



**Consultation Paper
For Successor to
Strategy for Science, Technology and
Innovation**

Interdepartmental Committee on Science, Technology and Innovation

February 2015

Context for consultation in preparation for the development of a Successor to the Strategy for Science, Technology & Innovation

Background

Prior to a Government policy decision to make a significant investment in science, technology and innovation (STI), research funding in Ireland was at very low levels. However, from 2000, an ambitious policy was adopted - investing in people, infrastructure and associated facilities to build the science base across many areas of scientific research in both our higher education institutions and other public research organisations; and direct support to the enterprise sector to help individual companies to build their capacity for research and development. This was copper fastened as Government strategy in the **Strategy for Science, Technology & Innovation (SSTI) 2006 to 2013** and the associated National Development Plan and as a result Ireland had successfully built up research capacity and a significant reputation for research excellence and has an increasing base of enterprises engaging in R&D and innovation activity. The SSTI was a broad based strategy which covered funding for research and innovation across the full continuum from basic to applied as well as commercialisation of research and across all sciences and disciplines including STEM (Science, Technology, Engineering & Maths) as well as the Humanities and Social Sciences (HSS). As a result significant steps were made in establishing a strong public research environment based on scientific excellence in a number of strategic areas, in many cases meeting and exceeding targets set out in the SSTI.

Research Prioritisation emerged in the intervening period as the Government's primary STI policy goal and this saw a concentration of the majority of competitive funding on areas which were deemed most likely to secure greater economic and societal impact, particularly in the form of jobs. Research Prioritisation saw a greater emphasis on the impact of research but also its relevance to the enterprise base and by its nature a focus on the STEM disciplines in support of this strategy. Research Prioritisation was complemented with a range of other policies including the consolidation of investment in units of scale, increased collaboration between Higher Education Institutes as well as with enterprise and further facilitation of transfer of knowledge from Research Performing Organisations to enterprise to optimise support for maintenance and creation of jobs.

Research Prioritisation did not represent a move away from funding basic research. Policy has always endeavoured to support research across the full continuum from basic to applied and through to commercialisation of research. Research Prioritisation did result in the majority of competitive funding being targeted at areas where we were most likely to get an economic and societal return and this approach will continue to underpin policy into the future and will be a central pillar of the Government's Strategy.

In order to be able to prioritise research funding in the future and in the context of our vision for the future, we must have a strong and excellent research base particularly in areas where our strengths can match opportunities. Excellence in scientific research has been and will continue to be a constant cornerstone in the development of our science base in Ireland and this has been complemented in recent years by a sharper focus on the impact of research across all disciplines and sciences, as well as wider national and societal challenges.

In the Higher Education sector, the Government has designated research as a core objective for the sector and this is reflected in the Higher Education Performance Framework and associated System Performance Report. The key interaction between teaching and learning and research remains at the heart of the approaches which have been adopted in relation to developing and supporting Ireland's essential talent formation.

New strategy

It is now timely to place Research Prioritisation and the focus on research relevance and impact within a broader context and to develop and articulate a vision for science policy across all disciplines (including STEM and AHSS) and in doing so incorporate policy around research to support the broader knowledge base and research to support the development of policy in key sectors of relevance to the economy and society (e.g.

health, agriculture, marine, energy, environment, communications) and address key challenges. Research for policy, such as research that provides the basis of regulatory actions designed to promote health, safety, environment and quality of life and address key societal challenges did not fall within the direct scope of the Research Prioritisation exercise. Within their remits, relevant Departments and Agencies have continued to fund such sectoral research programmes associated with policy and public good agendas.

A new Strategy provides a clear opportunity for Ireland to develop a new whole-of-Government strategy for research and innovation. This can build on the progress made to date in developing Ireland's research and innovation system, as well as addressing identified challenges. The formulation of this new Strategy is timely as Ireland moves into a new phase of economic growth and societal development. It gives us the chance to advance fresh strategic ideas that will distinguish Ireland globally through its ability to make research work to maximum effect for the country. Such returns will manifest themselves in the form of skilled people capable of building a sustainable and resilient society, gaining and creating jobs, as well as innovative companies that will succeed internationally and that will provide employment, and that will leverage a vibrant public research base here to do so. This research base will have a strong global reputation on foot of its contribution to international research excellence, its attractiveness to firms across the world and its catalytic role in Ireland's national innovation ecosystem. Ultimately, it will translate into a better society based on economic, social and environmental sustainability and scientific excellence.

The new Strategy will seek to articulate a vision for Ireland's research and innovation system and identify its defining characteristics. It will also set out agreed strategic goals and targets which are linked to relevant Government policy agenda, based on a robust evidence base, our vision and an examination of international trends and good practice.

Based on this vision, the Strategy will:

- a. identify key policy interventions required to achieve these strategic goals/ targets, thereby enabling Ireland to transition successfully from today's baseline to its future vision;
- b. embed Research Prioritisation as a key policy objective to ensure a continued focus on public funding of research in areas of sustainable economic growth in Ireland and contextualise it within the framework of this national Strategy and other relevant Government policies;
- c. provide means by which research priorities that support key Government policy objectives can be delivered successfully now and into the future through excellent and impactful research across all disciplines and across the full continuum from basic to applied as well as commercialisation of research;
- d. maintain and build further the capacity and capability of people in academia, RPOs and in enterprise through the acquisition and transfer of knowledge;
- e. support and build Ireland's talent pool to maximise the flow of skilled individuals going into companies, creating companies and working in the public research system;
- f. ensure a state-of-the-art research environment in Ireland based on adequate, appropriate infrastructure (and open access to it), maintaining and building further relevant infrastructures across all the sciences but in particular in areas of economic relevance to the enterprise base to address the jobs crisis;
- g. build on consolidation of the system by enabling better, more productive access by Irish companies to Irish Intellectual Property;
- h. identify where the key responsibilities for driving and implementing actions within the Strategy lie and identify and clarify the operational interlinkages between the governance arrangements for the different elements of the Strategy and with relevant external stakeholders

This document sets out some background to a range of issues, around eight key pillars, to be considered in the formulation of a new Strategy:

1. Investment in STI and key goals/targets
2. Prioritised Approach to Public Research Funding
3. Enterprise-level R&D and Innovation Performance
4. International collaboration and engagement
5. Organisational/ Institutional arrangements to enhance research excellence and deliver jobs
6. World class IP regime and dynamic systems to transfer Knowledge and Technology into jobs
7. Government wide goals on innovation in key sectors for job creation and societal benefit
8. Research for knowledge and the development of human capital

At the end of each chapter, there are key questions for consideration in the development of the new Strategy. Your written views are invited in the context of these questions, to be submitted by **23 March 2015** to IDCsecretariat@djei.ie

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1. *Investment in STI and key goals/targets*



Achieving Enterprise Policy Goals
Addressing Societal Challenges
Recommitting to national targets

2. *Prioritised Approach to Public Research funding*



Maximising Impacts from public investment
in Science, Technology and Innovation

3. *Enterprise-level R&D and Innovation Performance*



Strengthening the performance of
enterprises
Securing the optimal return from public
investment in firms' R&D

4. *International collaboration and engagement*



Developing links with top international research institutions and
enterprise markets
Reinforcing Ireland's standing as a top-class research-performing
nation

5. *Optimising organisational / institutional
arrangements to enhance research
excellence and deliver jobs*



Coherence and easier access to research
centres
Greater Impact for Industry
Strengthening applied research capacity

6. *World class IP regime and dynamic systems
to transfer Knowledge and Technology into
jobs*



Optimising technology transfer
Turning knowledge into jobs
Promoting and opening up Ireland's research offering to industry

7. *Government-wide goals on innovation in key
sectors for job creation and societal benefit*



Prioritising sectors of opportunity and
systematically removing obstacles and
developing enabling policies.

