Ireland’s economic development.

The Naval Service will continue to be part of the Irish Maritime and Energy Resource Cluster (IMERC), along with its partners, Cork Institute of Technology and University College Cork. This research and commercial cluster brings together expertise in the fields of energy engineering, maritime operations, maritime technology and ecosystem governance. It aims to realise Ireland’s economic potential in the global maritime and energy markets, and both the cluster and the Naval Service will continue to work closely with the Marine Institute.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
4.25	Develop the Defence Enterprise Initiative further over the course of the White Paper.	Continue to support Ireland-based enterprise in its engagement with the European Defence Agency (EDA) and in accessing EDA and Horizon 2020 programmes. Continue to progress opportunities for cooperative-collaborative engagement between the Defence Forces and Ireland-based enterprise and research institutes.	D/Defence, Enterprise Ireland D/Defence, Enterprise Ireland, HEIs	2016 - 2020
4.26	Establish a Security and Defence Enterprise Group	This group will bring together enterprise and academic researchers and practitioners in the areas of security and defence with the purpose of identifying areas of common endeavour and collaboration.	D/Defence	2016

5

THE ROLE OF INTELLECTUAL PROPERTY IN INNOVATION

Intellectual Property drives innovation

Business sectors that depend on and use intellectual property (IP) strategically represent an important and growing part of modern economies, and are substantial drivers of GDP and employment growth. A joint study carried out in 2013 by the European Patent Office and the Office for Harmonisation in the Internal Market found that 39% of total economic activity (GDP) and 26% of employment in the EU is generated by IP-intensive sectors. These sectors accounted for most of the EU's trade with the rest of the world, and workers in these sectors enjoy a wage premium, with 40% higher remuneration than in industries engaged in non-IP-intensive sectors.

A competitive IP protection regime supports the creation of proprietary knowledge and simultaneously encourages its exploitation by rewarding the knowledge creators. A fit-for-purpose IP regime acts therefore as an important driver of innovation, leading to economic and employment growth.

We will strengthen knowledge transfer for Innovation...

Optimising the transfer of knowledge from our public research system to enterprise has been central to our strategy for science and innovation for many years. We have built up capacity within the public research system to engage with industry on issues relating to intellectual property, and we have assisted industry – and SMEs in particular – to absorb research outputs and to engage with the academic research community. Key recent initiatives in this regard include the development of an IP Protocol³⁰ that provides a framework for industry-academic collaboration, and the strengthening of the technology transfer offices within the HE sector, coordinated through Knowledge Transfer Ireland (KTI) since 2013.

KTI, which is based within Enterprise Ireland and co-funded by the Irish Universities Association, operates as a partnership between the public research system and the enterprise sector. It enables the enterprise sector to leverage the commercial potential of Irish research and innovation by connecting businesses with cutting-edge research, expertise and opportunities. KTI has promoted the use of the IP Protocol across the public research system and industry and is already preparing a revision to take account of the experiences of users. The Protocol, which of its nature is technical and legalistic, will be complemented by practical 'how to' guides to help researchers and enterprises to engage with each other on matters relating to IP.

30 *Putting Public Research to Work for Ireland*, Department of Jobs, Enterprise & Innovation, June 2012

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
5.1	Publish a revised IP Protocol to ensure that the Irish protocol remains ‘best in class’	A revised IP Protocol will be published incorporating feedback from industry and other stakeholders on issues identified in operating to the current protocol	DJEI, KTI	2016
5.2	Provide additional resources and tools to improve industry-academic collaboration	Expand resources and tools for enterprise to engage with the public research system and to access IP, including model agreements, practical guidelines and improved information on expertise within the public research system.	KTI	2016

We will promote more extensive commercialisation of public research...

The Irish knowledge transfer system has been ranked first in Europe by the European Commission. Enterprise Ireland works with researchers in higher education and other RPOs to help maximise the commercial return from publicly-funded research. The Enterprise Ireland Commercialisation Fund provides directed, specialised funding for academic researchers to take research outputs with commercial potential and bring them to a point where they can either be transferred into enterprise or spun out into a new start-up company. This instrument is relatively unique globally and is recognised as a key tool for translating research into spinout companies and commercially valuable technologies in Ireland. Other routes to commercialisation include the Department of Agriculture, Food and the Marine’s Research Plus programme, which provides supplementary funding to applied Food Industrial Research Measure projects nearing completion to bring them to a point where they can access EI support, and the SFI/EI Technology Innovation Development Award, which enables researchers to undertake applied research projects with commercial potential.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
5.3	Encourage commercialisation of publicly-funded research	All funders of public research will increase the commercialisation of the research that they support, using the available commercialisation and technology transfer programmes, to ensure the efficient transfer of economically valuable research outputs to enterprise and to meet the following targets: <ul style="list-style-type: none"> a. Commercially relevant technologies (Licences, Options, Assignments): 175 b. Spinouts: 40 c. High Potential Start Ups (HPSUs) from Spinouts: 16 d. Collaborative research projects between enterprise and the public research system: 920 	All research funders	2016 - 2020

Having built knowledge transfer capacity across the system, the focus of our endeavours over the course of this strategy will shift increasingly to the quality of IP that is being protected and the quality of engagement with the users of IP. Our focus on quality engagement will be reflected in a new set of impact metrics for knowledge transfer that move beyond counting licences and spinouts to measuring the quality and longer-term economic impact of these outputs.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
5.4	Set new targets for the commercialisation of research	Develop new impact metrics for commercialisation of publicly funded research and set targets for both outputs and impacts commensurate with increased public investment.	DJEI, EI	2017

KTI is also responsible for implementing the Technology Transfer Strengthening Initiative (TTSI), the funding instrument through which resources are provided to the Higher Education sector to provide expertise in knowledge transfer as well as funding for patenting and related activities. Since TTSI was first introduced in 2007, over €50m has been invested in Ireland’s technology transfer infrastructure. An interim performance review at the end of 2014 by an international panel of experts concluded that there had been significant value achieved from the investment in the TTSI programme to date. Cited in particular was the speed of evolution of the technology transfer infrastructure and the novel approach to scaling through the creation of consortia.