8. *Research for knowledge and the
development of human capital*



Developing human capital required for
a sustainable, competitive STI system

Pillar 1 Investment in STI and key goals/targets

Rationale for Investment

Innovation - which includes the invention and diffusion of new technologies, the development of new and improved products, processes and services, and innovations in organisational models - is one of the major factors driving global economic growth. In some leading OECD economies, investment in innovation – including spending on research and development, software, databases and skills – is the main driver of economic growth. In other countries, the traditional sources of growth – increased labour inputs, and investments in physical capital – are declining in importance, leading to an increasing need to develop innovation as a new source of growth. The primary rationale for Government investment in STI is to develop a competitive knowledge based economy. It aims to drive innovation in enterprise, build human capital and maximise the return on R&D investment for economic and social progress.

Balancing supports between grants and R&D tax credit

Expenditure

The internationally recognised indicator for benchmarking State-funding performance of R&D is the Government Budget Appropriations or Outlays on R&D (GBAORD), that is, all the money allocated by Government to R&D to be performed in all sectors of the economy and includes:

- funding for R&D programmes in the higher education sector administered by the Department of Education and Skills, the Higher Education Authority (HEA), Science Foundation Ireland (SFI) and others;
- funding for business sector R&D, administered via State agencies including IDA Ireland, Enterprise Ireland and others; and
- funding for R&D performed in the Government sector e.g. funding administered by Department of Agriculture, Food and the Marine (DAFM) relating to Teagasc & the Marine Institute; and others.

Table 1: Main Government Departments/Agencies with spending on R&D 2013

Funding Department/Agency	2013 €m	% of Total
Higher Education Authority (HEA)	195.6	26.7%
Science Foundation Ireland	152.3	20.8%
Enterprise Ireland	100.4	13.7%
Teagasc	58.5 ¹	8.0%
IDA Ireland	58.2	7.9%
Health Research Board	39.2	5.4%
Irish Research Council	31.4	4.3%
Dept. of Agriculture, Food and the Marine	26.9	3.7%
Dept. of Jobs, Enterprise and Innovation	21.6	2.9%
Environmental Protection Agency	8.8	1.2%
Marine Institute	8.81	1.2%
Sustainable Energy Authority of Ireland	3.2	0.4%
Others	27.7	3.8%
Total	€732.6m	100%

¹ Inclusive of a significant portion of the recurring annual grant-in-aid funding from the Department of Agriculture, Food and the Marine relating to research & innovation activities.

The three major funders (HEA, SFI and Enterprise Ireland) accounted for 61.2% or €448.3m of total state investment in R&D in 2013. The spend on GBAORD by Teagasc is €58.5m (8%) and is followed closely behind by IDA Ireland with €58.2m (7.9%). The remaining contributors comprise 22.9% of state investment in R&D at a total of €167.5m in 2013.

Tax incentives

The number of countries providing indirect support for business spending on R&D through tax incentives is rising. As of 2011, 27 of the OECD's 34 members provided tax incentives to support business R&D – more than double the number in 1995. Many non-OECD countries, such as Brazil, China, Singapore and South Africa, also offer a generous tax environment for investment in R&D. The OECD has found that R&D tax incentives encourage firms to perform R&D by reducing its costs. Compared with direct subsidies, R&D tax incentives allow firms to decide the nature and orientation of their R&D activities, on the assumption that the business sector is best placed to identify research areas that lead to business outcomes. R&D tax incentives are market-friendly instruments that are by nature more neutral than direct support instruments.

OECD STI Outlook 2014

In the 2014 STI Outlook, the OECD found that the general trend over the past decade has been to increase the availability, generosity and simplicity of use of R&D tax incentives in the OECD area and beyond. Countries have redesigned their tax arrangements to make them more generous and attractive by raising thresholds on R&D expenditures and tax concessions, or by increasing deduction rates and enlarging eligibility criteria. Many countries have abandoned incremental design for volume-based schemes that are simpler to implement for tax authorities and simpler to adopt for firms. As a consequence, public funding allocated to business R&D through tax incentives has increased markedly and R&D tax incentives have become a major instrument of STI policy in many countries.

Department of Finance Review of R&D Tax Credit

The annual value of the R&D Tax Credit, which was introduced by Government in 2004, is estimated at around €260 million. As well as addressing market failures, it was intended that such a scheme would improve Ireland's international competitiveness in attracting mobile R&D investment by multinational companies – particularly in the context of similar incentives that are operational in other jurisdictions. The Minister for Finance announced a review of Ireland's R&D Tax Credit as part of Budget 2013. The goal of the review was to ensure that the R&D Tax Credit remains 'best in class' internationally and represents value for money for taxpayers.

Review Findings

- The R&D Tax Credit plays an important role in assisting Ireland in meeting its Europe 2020 target of achieving a level of expenditure on R&D of 2.5% of GDP.
- The R&D Tax Credit is of significant importance to the R&D investment decisions of claimant companies and that, by encouraging firms to invest in R&D, the tax credit is contributing to national and EU policy goals.
- The international comparison with R&D tax incentives in other jurisdictions demonstrates that the Irish regime stands up well in terms of international best practice.
- The tax credit is viewed as a very important element of Ireland's Corporation Tax regime in terms of attracting foreign direct investment to Ireland.
- The generally positive findings of the review indicate that a major overhaul of the R&D Tax Credit was not required.

In Budgets 2014 and 2015 a number of improvements were made to the R&D tax credit including an increase in the limits on the amount of expenditure on R&D outsourced to third parties which can qualify

for the R&D Tax Credit, and the removal of the 2003 base year restriction from 1 January 2015.

Knowledge Development Box

The OECD STI Outlook 2014 also informs us that several governments offer preferential tax treatment for corporate income from royalties licensing and R&D capital gains in order to encourage the commercialisation of R&D results and to attract or retain intellectual property. The 'patent box' schemes are related to tax incentives for R&D expenditures, because they may help anchor the exploitation of patented knowledge in the country in which the R&D is performed and help complete an innovation chain from knowledge production to commercialisation. The Minister for Finance announced in the context of Budget 2015 that consideration is being given to the introduction of a Knowledge Development Box – a competitive income-based regime for intangible assets - along the lines of patent and innovation boxes which exist in other countries. A public consultation process has been launched to gather views on how the Knowledge Development Box should operate. The intention is to legislate for it in the 2015 Finance Bill or as soon as EU and OECD discussions conclude.

Returns on RDI

Returns on Research, Development and Innovation (RDI) Investment

The 2014 Report by the UK IRC: "The Economic Significance of the UK Science Base" finds that "...there is a wide variety of positive impact links between the science base and the private sector. Moreover, there appears to be a 'crowding in' effect of public sector R&D on domestic and foreign R&D activities in the UK. Second, a further and related key finding is that the link from the science budget to Total Factor Productivity growth in an industry depends crucially on the R&D performance, or co-operation with the university sector, of the industry itself. This can be interpreted as the joint effect of an appropriate scaling of the public science budget to get the usable knowledge stock for each industry, and as a measure of the absorptive capacity of the industry. These findings are consistent with a wide range of evidence suggesting a complementary relationship between industry and public sector R&D."