Ireland’s knowledge transfer system is comparable with some of the best international performers:

- Invention activity – on average, Ireland files 25 new patent applications a year per €100m in research expenditure, similar to the average for middle-ranking UK universities;
- Licensing – on average the public research system produces 30 new licences per annum per €100m in research expenditure, which is on a par with a number of leading US universities;
- Spinout companies – on average Ireland is forming eight new spinouts per €100m in research expenditure annually and has a three-year survival rate for spin-outs of 20 per €100m. This compares favourably with some of the best performing research institutes in the US.

The current round of funding (TTSI 2) will run to the end of 2016, and the design of a successor programme is already underway. As well as the traditional outputs of patents, licences and spinouts, there will be a greater focus in the next programme on the quality of IP being generated and protected and this will be reflected in the impact measures used (for example, the conversion of spinouts into High Potential Start-Ups, and the income generated from patents and licences). Linked to the development of a successor to TTSI 2, the operations and funding of KTI will be reviewed in 2016 with a view to deciding on structures for knowledge transfer from 2017 onwards.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
5.5	Implement a successor to the current Technology Transfer Strengthening Initiative and review the operations of KTI	Launch a further TTSI programme (TTSI 3) to embed knowledge transfer within the public research system; review operations and funding of KTI.	DJEI, EI with IUA	2017

We will improve IP exploitation by Irish enterprises

IP is a key enabler to support innovation in the enterprise base. It is increasingly considered a strategic tool for value generation, with IP portfolios being assessed on the basis of potential markets rather than the potential of technologies. Therefore, IP rights have become building blocks of entire business models, making the skill of good IP management a decisive success factor for business in many innovative industries, and IP management an important focus of innovation policy.

Direct State supports include IP advisory and filing costs through the general R&D support schemes and Enterprise Ireland’s High Potential Start-Up scheme. Indirect State supports for IP are also available as an incentive to firms in Ireland via a variety of tax-related measures. In terms of softer supports, the EU IP rights Helpdesk acts as a useful first port of call for IP enquiries and, at national level, the Patents Office engages in awareness-raising activities working alongside the enterprise agencies.

A report by Technopolis in 2015³¹ concluded that there was an overall lack of awareness around IP and limited IP management capability within the Irish enterprise base. Research also supports the view that IP performance in Ireland trails firm-level innovation performance and that there is a basis for policy intervention to help increase usage of IP by firms. The report concluded that, to realise the ambition of enhanced IP activity by firms, there is a need for policy intervention aimed at raising the profile of the enterprise opportunities related to IP and seeking to develop IP management capacity in firms.

31 Enhancing the intellectual property activities in the firm base in Ireland

Consideration of the approaches adopted in innovation-leading countries highlights the opportunity to evolve current supports and initiate new supports in order to drive an increase in IP use across our enterprise base. The research indicates that such IP supports should be focused across all forms of IP (both formal and informal) and should seek to raise awareness of IP, support the development of a stronger IP culture, and support increased IP knowledge and IP management capability in firms across the enterprise base. In implanting these IP supports, international practice suggests that the supports should be connected to the broader innovation and business support landscape, not treated as a separate, specialist subject.

The introduction of the Knowledge Development Box announced in Budget 2016 with a startup date of 1 January 2016 will act as a further incentive for companies engaged in R&D, allowing them to claim tax relief on profits arising from qualifying IP.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
5.6	Raise IP awareness	Strengthen IP awareness of the opportunities for firms to engage in IP activity.	DJEI, Patents Office, EI and LEOs	2016 - 2020
5.7	Build IP capability and resilience at enterprise level	Focusing on Ireland-based R&D-active and export-oriented client base, establish an inter-agency group (led by EI) to develop a roadmap for building IP capability and resilience at enterprise level.	EI, DJEI with relevant agencies	2016 - 2020
5.8	Invest in widespread IP education	Review opportunity to include modules on IP management in relevant courses in higher education.	HEA, DES	2017
5.9	Measure progress of IP activity in firms	Develop an approach for measuring and monitoring progress of IP activity in the firm base.	Inter-agency group at 5.7	2017

We will position Ireland's IP framework to encourage innovation

We recognise that a competitive IP framework is essential to facilitating innovation, leading to economic development and growing employment.

The IP system creates a system of IP rights that take a number of legal forms, both formal and informal: formal IP rights are normally registered, and include patents, industrial designs and trademarks; informal IP rights are not normally the subject of formal registration systems, and include trade secrets and works protected by copyright, such as software, and musical and artistic works. Regardless of the nature of the IP rights, the system of IP protection seeks to strike a balance between the need for the creators to derive economic benefit from their creations/inventions on the one hand, and that of the wider public policy imperative of facilitating innovation on the other.

Over the course of the strategy, we will seek to strengthen our IP regime by continuing to review and modernise it, in relation to both formal and informal rights, by bringing forward legislative measures to deal with priorities at domestic, EU and international level. We will also focus on the administration of justice with a view to improving IP enforcement at reasonable cost.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
5.10	Introduce legislative changes relating to copyright	Bring forward legislative proposals to implement reforms recommended by the Copyright Review Committee aimed specifically at exploring greater use of certain copyright exceptions to promote innovation.	DJEI	2016 - 2017
5.11	Improve patenting options for business	Implement European unitary patent system and work with stakeholders to make the case for approval by referendum of the Unified Patent Court with a presence in Ireland.	DJEI	2016 - 2017
5.12	Address cost issue of IP enforcement through access to the lower courts	Improve accessibility and cost issues for IP enforcement by facilitating enforcement of lower value claims through the lower courts.	DJEI, DJE	2016 - 2017
5.13	Support the Knowledge Development Box	Develop outline scheme and attendant legislation to support the Knowledge Development Box for qualifying IP assets.	DJEI, Patents office	2016

6

INNOVATING WITH THE EU AND THE WIDER WORLD

“...the future of innovation lies in bringing as many different people, concepts and fields together.”

- Carlos Moedas, EU Commissioner for Research, Science and Innovation

“The most impactful science comes from international collaborations, from interdisciplinary teams often from academia and industry. And that’s not surprising because many scientific advances occur at the interfaces. That’s where exciting things happen.”

**- Professor Mark Ferguson, Chief Scientific Adviser to the Government,
Director General of Science Foundation Ireland**

We will engage with the rest of the innovation world

As a small, open economy, Ireland relies on external demand and international markets for sustainable and continued growth. The market for innovation and research is also global – international cooperation in research and innovation plays an important role in the development and sustainability of a world-class innovation and research system. We will facilitate, develop and exploit global research cooperation, and we will reinvigorate our networks with global partners in the development of solutions to shared societal problems and the pursuit of innovation.

International cooperation maximises the impact of international and national investment in research and innovation. It contributes to the development of Ireland as a research and enterprise partner, underscoring and enhancing the excellence of our research and innovation system and facilitating engagement with the Irish diaspora. A key plank of our engagement in international cooperation is participation of our researchers and enterprise in the EU Framework Programmes for Research and Innovation. We have performed well in winning competitive funding under these Programmes. The majority of funding is secured by our Higher Education Institutes, with the balance being won by enterprise and public bodies. We intend to build on past success and we have set an ambitious target of €1.25bn for the current programme, Horizon 2020, the largest ever EU research and innovation programme.

Through engagement in bilateral cooperation, via research and innovation agreements, we build innovation capacity, facilitate researcher mobility, and allow for economies of scale. An example is increasing access to large research infrastructures – this engagement leads to sharing of experience, improving our research reputation, increasing innovation opportunities, and further enhancing the excellence of our research. Our research funders in different sectors engage in international cooperation to seek to influence European and international agendas and also to assist developing countries in addressing their challenges.

The manifold benefits of international engagement accrue not only to our researchers but also to our enterprise base and to our public policy makers.

We will deepen Ireland's engagement in the EU

Our current engagement at EU level focuses on contributing to the creation of the European Research Area and on maximising Irish participation in Horizon 2020.

Irish participation in Horizon 2020

Horizon 2020, with a budget of approximately €78bn, is based on three pillars:

- Excellent science
- Industrial leadership
- Addressing societal challenges

The first pillar focuses on basic research. Under this pillar the European Research Council (ERC), a key part of Horizon 2020, provides grants to individual researchers or research teams. Excellence is the only criterion. Irish researchers have performed well in winning these prestigious awards so far under Horizon 2020. We plan to build on this success, as these awards are a global as well as a European benchmark of excellence.

The industrial leadership pillar aims to support ground-breaking technologies that will underpin innovation across all sectors. There is more of an innovation focus to the current Framework Programme, with closer-to-market opportunities. This pillar includes a specific SME initiative called the SME Instrument and a Fast Track to Innovation pilot.

Seven priority societal challenges have been identified, where funding in research and innovation may have a real impact for Europe's citizens. These include:

- Health, demographic change and wellbeing
- Food security, sustainable agriculture and forestry, marine and maritime and inland water, research and the bio-economy
- Secure, clean and efficient energy
- Smart, green and integrated transport
- Climate action, environment, resource efficiency and raw materials
- Europe in a changing world – inclusive, innovative and reflective societies
- Secure societies – protecting freedom and security of Europe and its citizens

In addition, the European Institute of Innovation and Technology supports consortia to boost the EU's innovation capacity in what are seen as key societal challenges for Europe. A number of our HEIs and enterprises have had success in engaging with these consortia (for example, in health and raw materials), and our ambition is to replicate that success in future consortia.

The benefits for successful participants include working with lead researchers, gaining new scientific knowledge and skills, access to funds, the sharing of risks and costs and – crucially – building transnational linkages that can provide the basis for future collaborative partnerships.

Under Framework Programme 7 (FP7), the predecessor to Horizon 2020, we succeeded in winning funding of €625m, surpassing the national target of €600m. For Horizon 2020, we have more than doubled our ambition and have set a target of €1.25bn. This recognises the significant development of our national research and innovation system over the lifetime of FP7 and previous framework programmes.

A national strategy to support and drive our participation in Horizon 2020 has been put in place and a National Support Network, coordinated by Enterprise Ireland, provides hands-on assistance to our researchers and companies to actively participate in Horizon 2020. To optimise the return to Ireland, this network and other stakeholders work to influence the EU agenda in favour of Ireland's interests.

The national effort to achieve our Horizon 2020 goals is overseen and driven by the High Level Group (HLG) chaired by Department of Jobs, Enterprise and Innovation. All research-funding Government departments and agencies are represented on this Group, as well as the higher education sector and InterTradelreland.

Achieving the ambitious national target will require success in projects of higher scale and value than previously. In recognition of this, the Strategic Research Proposals Group (SRPG) was established under the auspices of the HLG. The SRPG is chaired by the Chief Scientific Adviser to the Government and is working to catalyse the development of larger project proposals. This strategic approach aims to bring together researchers and companies across sectors to exploit large-scale opportunities in Horizon 2020.

To support more Irish collaboration with other countries in Europe, and thereby increase the potential for large-scale Horizon 2020 wins, more effective and sustainable support will be developed, particularly in areas where Ireland can provide a unique selling point. Some of these areas of strength include, but are not limited to:

- Marine (observation, energy and aquaculture)
- Smart/precision agriculture
- Food for health
- Pharma (process development and manufacturing)
- Microelectronics
- Internet of Things
- Advanced materials/additive manufacturing
- Alternative energy
- Smart grids
- Data privacy/Big Data.

All Island Horizon 2020 cooperation

There is a North-South dimension to our participation in Horizon 2020, with a target of €175m for North-South collaborations. An All Island Horizon 2020 Steering Group, chaired by InterTradelreland, monitors North-South collaborative participation and drives forward the level of North-South projects through InterTradelreland awareness campaigns and by building research links between the respective contact points North and South. Successful North-South collaborations are taking place in the areas of Marie Skłodowska-Curie Actions, ICT, health and agri-food. The strengthening of collaboration between the two jurisdictions to maximise mutual benefit under Horizon 2020 is closely monitored by the North-South Ministerial Council.