The importance of investment in science, technology and innovation to Ireland's on-going and future economic and social development has been well recognised by Government. Government budget appropriations and outlays on R&D (GBAORD) have increased considerably over the past decade, increasing from €504m in 2002 to €801m in 2011, peaking at €948m in 2008, although as set out earlier in this chapter the figure for 2013 is €732.6m. The ramp up in investments over the last decade and a half, which started from a very low base by international comparisons, has resulted in the build-up of a very strong science base which has yielded results in terms of economic and societal impact.

Globally, we are ranked:

- 1st in the world for the availability of skilled labour [Source: IMD World Competitiveness Yearbook];
- 11th in the Global Innovation Index 2014 (out of 143 countries) [Source: Cornell University, INSEAD and WIPO 2014]
- 13th in the world for university-industry collaboration on R&D [Source: Global Competitiveness Report 2013-2014]

Since 2009, Ireland has been listed among the top 20 countries in global rankings for the quality of our scientific research. We have excelled in certain scientific disciplines and Ireland is ranked:

- 1st in immunology,
- 1st in animal and dairy,
- 3rd in nanotechnology and
- 4th in computer science.

[Source: Thomson Reuters Essential Science Indicators]

We are ranked third in the EU, according to the "Indicator of Innovation Output" [Source: European Commission Innovation Union Scoreboard 2013], which measures the extent to which ideas from innovative sectors are able to reach the market, providing better jobs and making Europe more

competitive.

Nature, the scientific publishing journal, has named Ireland as a top five country for up-and-coming high-level research, based on the quality and quantity of scientific research being carried out in its research institutes.

Ireland's strengthened national research ecosystem has enhanced IDA's capacity to attract increased levels of high-value R&D projects which qualitatively transform and deepen the roots of key multinationals here. In 2013 SFI had linkages to 72% of IDA Ireland job announcements made which are within SFI's remit. Of the total of 54 company announcements made by IDA Ireland, 30 of these projects were considered to be within SFI's remit. The total number of jobs associated with the 30 projects was 1,757 of which SFI had links to 1,265 (72%).

Numbers of R&D performing firms in Ireland and the scale of their R&D effort are growing- Business Expenditure on R&D (BERD) in Ireland rose from €1.245 billion (0.93% of GNP) in 2003 to an estimated €1.962 billion (1.47% of GNP/1.2% GDP) in 2012. The OECD average BERD intensity rate is 1.59%. Around two thirds of total research performed in Ireland is privately funded, with the remaining one third publicly funded. This 2:1 private to public ratio is regarded as optimal (it was envisaged at the Barcelona Summit 2002 that the ratio of private to public funding for R&D in all sectors should increase to 2:1, in order to meet the objectives of the Lisbon Strategy, and to bring EU practice closer in line with that of competitors such as Japan and the USA) and is similar to that in the leading European R&D performers.

Total researchers in the higher education sector almost trebled from 2,148 Full Time Equivalent (FTEs) in 2000 to 5,729 FTEs in 2010. PhD graduates from the university sector increased from 774 in 2005 to 1,153 in 2010. (Most up to date HERD figures will be available later in Q1 2015).

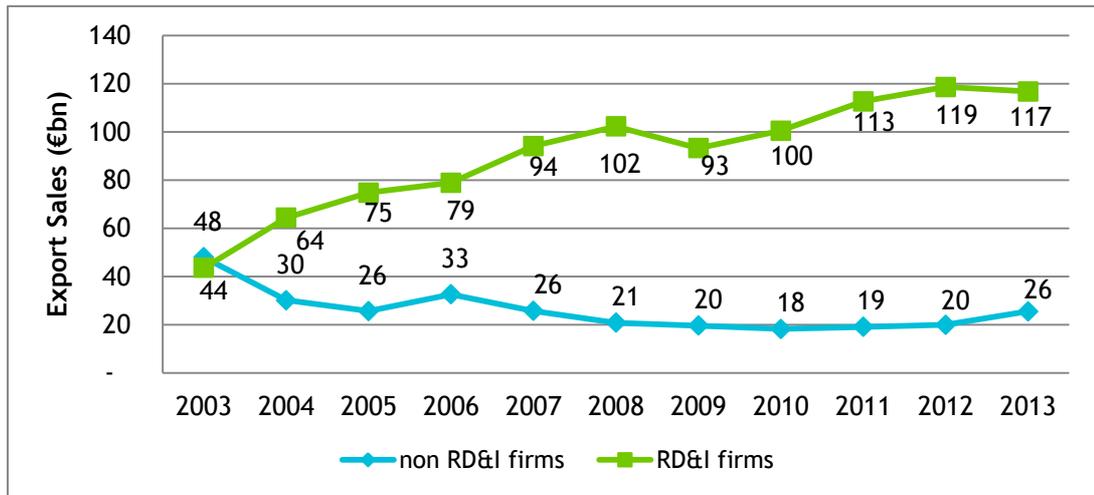
Ireland is in the top 20 countries ranked by citations per thousand population [Source: Thomson Reuters international citation rankings] and as already mentioned earlier in the chapter, our scientific output is now of leading international quality in a number of areas, as measured by citations per paper.

European Research Council (ERC) Starting Grants support up-and-coming research leaders who are about to establish a proper research team and start conducting independent research in Europe and is perceived as a proxy for national scientific excellence. In 2014, Ireland achieved a 17% success rate which is the 2nd highest national rate (only Israel was higher), and compares with an overall success rate of 10% for the call as a whole.

R&D Active firms

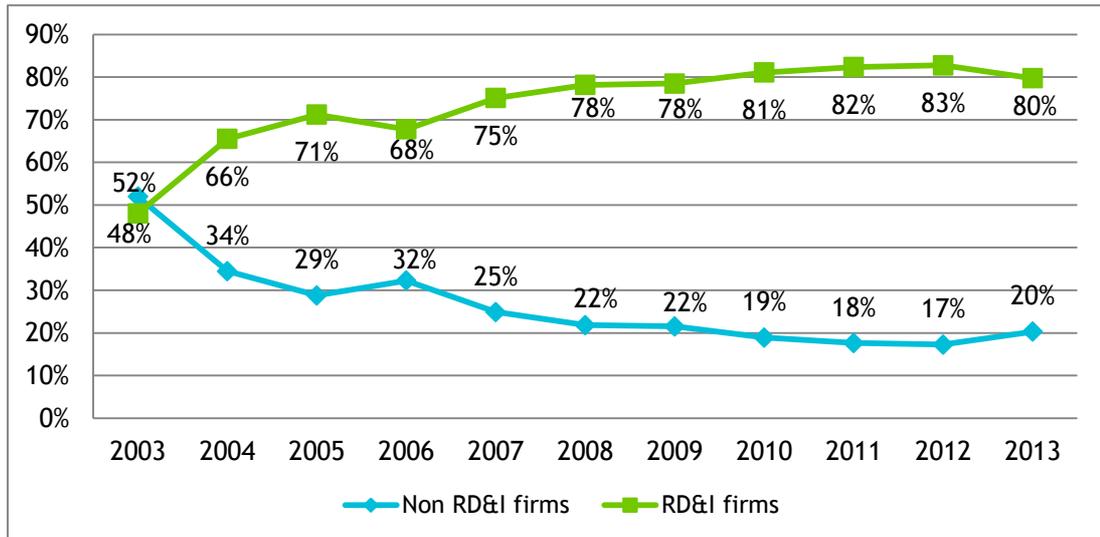
Statistics show that RDI performers are gaining an increasing share of sales, export sales and are accounting for increasing shares of employment. In addition RDI performing firms have demonstrated better employment retention during the current challenging economic period. Exports from R&D performing companies have increased from €44bn in 2003 to €117bn in 2013, while for non R&D performing companies, exports decreased from €48bn to €26bn, over the same period.

Chart 1: Export Sales of RD&I and non RD&I performers (€bn) 2003 – 2013:



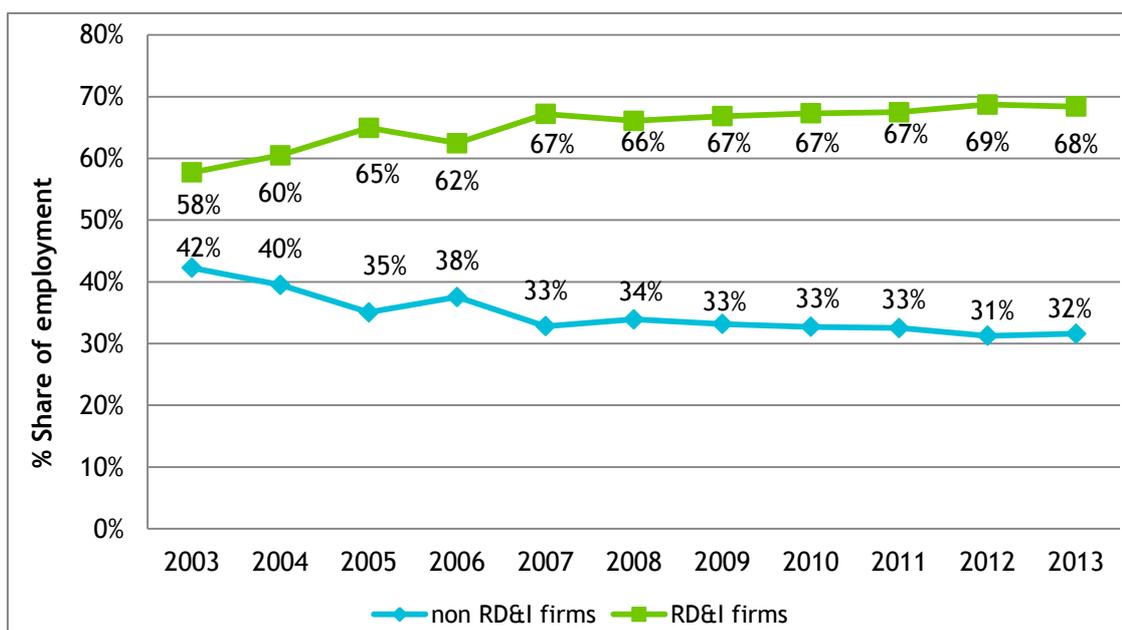
Source: Forfas analysis of ABSEI (Annual Business) survey

Chart 2: Sales of RD&I and non-RD&I performers as % of total sales 2003-2013:



Source: Forfas analysis of ABSEI (Annual Business) survey

Chart 3: % Share of employment RD&I and non-RD&I performers 2003-2013



Source: Forfas analysis of ABSEI (Annual Business) survey

Evaluations

Evaluations

A range of independent evaluations have been commissioned in the recent past to assess the economic impact of our STI investment. These evaluations continue to demonstrate that impressive, tangible economic returns are being generated. For example, reviews of key Enterprise Ireland programmes have shown that:

- The introduction of the Technology Transfer Strengthening Initiative had, by 2012, led to a seven fold increase in the average number of license, option or assignment agreements executed each year when compared with data from 2005. The number of spin-out companies created each year was averaging 22, an increase of nearly 450%.
- The Technology Centres Programme has, after accounting for the impacts of deadweight, displacement, leakage, substitution and the multiplier effect, helped to create €65m of turnover to date, expected to rise to €272m by 2018; €25m of Economic Value Added (EVA) to date, expected to rise to €97m by 2018; 159 gross FTE jobs to date, expected to rise to 371 FTE jobs by 2018.

Furthermore, Forfás undertook a comprehensive evaluation of the suite of enterprise support programmes provided by the enterprise development agencies. This involved the systematic evaluation of programmes across the agencies IDA, SFI and Enterprise Ireland.

On completion of the evaluations, the evidence points to:

- increased academic-industry links;
- an increase in the industry relevance of the research conducted in research groups;
- increased mobility of research staff to industry and enhanced in-firm capabilities.

There is also evidence of attributable economic returns:

- Companies demonstrated resilience through recessionary period;
- Greater export intensity in Irish owned firms;
- Foreign owned firms more embedded / transformational change;
- Higher skills levels / competences;
- Continued investment in R&D activities.

*Continued
commitment
to investment
in innovation*

Need for continued commitment to investment in innovation

Despite these achievements, there are clear signs that Ireland needs to continue its commitment to investment in innovation. An internationally competitive research base requires sustained investment. The consolidation of research activities in recent years, as recommended in the National Research Prioritisation Exercise and the National Strategy for Higher Education, has helped to drive focus and improve value-for-money.

*Review of
National
Expenditure
Levels*

GBAORD trend in current prices, €m. (2005-2014)

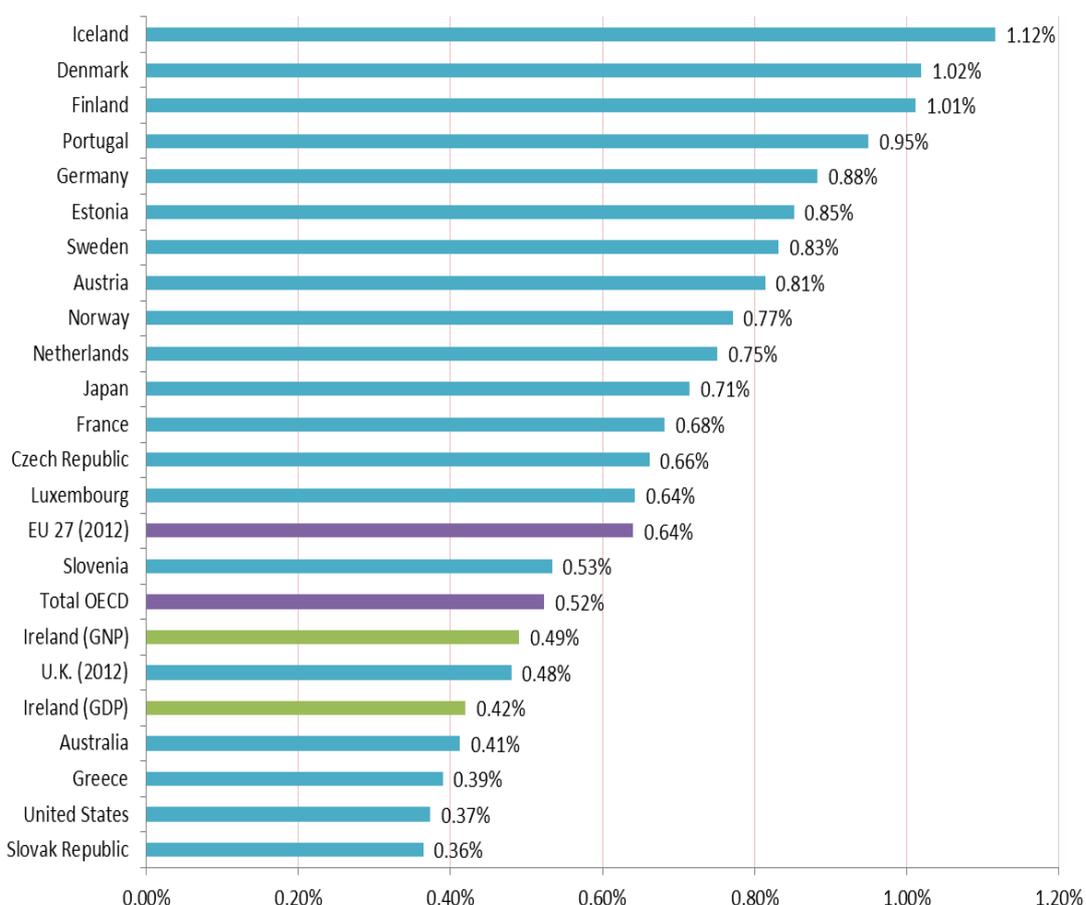
There has been a steady decline in State R&D funding over the last five years with expenditure in 2013 of €733m, a 3.6% decrease on 2012 levels. It is estimated that expenditure will reduce again in 2014 to €724m, a further decrease of 1.9%. Furthermore, it is low by international comparison - as a percentage of GNP, GBAORD has fallen from 0.64% in 2009 to an estimated 0.49% in 2013.