Through the Investigator Programme 2015, SFI has entered into a collaborative arrangement with Government departments and funding agencies North and South to build capacity, improve knowledge sharing and prepare the scientific community across the island of Ireland to compete, lead and win in Horizon 2020 funding programmes. Co-funding partners in this programme include the Northern Ireland Department for Employment & Learning, Teagasc, the Geological Survey of Ireland, the Marine Institute, the Environmental Protection Agency, and the Irish Research Council.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.1	Secure €1.25bn in funding from Horizon 2020	Optimise sectoral engagement (the higher education sector, industry and publicly funded research bodies) in Horizon 2020 to achieve the national target.	High Level Group, Horizon 2020 National Support Network, research performers	Throughout lifetime of Horizon 2020
6.2	Catalyse the creation of and participation in consortia to bid for large-scale Horizon 2020 projects	<p>a Ongoing analysis of large scale opportunities, facilitating of linkages between potential Irish leads and partners for consortia</p> <p>b Provide support and co-funding for large bids to H2020 led by Ireland</p>	<p>Strategic Research Proposals Group, reporting to High Level Group</p> <p>Horizon 2020 National Support Network, Research funders</p>	<p>Throughout lifetime of Horizon 2020</p> <p>Throughout the lifetime of Horizon 2020</p>
6.3	Influence EU Commission in formulating the work programme and represent Ireland's interests	Canvass intelligence from relevant stakeholder communities and effectively represent Ireland's position.	<p>Horizon 2020 National Support Network</p> <p>Irish Permanent Representation Brussels</p> <p>Irish Research Community</p>	Throughout lifetime of Horizon 2020

CASE STUDY:

The DRIVE consortium, led by RCSI and AMBER

The DRIVE consortium is developing a new system to more effectively deliver insulin-producing β -cells in the treatment of diabetes. This will allow more patients, where control of their condition is poor, to avail of a more effective long-lasting treatment, and reduce demand for donor pancreases. The consortium will also investigate combining DRIVE's technology with future stem cell-derived β -cells to widen the availability of transplantation therapy to all insulin-dependent patients.

The consortium is led by the Royal College of Surgeons in Ireland and AMBER – the Advanced Materials and BioEngineering SFI Research Centre. The consortium has 14 partners from seven European countries. Other Irish partners include Dublin City University, University College Dublin and Boston Scientific. €8.9m is being provided in funding from Horizon 2020, under the Leadership in Enabling and Industrial Technologies part of the Programme. The project will run from June 2015 to May 2019.

CASE STUDY:

The RealValue Consortium, led by Glen Dimplex

Glen Dimplex identified an opportunity in Horizon 2020 in 'Secure, Clean and Efficient Energy' which allowed them to leverage their own 'Quantum' technology in a large-scale pilot research project. They led a 12-member consortium – RealValue – across four European countries with several big European energy companies. Their Irish partners include Intel, Eirgrid, ESB Networks and University College Dublin. 'Quantum' is a new energy storage system that works by storing excess energy generated by windfarms at off-peak times and releasing it as heat when required.

Glen Dimplex's engagement at EU level pre-dated Horizon 2020. They started in 2011 to actively participate in a number of EU bodies involved in the energy sector and contributed to EU policy development through various committees and working groups. With the assistance of Irish Government departments and agencies, they made connections in relevant Directorates of the European Commission, building important relationships and networks, and influencing and showcasing their own credentials.

As a result of their success, €12m in funding will be provided from Horizon 2020, of which €7.2m will come to Ireland. Starting on 1 June 2015, RealValue is using a combination of physical demonstration and modelling to demonstrate how local small-scale energy storage, optimised across the EU energy system with advanced ICT, could bring benefits to all market participants. 1,250 homes in Ireland (North and South), Germany and Latvia will participate in the physical demonstration aspect of the project.

We will deepen our engagement with the European Fund for Strategic Investment

The European Fund for Strategic Investment (EFSI) is an EU initiative launched jointly by the European Commission and the European Investment Bank (EIB) Group to help overcome the current investment gap in the European Union by mobilising private financing for strategic investments. It will support investment in a number of areas, including research and development, and will provide support for smaller businesses and midcap companies. Its specific objectives are to increase the volume of higher risk projects financed by EIB Group and to address the market failure in risk-taking which hinders investment in Europe. EFSI is not a fund – it is based on a €16bn EU guarantee which will offer cover to investments financed by the EIB Group. It aims to unlock €315bn of investment over the period 2015-2017. Ireland is keen to maximise engagement with this programme, particularly in the areas of research and development.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.4	Assess EFSI potential for funding for research and innovation in Ireland	Investigate the potential of national initiatives to engage with EFSI.	DJEI	2016 - 2020

We will optimise European Structural Funds

We have been successful in securing funding under the European Structural and Investment Funds (ESIF) for the period 2014-2020. Eligible programmes are supported under the European Regional Development Fund (ERDF) and the European Territorial Cooperation (ETC) strands of ESIF. These programmes, which qualify for 50% funding from ESIF, have as their objective increasing industry-relevant R&D capacity across their respective regions.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.5	Ensure full benefit to Ireland from European Structural and Investment funding for research and innovation	Participate fully in ERDF and ETC programmes.	DJEI	2016 - 2020

We will optimise our engagement in the European Research Area (ERA)

The *2015-2020 European Research Area Roadmap* identifies a number of key implementation priorities which are likely to have the biggest impact on Europe’s science, research and innovation systems. Ireland’s and other States’ contributions to the ERA will bring benefits by enhancing the efficiency, effectiveness and excellence of the EU research system through the free circulation of researchers, knowledge and technology, and thus support the achievement of economic competitiveness and the development of solutions to societal challenges.

We will continue to progress the six priorities of the European Research Area. These are:

- 1. More effective national research systems** – Effectively designed and efficiently functioning national research and innovation systems that are responsive to the objectives of each Member State.
- 2. Jointly addressing grand challenges and making optimal use of public investments in research infrastructures** through the EU Joint Programming Initiatives (JPIs). The overall aim of the JPIs is to pool national research efforts in order to make better use of Europe’s public R&D resources and to tackle common European challenges more effectively in key areas. There is scope for better coordination and more support at national level to enhance our engagement in these programmes.

Research infrastructures also optimise transnational cooperation and competition in the ERA, forming the bedrock for collaborative research in academia and industry. Through the European Strategy Forum on Research Infrastructures (ESFRI), large infrastructures (both single-sited and distributed) of long-term European interest are designated via a competitive process. We play an active role at EU level in ESFRI, are a core partner on a number of ESFRI projects, and aim to expand our involvement further into existing and new ESFRI-endorsed projects. To deepen this engagement, we will develop a national roadmap for research infrastructure.