Chart 4: GBAORD trend in current prices, €m. (2005-2014)



Source: State Investment in Research and Development 2013-2014

Chart 5: GBAORD % GNP/GDP, 2013 - International Comparison



Source: State Investment in Research and Development 2013-2014

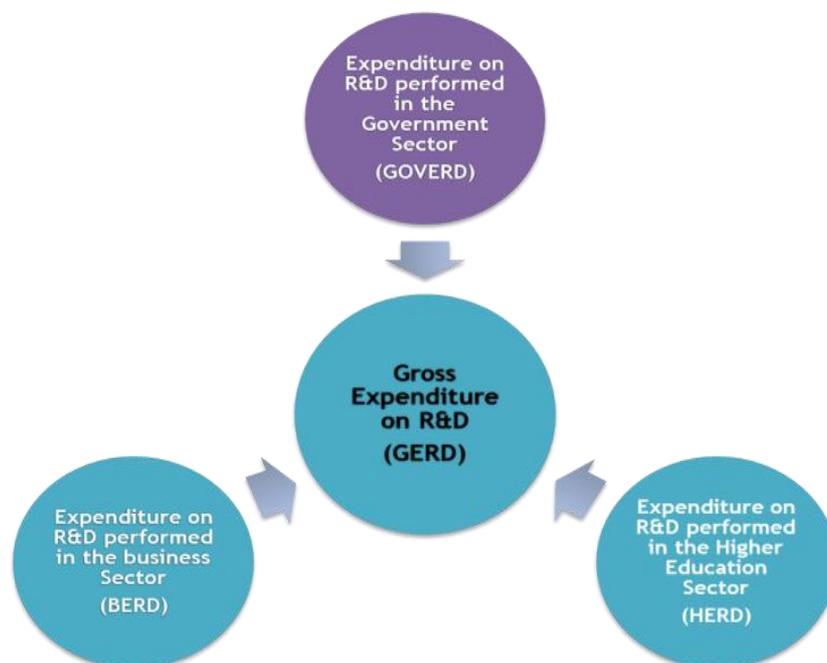
Ireland's GBAORD intensity at 0.42% of GDP or 0.49% or GNP is below the EU average of 0.64% and the OECD average of 0.52%. It is also significantly lower (less than half) than that of comparable small countries with whom we compete: Denmark – 1.02% and Finland – 1.01%.

National Reform Programme – Europe 2020 Strategy

While the SSTI 2006 -2013 envisaged achieving a target of 2.5% of GNP by 2013, this trajectory was interrupted by economic circumstances, so that in 2011 the timeframe for achieving the target was extended out to 2020. Under Europe 2020 and as committed to in our National Reform Programme in 2011, Ireland's research target is to raise combined public and private investment in R&D to 2.5% of GNP (roughly 2% of GDP) by 2020. This research intensity ratio relates to Gross Expenditure on R&D (GERD) as a percentage of GNP. GERD includes both public investment in R&D through Government Departments, State Agencies and our higher education system and private investment in R&D performed in the enterprise and higher education sectors.

National Reform Programme – Europe 2020 Strategy

Chart 6: Gross Expenditure on Research and Development



There were two assumptions underpinning the target when it was set in 2011:

- firstly, that Government would maintain public investment in R&D until 2014, after which it would see an upward trajectory, and
- secondly, that BERD would increase at around 3% per annum until 2014 after which it too would increase at a faster rate annually.

The research intensity rate for 2012 for Ireland has been confirmed 1.91% of GNP and 1.58% of GDP (only slightly up from 1.53%/1.89% in 2011.) This slight increase was due primarily to an increase in BERD which grew from €1.86 billion in 2011 to €1.962 billion in 2012.

- GERD (Gross Expenditure on Research and Development, the total amount spent on R&D in the economy) increased from €1.637 billion in 2003 to €2.724 billion in 2012 (+66%).
- Within this, although HERD increased from €378m in 2002 to €750m in 2008, since 2009 it has decreased annually and is estimated at estimated €649m in 2013.
- Conversely, BERD (the total amount spent on research and development in the enterprise sector, including funding allocated to businesses by State agencies including IDA Ireland, Enterprise Ireland and others) increased significantly from €1.245 billion in 2003 to €1.962 billion in 2012 (+58%). Approximately two thirds of Ireland's R&D is in the private sector. (However, the RDI performance of the enterprise base in Ireland is still below selected comparator countries as further detailed in Pillar 3.)
- GovERD (Government Expenditure on R&D performed directly in the state sector) increased from €145.8m in 2002 to €169m in 2008 although it has since fallen back to €132m in 2012.

In order to ensure that Ireland reaches the Europe 2020 research intensity target, it is essential that public investment in R&D not only be maintained, but must now see an upward trajectory between 2015 and 2020. This is particularly true as economic recovery continues, resulting in an increase in GNP/GDP, given that the R&D intensity target is calculated as a percentage of GNP/GDP.

Furthermore, National Accounts are compiled in the EU according to the European System of National and Regional Accounts (ESA) framework. Since the introduction of the R&D intensity target, a new European System of National and Regional Accounts Framework (ESA 2010) has replaced the ESA 95 version with all EU Member States obliged to adopt ESA 2010 by September 2014. This has had the effect of increasing Ireland's GDP and GNP figures (and that of all Member States), thus reducing the percentage of GDP/GNP attributable to GERD.

Declining investment trends in higher education in particular - the reduction in funding per student, increases in the staff/student ratios and a significant reduction in the HERD - is a critical issue that must be acknowledged. The Expert Group on the Future Funding of Higher Education are considering long term funding issues, declining research investment needs consideration.

- Higher Education Research and Development (HERD) (the total amount of money spent on research and development in the higher education sector, including both private funding and funding allocated by state agencies) has decreased in more recent years from a high of €750m in 2008 to an estimated €649m in 2013 as a result of the economic crisis. HERD as a percentage of GDP is now at EU and OECD average but still lags behind leading small innovative economies.
- Indirect funding for HERD comes mainly through the proportion of the Higher Education Authority's block grant dedicated to R&D. The block grant is allocated to cover core teaching and research activities within institutions - the internal allocation of funds as between teaching and research are a matter for each institution. The level of the grant is determined on a per capita basis with regard to the number of undergraduates and post graduates. The R&D component of the block grant is determined by a formula based on an estimate of time dedicated to research activities. The vast majority of the R&D element goes to salaries and overheads. It is therefore not possible to measure the quantifiable impact of this funding apart from the contribution it makes to the development of human capital in the HEIs.

Key areas to be explored include:

- **What should Ireland's ambition be in STI?**
- **Ireland is currently an innovation follower and lags other small developed countries in R&D intensity. Should we have more ambitious targets for investment?**
- **How can that level of ambition be justified? Where would we target increased funding and how could this be justified?**

Pillar 2 Prioritised Approach to Public Research Funding

Research Prioritisation

The Strategy for Science, Technology and Innovation 2006-2013 set out a vision that “Ireland by 2013 will be internationally renowned for the excellence of its research, and will be to the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture.” The SSTI also set out a range of goals regarding innovation in health, agri-food, energy, the environment, and marine.

During the lifetime of the SSTI, however, both resource availability and strategic direction changed. In 2011, in response to the economic situation, the National Research Prioritisation Exercise, which is the basis for Ireland’s smart specialisation strategy for research and innovation (see below), identified 14 priority areas of research that are most likely to give demonstrable economic and societal return, and where Ireland should focus investment.

Four criteria were used in selecting the 14 Priority Areas for future, competitively-awarded investment for economic objectives:

1. The Priority Area is associated with a large global market or markets in which Irish-based enterprises already compete or can realistically compete.
2. Publicly performed R&D in Ireland is required to exploit the Priority Area and will complement private sector research and innovation in Ireland.
3. Ireland has built or is building (objectively measured) strengths in research disciplines relevant to the Priority Area.
4. The Priority Area represents an appropriate approach to a recognised national challenge and/or a global challenge to which Ireland should respond.

Table 2: The 14 Priority Areas

A Future Networks & Communications	H Food for Health
B Data Analytics Management, Security & Privacy	I Sustainable Food Production & Processing
C Digital Platforms, Content & Applications	J Marine Renewable Energy
D Connected Health & Independent Living	K Smart Grids & Smart Cities
E Medical Devices	L Manufacturing Competitiveness
F Diagnostics	M Processing Technologies & Novel Materials
G Therapeutics - synthesis formulation, processing & drug delivery	N Innovation in Services & Business Processes

In addition, the Report identified the need to support infrastructure and key platform Science and Technologies necessary to underpin research in the Priority Area. The platform technologies identified include: Basic biomedical research, Nanotechnology, Advanced Materials, Microelectronics, Photonics and Software Engineering, although it was acknowledged that this was not an exhaustive list.

The Report also set out thirteen systemic recommendations aimed at improving the efficiency and effectiveness of the STI system.

Research Prioritisation sets the agenda for the five-year period, 2013-2017 and is now and will continue to be Ireland’s primary STI policy goal in the context of the new Strategy. Implementation is driven under the authority of the Cabinet Committee on Economic Recovery and Jobs.

Disruptive Reforms

Action Plan for Jobs Disruptive Reforms

The Action Plan for Jobs contains “Disruptive Reforms” – a new category of high impact, cross cutting measures that were identified as having potential to have a significant impact on job creation, to support enterprises, or where Ireland can profit from a natural advantage or opportunity that presents itself to the economy. A number of these disruptive reforms are supported under the research prioritisation priority areas:

- **Big Data and Data Analytics**, which aims to build on existing enterprise strengths to make Ireland a leading country in Europe in Big Data;
- **Manufacturing - National Step Change**, with the ambition that by 2020, Ireland will be internationally renowned as a place that excels in manufacturing and where manufacturing accounts for a significant share of economic activity;
- **National Health Innovation Hub**, which aims to drive collaboration between the health system and the enterprise sector leading to the development and commercialisation of new healthcare technologies, products and services emerging from within the health system and/or the enterprise sector.

Smart Specialisation

Smart Specialisation

National or Regional Research and Innovation Strategies for Smart Specialisation (RIS3 strategies) are integrated, place-based economic transformation agendas with the following features:

- They focus policy support and investments on key national/regional priorities, challenges and needs for knowledge-based development.
- They build on each country/region’s strengths, competitive advantages and potential for excellence.
- They support technological as well as practice-based innovation and aim to stimulate private sector investment.
- They get stakeholders fully involved and encourage innovation and experimentation.
- They are evidence-based and include sound monitoring and evaluation systems.

A feature of smart specialisation strategies is that they are intended to be dynamic with mechanisms in place to assess performance and apply learnings from experience into further evolution of the strategy.

Ireland’s smart specialisation strategy for research and innovation is the National Research Prioritisation Exercise together with its implementation arrangements and monitoring framework.

Prioritisation Action Group

In order to reinforce both political and policy goal commitment to delivering the research prioritisation agenda, the Government established, in March 2012, the Research Prioritisation Action Group (PAG), chaired by the Minister for Research & Innovation.

The PAG is an all-of-Government forum which brings together senior officials from ten State Agencies and six Government Departments with responsibility for funding research and innovation. It also includes the Department of the Taoiseach; the Department of Public Expenditure and Reform; and the Department of Foreign Affairs and Trade.

The first task for the PAG was to oversee the development of an action plan for each of the fourteen Priority Areas. These action plans were agreed by the Government and published in July 2013. The plans set out in considerable detail the steps necessary in order that Ireland can realise the opportunity associated with the Priority Areas. For each action the body with primary responsibility for its implementation is identified (typically a Government department or State agency) and also the timeline by which key milestones are to be achieved.

To add further impetus to implementation, a Champion was appointed for each Priority Area from the PAG. In most instances this person chaired the Working Group that developed the corresponding Action Plan. Therefore, each Champion has an in-depth understanding of the vision for the Area and the intention behind each of the actions. While the Champions do not have any executive responsibility for driving implementation outside of their own agency, they are well-placed to provide a high-level, holistic, cross-agency view of progress towards realisation of the opportunity associated with the Area.

The second key task for the PAG was to devise the indicators to be used to measure the impact of implementation of research prioritisation in the 14 Priority Areas and more generally the impact of public STI investment. This task addresses one of the systemic recommendations in the Report of the Research Prioritisation Steering Group. To this end, it developed a Framework of Metrics and Targets which was also adopted by Government in July 2013.

The First Progress Report on Implementation of Research Prioritisation was published in July 2014 and reflects progress made in implementation of Action Plans for the 14 Priority Areas, updates on achievements of targets to measure the impact of STI investment, as well as progress in implementation of the 13 Systemic Recommendations designed to improve the efficiency and effectiveness of the STI system, in order to support the implementation of prioritisation.

Key highlights of implementation at the time of the Progress Report's publication included:

- Of the 186 actions with key milestones, 150 are complete or substantial progress has been recorded;
- Enhanced coordination and cooperation between State agencies and Government departments funding research shown by a range of inter-agency collaborative initiatives;
- Seven large scale SFI Research Centres (and a further five since the publication of the Progress Report) and 15 Enterprise Ireland / IDA Ireland Technology Centres aligned with the 14 Priority Areas;
- 93% of Teagasc's funded projects in 2013 are aligned to two of the Priority Areas, namely, Sustainable Food Production and Processing and Food for Health;
- Establishment of the central Technology Transfer Office known as 'Knowledge Transfer Ireland (KTI)' to showcase the wealth of technology opportunities and academic talent that exists in Research Performing Organisations;
- Determining enterprise research needs across the 14 Priority Areas on the basis of input from all research funders in the system and through feedback from industry;
- A steady increase in the supply of mainstream science and technology graduates e.g. the higher education system is on course to achieve a doubling in the numbers of ICT level 8 graduates two years ahead of the schedule set out in the National ICT Action Plan.