3. **An open labour market for researchers and researcher mobility** are essential to the operation of our innovation system, and Ireland has a range of policies, supports and programmes in place to support this mobility, as outlined in Chapter 3, including the EURAXESS Ireland office, hosted by the Irish Universities Association.
4. **Gender equality and gender mainstreaming in research** - Chapter 3 of this strategy outlines proposals for enhanced career progression for researchers and initiatives currently in place to improve participation of women in research and innovation activities.
5. **Optimal circulation and transfer of scientific knowledge** - Our commitment to the principle of open access and our plans for implementing it are outlined in Chapter 4. In short, outputs from publicly-funded research should be publicly available to researchers, and to potential users in education, business, charitable and public sectors, and the general public. A series of actions for improving knowledge transfer in Ireland are also envisaged, as outlined in Chapter 5.
6. **International dimension** - As outlined in this Chapter, we also fully support the need for cooperation with countries outside of Europe in order to address grand societal challenges, ease access to new and emerging markets, and increase the attractiveness of the ERA for talented minds and investors worldwide.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.6	Ensure effective national coordination and oversight of participation by Ireland in Joint Programming Initiatives	National Steering Group for Joint Programming Initiatives will meet up to twice a year, with bilateral meetings as appropriate to ensure effective oversight.	DJEI	2016 - 2020
6.7	Enhance national participation in JPI and ERA-NET.	Develop further involvement in relevant JPI activities and ERA-NET initiatives.	Relevant research funders	2016 - 2020

We will work with other countries to develop our innovation system...

We currently have bilateral inter-governmental agreements with China, India and Japan. A number of workshops, exchanges and joint projects have been undertaken under these agreements. Ireland’s embassy network will continue to seek out opportunities for cooperation with third countries, particularly those with strong education and research links to Ireland.

Regular meetings of the Secretaries General and Permanent Secretaries of relevant Government departments in the UK and Ireland facilitate cooperation on a range of issues, including research and innovation, and we will continue this engagement with a view to enhancing further collaboration with the UK. Ireland also collaborates very closely with Northern Ireland on research and innovation, including through the EU’s INTERREG Programme designed to enhance cross-border industry-relevant research and innovation capacity, and there is a strong basis on which to grow cooperation to mutual benefit.

The US-Ireland R&D Partnership is a product of the Northern Ireland Peace Process and involves the governments of the United States of America, Ireland and Northern Ireland working together for scientific progress by awarding grants for research on a competitive basis. Areas of focus include health, telecommunications, energy, and, more recently, agriculture. The Partnership is helping to link relevant scientists and engineers across academia and industry to make an important contribution to the three economies and expand educational and career opportunities in science and engineering. Future focus will be around further expansion in areas of mutual interest to the three jurisdictions.

Our cooperation with other countries will also be progressed through initiatives such as the SFI International Strategic Cooperation Award (ISCA) programme.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.8	Enhance collaboration with the UK	<ul style="list-style-type: none"> a. Co-fund with the Wellcome Trust biomedical and clinical research in Ireland b. With Royal Society support University Research Fellowship scheme for early stage researchers to carry out research in Ireland c. Supports collaborative research between Irish and UK researchers in key areas d. Explore options for further collaboration, such as Horizon 2020, EIT and NCP Networks. e. With UK Environment agencies in ShARE, support collaborative research for evidence to underpin environmental regulation. 	<p>SFI, HRB</p> <p>SFI</p> <p>SFI, DAFM</p> <p>DJEI</p> <p>EPA</p>	2016 - 2020
6.9	Explore future joint funding opportunities with Northern Ireland	Consider mechanisms under research infrastructure, research cooperation and researcher exchange	SFI, DAFM	2016 - 2020
6.10	Deepen collaboration through the US-Ireland R&D Partnership	<ul style="list-style-type: none"> a. Expand remit of Partnership in areas of mutual interest to US, Ireland and NI. b. Support the NSF/GROW Programme for NSF Graduate Research Fellows to carry out research visits to Ireland. 	<p>DJEI, ITI</p> <p>SFI</p>	2016 - 2020
6.11	Develop follow up initiatives to the ISCA programme	Develop funding partnerships with international funders in countries such as China, Brazil, India and Japan to support international collaborative research projects.	SFI	2016 - 2020

We will participate in International Research Organisations...

To be a Global Innovation Leader, Ireland must be a member of the key International Research Organisations (IROs). Ireland is currently a member of six IROs – the European Space Agency, the European Molecular Biology Laboratory, the European Molecular Biology Conference, EUREKA, COST, and CECAM.

The costs and benefits of our membership of these organisations and the potential costs and benefits of a further nine international research organisations were reviewed in a recent study³². For those IROs of which Ireland is not a member, potential benefits were identified in the following cases:

- CERN – nuclear research using particle accelerators and detectors
- The European Southern Observatory (ESO) – astronomical research using ground-based observing facilities
- ELIXIR – infrastructure for biological information
- The LOw Frequency ARray (LOFAR) – a distributed radio telescope which uses a large array of low-cost sensors. However it is acknowledged that funding for a national node needs to be secured in advance of applying for membership of LOFAR.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.12	Initiate negotiations with CERN for Ireland’s membership options	Enter discussions with CERN.	DJEI	2016
6.13	Initiate negotiations with ESO for Ireland’s membership options	Enter discussions with ESO.	DJEI	2018
6.14	Initiate membership application for full membership of ELIXIR	Observer status secured in 2015. Undertake process to progress to full membership.	DJEI	2016
6.15	Formally review membership of IROs at least every five years	Undertake review of the costs and benefits of existing and potential IRO memberships on basis of scientific and industry benefits relative to full cost of memberships.	DJEI	2020

We will benchmark our innovation system

In the past three years, Ireland, together with New Zealand, Finland, Denmark, Singapore and Israel, formed the six Small Advanced Economies Initiative to learn from and benchmark against each other in science, innovation, economy and foreign affairs. The science and innovation stream has been most active and, led by SFI, published an agreed guide to impact assessment in 2015³³.

Irish funding agencies (SFI, HRB, IRC) are members of Science Europe – a collective entity of all of the major EU research-funding bodies. Ireland is also represented by the Chief Scientific Adviser on the Global Research Council – a grouping of all of the major international funders of research – and the ICSU (International Council for Science). Through these bodies we continue to input into, and benefit from, international science policy and initiatives. Enterprise Ireland, through the European Association of Leading National Innovation Agencies, has also entered into a benchmarking exercise with significant European innovation agencies.