Coherence of the Public STI System

One of the most important impacts of the Research Prioritisation exercise has been the enhanced coordination and cooperation it has engendered between the State agencies and Government departments funding research. The funding agencies and departments have a range of mandates, spanning enterprise development (IDA Ireland, EI, SFI); sectoral development (DAFM, MI, Teagasc, SEAI); societal challenges (HRB, EPA) and cross-cutting (HEA, IRC). The PAG, by convening senior officials and executives from the funders on a regular basis, provides a forum which facilitates communication and coordination between these bodies, while respecting the diversity of their mandates. Furthermore, the development and implementation of the Action Plans has driven practical cooperation at the operational level as the majority of the actions in the Plans require several funders to cooperate in their implementation.

A further impetus for cooperation has come from the cross-cutting Priority Areas, such as Manufacturing Competitiveness and Innovation in Services and Business Processes. As these areas span many sectors of the economy and hence fall within the remit of several Agencies and Departments a unified, national approach is required in order to fully exploit the opportunities identified in these areas. Such an approach is now evident in these areas.

The cumulative effect of these developments has been to bring a greater coherence to the public research and innovation funding system. This should in turn lead to greater efficacy and efficiency in the STI system, which was one of the key challenges identified in the report of the Research Prioritisation Steering Group.

Identification of Research Needs

Work was undertaken to develop a finer grained identification of the sub-topics for future research within each of the 14 Priority Areas through a series of workshops to facilitate sharing and collation of information between the State's enterprise development and research funding agencies on this question. The criteria for the sub-topics selected within each of the 14 Priority Areas was that research capacity within the public research system, on the particular topic, is required to support enterprise development in associated sectors of the internationally-trading economy. The sub topics of research were identified by the agencies/Departments based on enterprise need as evidenced by the views of the enterprise base, from the tacit knowledge obtained in their day-to-day interactions and from specific research developed by the agencies. The fine grained analysis also identified cross-cutting themes that emerged across the Priority Areas and the enhancers that would support the capacity of the enterprise base to absorb the research emerging from the publicly funded research system and for the latter to increase its capacity to deliver to the enterprise system. The report prepared following this analysis was circulated to 14 enterprise representative associations for comment and validation. Feedback was positive and re-endorsed the findings in the report.

Independent Assessment

When approving implementation of the recommendations contained in the Report of the Research Prioritisation Steering Group, Government agreed that the Department of Jobs, Enterprise and Innovation, through the PAG, should monitor implementation of research prioritisation on behalf of the Government and that such monitoring should be validated by independent assessment. An independent panel, including international representatives, was established to:

1. Assess progress in re-orienting competitively-awarded investment for economic objectives, in publicly-performed research, towards the 14 Priority Areas.
2. Assess progress in bringing about a "step change in the efficiency and effectiveness of the current STI system", with regard to the 13 systemic recommendations in the Report.
3. Assess progress in relation to the wider context identified for the Priority Areas, specifically, the six underpinning (platform) Science and Technology areas and Integrating Infrastructure.
4. Assess the effectiveness of the Research Prioritisation Action Group and its success as a mechanism to drive implementation of research prioritisation.

The panel met in December 2014 to carry out this work and a report of their findings is expected in Q1 2015.

Review of 14 Priority Areas

In 2017, it is proposed that a review of the 14 Priority Areas will be undertaken to examine the impact of research prioritisation on those areas and to ensure that the areas of opportunity most likely to deliver economic and societal return are supported.

Key areas to be explored include:

- **How can research prioritisation better serve our national objectives of a strong sustainable economy and a better society?**
- **How best do we identify emerging areas of opportunity and challenge i.e. horizon scanning?**

Pillar 3 Enterprise-level R&D and Innovation Performance

Current performance of the STI system

A strategic review to assess the current performance of the STI system carried out in 2013 indicates that significant advances have been made through public policy and STI investment in strengthening the research capacity and performance of the enterprise sector. This is illustrated by the resilience in terms of employment and exports of research and innovation intensive enterprises in Ireland since the onset of the global recession in 2008. The review of performance indicates that, in firms where innovation capacity has improved, these firms have performed and even grown through the recession. The STI investment has also led to the development of a strong public research environment including the establishment of scientific excellence in a number of strategic areas.

The policy goal of the SSTI was that of building technological and applied research and development capability in firms to support the development of high-value products and services across the entire enterprise base to support jobs and wealth creation. This still remains a national policy goal.

At the same time, despite recent increases in business expenditure on R&D and Innovation, the RDI performance of the enterprise base in Ireland is still below selected comparator countries, and the impacts of such expenditures are also lower. BERD (Business Expenditure on R&D) in Ireland increased from 0.77% of GDP in 2001 to 1.17% in 2011, but still lags behind comparator countries. Provisional EU data indicates an average EU R&D spend for 2011 of 1.26% of GDP.

A key output of the review has been the identification of a set of structural issues that may potentially be impacting on securing optimal returns from public investment in R&D in firms. Examples of issues identified in an analysis of the Annual Business Survey of Economic Impact (ABSEI) include:

- The dual nature of the enterprise sector in terms of indigenous and foreign owned firms, and between SMEs and large multinationals, and consequent differences in R&D performance and policy requirements. Ireland's enterprise R&D expenditure is dominated by foreign-owned firms. In addition, the evidence indicates that increases in RD&I expenditure and employment in Irish owned firms are being driven by small/medium sized companies, while increases in RD&I expenditure and employment in the foreign sector are being driven by large firms.
 - Foreign-owned firms accounted for 66.6% of total R&D expenditure in 2012.
- Ireland's enterprise R&D expenditure is dominated by a relatively small number of firms.
 - Around 300 firms account for almost 70% of total R&D expenditure in 2012.
 - 13% of foreign-owned firms (107 firms), each spending over €2m, account for 88% of R&D spending in the foreign-owned sector in 2012.
- Comparatively lower absorptive capacity of indigenous SMEs.
- A large proportion of foreign-owned firms (54%) are not R&D active.
- The pattern of R&D expenditure by sector for Irish-owned firms differs markedly from the pattern of R&D expenditure, by sector, for foreign-owned firms.
 - The four sectors 'Chemicals', 'Computer, Electronic and Optical Products', 'Medical Device Manufacturing', and 'Computer Programming', together account for around 80 per cent of R&D expenditure by foreign-owned firms. By contrast, these four sectors together account for only 15 per cent of R&D expenditure by Irish-owned firms.

- Most R&D expenditure in Irish-owned firms (72%) is being carried out in sectors that are not significant exporters.
 - Exports from indigenous enterprises are largely from low R&D-intensive and non-R&D active sectors. The top three exporting sectors for indigenous firms - Food, Drink & Tobacco, Other Traditional Manufacturing, and Business Services - account for around two thirds of sales and exports of Irish-owned ABSEI firms. Together, however, these three sectors account for only 28% of R&D expenditure in Irish-owned ABSEI firms.
 - Ireland's share of firms engaged in new product and services development, at 22% of innovating firms, appears to be low when compared to similar data for other countries.
 - There is evidence of low levels of formal collaboration between firms and with higher education institutions

Consultants were appointed in August 2014 to:

1. Undertake an analysis as to how public policy can best support and more effectively optimise the impacts of enterprise RDI investment, given the enterprise structure in Ireland and knowledge of other national innovation systems and policy mixes.
2. Conduct a series of workshops with key stakeholders to validate their findings and finalise recommendations on specific policy measures that Ireland could take to strengthen the performance and impacts of enterprise RDI in Ireland.