32 Review of Irish membership of International Research Organisations – July 2015

33 Broadening the Scope of Impact. Defining, assessing and measuring impact of major public research programmes, with lessons from six small advanced economies

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
6.16	Retain membership of international research funding organisations; benchmark Ireland and adopt best known practices.	Benchmark Ireland against large, small and EU countries. Learn from and adopt best known practice, policies and initiatives.	Relevant research funders	2016 - 2020

7

INNOVATION
IMPLEMENTATION

Whole-of-Government approach

Ireland will continue to adopt a whole-of-Government approach to innovation policy in order to ensure coherent, coordinated and streamlined implementation of this strategy. Appendix 3 provides a visual representation of the governance structure that will underpin the approach to delivering this strategy. The Cabinet Committee will continue to have a key role in overseeing development and implementation of science and innovation policy across all relevant Government departments.

The Innovation 2020 Implementation Group

To maximise efficiency of State resources in driving and overseeing implementation of this strategy, the number of groups in this area will be streamlined. The Interdepartmental Committee on STI, the Research Prioritisation Action Group and the Horizon 2020 High Level Group will all be merged into one coherent group – the Innovation 2020 Implementation Group – and this group will then deal with all of the agenda items previously dealt with by those three groups.

The Innovation 2020 Implementation Group will meet in three formations with smart agenda setting:

- A primary formation will drive and track implementation of the strategy at an overall level and will include IDC representatives as core members.
- The second formation will mirror the Research Prioritisation Action Group and will have a role in driving and reporting on implementation of various strands of the strategy at a more granular level – this group will identify what needs to be done by which funder/agency/department to deliver on higher level actions in this strategy. Membership of this formation will include IDC members plus research funders.
- The final formation will deal with EU issues, incorporating both the role of the Horizon 2020 High Level Group, and broader EU research issues, such as opportunities arising from the European Fund for Strategic Investment. Membership will include those on the research funders formation, representative bodies of the Higher Education Institutes, and Intertradelreland.

The Innovation 2020 Implementation Group will be at Assistant Secretary level and chaired by the Department of Jobs, Enterprise and Innovation.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
7.1	Establish the Innovation 2020 Implementation Group	To ensure a coherent approach to implementation of this strategy the IDC, the RPAG and the H2020 HLG will be merged to create one coherent group to drive implementation of this strategy – the Innovation 2020 Implementation Group.	DJEI	2016

Links between the Innovation 2020 Implementation Group and other relevant groups

The Innovation 2020 Implementation Group will be connected to a number of key groups that have a research and innovation remit and that share goals in terms of delivery of science and innovation policy. For example, the Department of Energy, Communication & Natural Resources (DCENR) leads an inter-departmental, inter-agency Committee on Energy Research Strategy, which provides strategic direction and oversight for the Irish energy research system (encompassing elements from pure research to commercialisation). To maximise synergies in developing and delivering energy research policy, DCENR representatives on the Committee will also be members of the Innovation 2020 Implementation Group. A similar approach will be taken where other groups are established with a sectoral remit in the research area to ensure coherent delivery of a whole-of-Government approach to science and innovation policy.

Technology Ireland’s role is to ensure maximum complementarity and coherence between the science and innovation programmes and initiatives of the enterprise agencies (EI, IDA, and SFI) and the Higher Education Authority. Under the aegis of the Department of Jobs, Enterprise & Innovation, it will continue to operate alongside the Innovation 2020 Implementation Group with a specific focus on enhancing synergies in initiatives to promote enterprise R&D. The Department of Education & Skills will join Technology Ireland, given the interface between the enterprise agencies and the Higher Education Sector which has a key role in delivering many enterprise programmes. The remit of Technology Ireland will be expanded to incorporate the role of the Industry Horizon 2020 Group in leading a cross-agency approach to developing and delivering initiatives aimed at increasing industry participation in Horizon 2020.

The Strategic Research Proposals Group, led by the Chief Scientific Adviser to the Government, will continue to operate, focusing on catalysing, developing and advising on large-scale Horizon 2020 proposals, including proposals in which Ireland can take a leading or major role. The Higher Education Research Group, led by the Department of Education & Skills, will continue to provide strategic direction for the approach of the higher education sector. Both of these groups will feed into discussions of the Innovation 2020 Implementation Group.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
7.2	Maximise synergies between the Innovation 2020 Implementation Group and other relevant groups in the science and innovation area	Put in place informal reporting mechanisms between the Innovation 2020 Implementation Group and other relevant groups to ensure coherence in development and delivery of policy across all relevant Government departments.	All relevant Government departments	2016 - 2020

Independent advice and stakeholder input

Chief Scientific Adviser to the Government

The Chief Scientific Adviser (CSA) provides high-level independent advice on science policy and on specific scientific issues of concern to the Government, and fulfils, on behalf of Government, a representational / ambassadorial role in the science field. In order to fulfil this role, the CSA may, as the need arises, liaise with relevant professional/scientific advisers operating under the remit of other Government departments. The CSA will be a member of the Innovation 2020 Implementation Group and may also be required to provide input to the work of ad hoc groups established, for example, to advise on future areas of focus for science policy or funding. The CSA reports directly to the Minister for Jobs, Enterprise & Innovation, but may also be required to attend Cabinet or Cabinet Committee meetings from time to time.

Broad stakeholder input

Input from a broad range of relevant stakeholders will be key to ensuring necessary and timely feedback on implementation of policy and also advice on future policy direction. Under this strategy, inputs from stakeholders will be sought through a number of mechanisms. We will convene fora on a regular basis to obtain feedback from industry, academia and civil society on implementation of the strategy. Inputs will also be sought from stakeholders regarding the implementation of relevant programmes, particularly in relation to new programmes. Representatives of the Universities and the Institutes of Technology will also participate in the EU formation of the Innovation 2020 Implementation Group, mirroring their participation to date in the Horizon 2020 High Level Group.

This represents a task-based approach to stakeholder engagement and consultation. In addition, wherever possible, we will seek inputs and advice on science policy and implementation from existing advisory structures, such as the NCC, and the DES's interface with the HEIs. Where this is not appropriate, ad hoc groups will be established to deliver on a specific task. Such ad hoc groups will be independently chaired, and members representing a broad base of stakeholders will be invited to participate on a pro bono basis with secretariat provided by DJEI. The first such group to be established will examine the continuing relevance of the 14 priority areas (now grouped under six thematic areas) identified under the National Research Prioritisation Exercise and advise on future priorities.

Research Integrity

A governance issue which cuts across all of the research funders and providers is that of Research Integrity. Research integrity relates to the performance of research to the highest standards of professionalism and rigour, and to the accuracy and integrity of the research record in publications and elsewhere. The Irish research system must protect its reputation for the quality and integrity of its research activity and outputs, to ensure that we and our international partners may rely on those outputs to promote economic and social development and growth.

To promote a coherent approach to this important issue, a working group on research integrity was established in 2011, involving key representatives of research performers and funders and in 2014 a *National Policy Statement on Ensuring Research Integrity in Ireland* was adopted incorporating international best practice such as the *European Code of Conduct for Research Integrity* and the *OECD Best Practises for Ensuring Scientific Integrity and Preventing Misconduct*.

A key proposal in the statement - a National Forum on Research Integrity – has been established under the aegis of the IUA and has developed a plan of action to deal with both policy and practice issues arising in ensuring that our research integrity system is best in class including:

- exploring how agencies can harmonise policies and processes to fully integrate the principles of research integrity and raise awareness of this issue amongst the research community
- harmonising implementation of research integrity policies within the research performers relating to staff and students, including the development/roll-out of suitable training

SFI is currently piloting a series of Research Integrity audits, and consideration will be given to extending and expanding these audits nationally to include all research performers and funders. A standardised mechanism should also be developed for the publication of the results of any research integrity investigations in Ireland.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
7.3	Implement, monitor and build on the Irish National Policy on Ensuring Integrity in Research	<ul style="list-style-type: none"> a. Develop and implement nationally harmonised best practice guidelines, training curricula, grant conditions, and processes for handling research misconduct. b. Agree a process and format for the publication of the outcome of research integrity investigations having regard to existing regulations relating to misconduct and discipline. c. Consider expanding and extending SFI pilot audits to all funders i.e. national shared audit scheme 	Research Integrity Forum, research funders and performers	2016 - 2020

Measuring success

Building on the work of the Research Prioritisation Action Group, which developed a framework for monitoring public investment in STI, a number of high-level national indicators with associated targets to 2020 have been selected to measure success in implementing this strategy. Effective and timely delivery of the range of actions in this strategy will also be a key indicator of success, and the Innovation 2020 Implementation Group will report annually to the Cabinet Committee on progress in achieving high-level targets and delivering on actions. Key actions will also be delivered through the annual Action Plan for Jobs process. Implementation of this strategy will also be evaluated at mid-term to ensure that we are on track for delivery and that any necessary adjustments can be made in a timely manner. A retrospective evaluation will also be carried out on this strategy at the end of its term to inform the development of its successor.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
7.4	Report to Cabinet Committee on progress implementing the strategy	The Innovation 2020 Implementation Group will report annually to the Cabinet Committee on implementation of the strategy, including on progress on levels of investment necessary to reach the 2.5% target	Innovation 2020 Implementation Group	2016 - 2020
7.5	Evaluation of this Strategy	<ul style="list-style-type: none"> a. A mid-term evaluation of this strategy will be carried out so that relevant adjustments can be made in a timely manner to ensure successful delivery on the vision and objectives. b. A retrospective evaluation of this strategy will be carried out to inform the development of its successor. 	Innovation 2020 Implementation Group	<p>2018</p> <p>2020</p>

Standardised classification of public investment in research

Currently, each research funding body records their investment in research using a classification scheme that reflects their mandate and domain of operation. The absence of a standardised, system-wide, classification scheme for recording public investment in research is a major impediment to system-level monitoring, management and impact assessment. To address this issue, a standardised categorisation scheme will be developed and adopted by all public funders of research.

	ACTION	DESCRIPTION	LEAD RESPONSIBILITY	TIMELINE
7.6	Standardised classification of public investment in research	<ul style="list-style-type: none"> a. Drive the development of a standardised categorisation scheme for tracking public investment in R&D based on an internationally recognised system. b. Adopt the standardised categorisation scheme for tracking public investment in R&D. c. Explore the possibility of identifying a set of national Key Performance Indicators to measure the impact of RDI investment, with associated targets to stretch the performance of the system. 	<p>Innovation 2020 Implementation Group</p> <p>All research funders</p>	2017

APPENDIX 1

Membership of Interdepartmental Committee on Science, Technology and Innovation

Department of An Taoiseach

Department of Jobs, Enterprise & Innovation (Chair)

Department of Education & Skills

Department of Agriculture, Food & the Marine

Department of Health

Department of Communications, Energy & Natural Resources

Department of Environment, Community & Local Government

Department of Public Expenditure & Reform

Department of Finance

Department of Foreign Affairs & Trade

Higher Education Authority

Chief Scientific Adviser to the Government

APPENDIX 2

Metrics and Targets

	METRIC	BASELINE ³⁴	TARGET 2020	DATA SOURCE
1	GERD	€2.9bn	2.5% of GNP	DJEI
2	Increase private funding of R&D performed in HE sector	€24m per annum	€48m per annum	HERD survey (DJEI)
3	Increase research masters and Ph.D. enrolments	1,750 (2015)	2,250	HEA
4	Research Personnel ³⁵ in Enterprise	24,785 (2013)	40,000	BERD survey (CSO)
5	Increase number of firms that are ³⁶ : a. Innovation active b. Significant R&D performers c. Large R&D performers	a. 58% b. 1,040 c. 170	a. 73% b. 1,200 c. 200	<i>Innovation in Irish Enterprises survey (CSO)</i>
6	Commercialisation Targets* a. Commercially relevant technologies (Licences, Options, Assignments) b. Spin-outs c. High Potential Start-Ups (HPSUs) from Spin-outs d. Collaborative research projects between enterprise and PRS ³⁷	a. 124 b. 29 c. 11 d. 878	a. 175 b. 40 c. 16 d. 920	EI/Knowledge Transfer Ireland
7	Drawdown Horizon 2020	€620m under FP7	€1.25bn	European Commission
8	Innovation Union Scoreboard: performance relative to EU average	+13 % (2015)	+20 %	European Commission
9	How informed the public feel about R&D in STEM	49% (2015)	60%	Barometer survey (SFI, biennial)

³⁴ Baseline year is 2014, unless otherwise indicated.

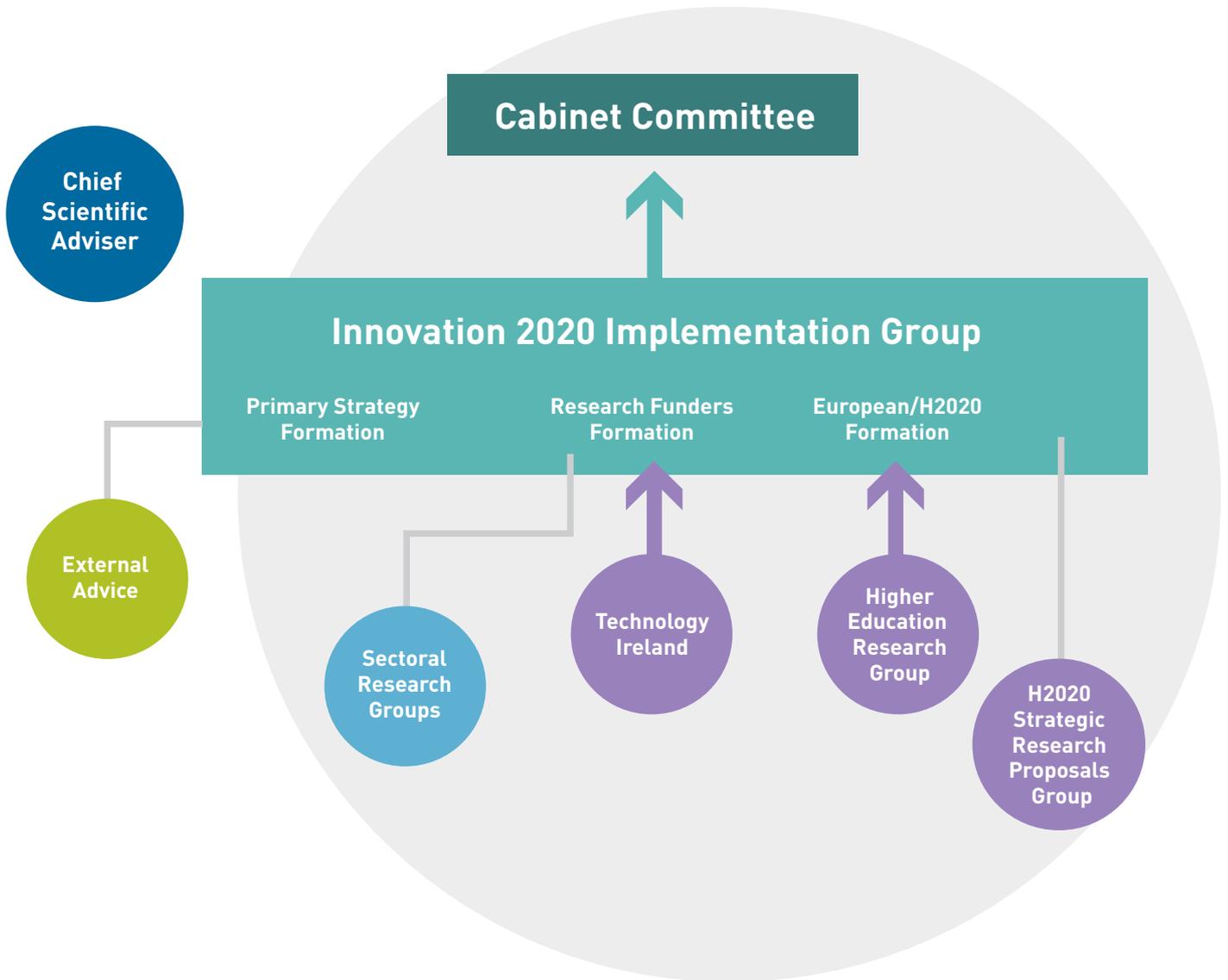
³⁵ Includes researchers, technicians and support staff.

³⁶ Using CSO definitions.

³⁷ Public Research System.

APPENDIX 3

Governance



APPENDIX 4

Glossary

ABSEI Annual Business Survey of Economic Impact

BERD Business Expenditure on Research and Development

CDA Career Development Awards

CERN European Organisation for Nuclear Research

COST European Cooperation in Science and Technology

CSA Chief Scientific Adviser

CSET Centre for Science, Engineering and Technology

DCENR Department of Communications, Energy and Natural Resources

DJEI Department of Jobs, Enterprise and Innovation

EAFRD European Agricultural Fund for Rural Development

EI Enterprise Ireland

EMBC European Molecular Biology Conference

EMBL European Molecular Biology Laboratory

EMFF European Maritime and Fisheries Fund

EPA Environmental Protection Agency

ERA European Research Area

ERC European Research Council

ERDF European Regional Development Fund

ESA European Space Agency

ESF European Structural Fund

ESFRI European Strategy Forum on Research Infrastructures

ESI European Structural and Investment

ESO European Southern Observatory

ETAP Environmental Technology Action Plan

EVA Economic Value Added

FP7 7th EU Framework Programme

FTE Full Time Equivalent

GBAORD Government Budget Appropriations or Outlays on Research and Development

GERD Gross Expenditure on Research and Development

GOVERD Government Expenditure on Research and Development

H2020 Horizon 2020

HEA Higher Education Authority

HEI Higher Education Institute

HERD Higher Education Research and Development

HPSU High Potential Start Up

HRB Health Research Board

IP Intellectual Property

IRC Irish Research Council

ISBP Innovation in Services and Business Processes

IUA Irish Universities Association

KTI Knowledge Transfer Ireland

LIRE Large Items of Research Equipment

LOFAR Low Frequency Array for Radio Astronomy

MERIL Mapping of the European Research Infrastructure

MI Marine Institute

NRPE National Research Prioritisation Exercise

OECD Organisation for Economic Cooperation and Development

OHIM Office for the Harmonisation of the Internal Market

PAG Prioritisation Action Group

PRTL Programme for Research in Third Level Institutions

RDI Research, Development and Innovation

RPO Research Performing Organisation

RPSG Research Prioritisation Steering Group

SEAI Sustainable Energy Authority of Ireland

SFI Science Foundation Ireland

SIRG Starting Investigator Research Grant

SME Small and Medium Enterprises

SRC Strategic Research Cluster

SSTI Strategy for Science, Technology and Innovation

STEM Science, Technology, Engineering and Maths

STI Science, Technology and Innovation

TTSI Technology Transfer Strengthening Initiative