The consultants have suggested that Ireland has significant potential to increase its innovation performance in support of enterprise. To do this, however, a number of key challenges need to be addressed. These are multifaceted and relate both to the different RD&I actors in Ireland, business, higher education and the public sector. The challenges relate to the interactions between the different actors:

1. Strengthening the number of innovation performers in the multinational sector
2. Broadening RD&I activity in the indigenous sector and building absorptive capacity
3. Strengthening collaborative linkages between firms and the higher education sector
4. Better focusing of RD&I activities around public and societal challenges

These challenges are not short term in nature, but point towards a need for concerted strategic action on the part of government, business and higher education institutions. If Ireland is successful then the opportunity is one of helping Ireland to both build its innovation capacity performance to become one of the EU's Innovation Leaders with a balanced innovation policy that achieves an appropriate mix of policy measures and which takes maximum benefit from Ireland's mixed economy and creates new products, processes and services that significantly contribute to quality of life, society and the economy. The report is due to be finalised in early 2015.

Innovation in Services and Business Processes

As mentioned in Pillar 1, innovation is broad based and not limited to technological innovation but includes the development of new processes and services as well as innovation in organisational models. This was recognised in Research Prioritisation by the identification of '**Innovation in Services and Business Processes**' as one of the 14 Priority Areas. Advances in technology have presented new opportunities for companies to innovate their service delivery and business processes, such as: new monetising models; new channels for service delivery; and improved customer experience. The vision/opportunity for this Priority Area is to capture customer centric innovation that combines non-technological and technological know-how in order to conceive and develop new globally successful operating models, products and business services.

This Priority Area is unique in that, firstly, it is cross-cutting, i.e. spanning multiple, if not, all enterprise

sectors. Secondly, it is also a nascent area as it has not been considered as a theme in its own right prior to Research Prioritisation. In order to address this uniqueness and to “kick-start” activity in the area, a study under the auspices of the PAG was undertaken to identify how Ireland might best support RDI in Innovation in Services and Business Processes (ISBP).

The research found a growing awareness among businesses of the need to innovate in services and business processes for success in markets, and that correspondingly, public support measures and publicly-funded research programmes need to adjust to better support ISBP. The final report, ‘Assessment of Publicly Funded RD&I Supports for Innovation in Services and Business Processes’, sets out a detailed roadmap and associated actions to ensure that public supports for ISBP in Ireland are aligned with international best practice.

The report was adopted by PAG at its meeting in March 2014 and implementation of the recommendations is to be progressed through the PAG. An advisory group comprising representatives from the Department of Jobs, Enterprise and Innovation, IDA Ireland, EI, SFI and IRC has been established to facilitate implementation. The Advisory Group is specifically addressing the following four recommendations from the report:

1. Reviewing existing RDI instruments

This recommendation seeks to ensure that existing public RDI supports are kept under continual review and tested to ensure as far as possible that projects involving ISBP are eligible for funding and support.

2. Building interdisciplinary skills capacity

This recommendation seeks to begin to address the deficit in Ireland’s HEI system with regard to research capacity in this area through joint agency calls for interdisciplinary research in ISBP.

3. Adding ISBP capacity to existing research centre(s)

This recommendation seeks to demonstrate the added value of ISBP by establishing an ISBP research capacity to one or more existing HEI research centres.

4. Initiating a major public services initiative in ISBP

This recommendation seeks to align research in ISBP with research in one or more of the 13 other Priority Areas in order to demonstrate how public investment can result in job creation, the creation and diffusion of new technology-based products and services, and improved quality of public services and quality of life.

Work is progressing on each of these four recommendations, through the Innovation in Services and Business Processes Advisory Group who will report to PAG on progress made regarding the implementation of these recommendations. Some progress is already being made in reviewing existing RDI instruments. For example:

- EI have introduced a new grant - Business Innovation Initiative – a grant which is now possible due to the changes to State aid rules agreed by the EU in June this year (EU State Aid Policy General Block Exemption Regulation No. 651/2014).
- Extension of funding for the Innovation Value Institute (IVI) Technology Centre for the next 5 years has also been secured. A portion of this funding will be used to drive adoption of the IVI framework by the SME community nationally.
- EI has also launched the Financial Services Governance, Risk and Compliance Technology Centre, which is closely related to this area albeit with a very financial services slant on their work.
- Furthermore, under the Commercialisation Fund, EI has recently approved a project in Waterford (TSSG) that looks at Security & Data privacy in the business process area. From a

commercialisation perspective several EI clients with interests in this area have been identified and it is intended that they will ultimately become part of the commercialisation path of this work in the future.

Key areas to be explored include:

- **A review of the outcomes of SSTI 2006-2013 shows that targets for the public research base were largely achieved or exceeded. Opportunities exist for further progress in regard to enterprise RD&I activity. How can public policy best support and more effectively optimise the impacts of enterprise RD&I investment - what actions could be taken to:**
 - o **strengthen the number of innovation performers in the multinational sector?**
 - o **broaden RD&I activity in the indigenous sector and build absorptive capacity?**
- **Do we need to enhance the suite of enterprise support programmes to further drive innovation in industry and/or is there scope for consolidation of the existing range of support programmes?**
- **How can we incentivise firms that are R&D active to scale their research efforts?**

Pillar 4 International Collaboration and Engagement

International collaborations

International Collaboration

International cooperation helps to develop links with top international research institutions and enterprise markets, in addition to reinforcing Ireland's standing as a top-class research-performing nation. Areas of activity include :

- Recruiting high-calibre researchers to Ireland
- Facilitating collaborations with world-class centres of research excellence
- Raising international awareness and recognition of Irish science and high-quality research
- Learning from other countries that have focused on R&D and innovation as key national policies.

In the context of international collaboration, Ireland's main partners are within the EU. However, Ireland has also entered into bilateral science and technology agreements with other countries, e.g. Israel and China. Furthermore, Ireland is a partner in the US-Ireland R&D Partnership, which was developed on foot of commitments made at the US Ireland Business Summit held in Washington in September 2002. The Partnership involves the governments of the United States of America, Ireland and Northern Ireland working together to advance scientific progress by awarding grants for research on a competitive basis. Areas of focus for collaboration include health, telecommunications and energy. The Partnership is helping to link scientists and engineers in partnerships across academia and industry to address crucial research questions in these areas, foster the potential for new and existing technology companies, attract industry that could make an important contribution to the three economies and expand educational and career opportunities in science and engineering. To date, nineteen projects have been awarded a total of €28.95m or £23.1m or \$38.77m from a combination of sources including the US National Science Foundation and the National Institutes of Health; Science Foundation Ireland and the Health Research Board in Ireland; and, in Northern Ireland, Health and Social Care R&D, in partnership with the Medical Research Council, the Department of Employment and Learning and Invest NI.

Ireland, via DAFM, is also a member of the Global Research Alliance (GRA) of Agricultural Greenhouse Gases which comprises 44 countries from around the world and via DAFM, Teagasc & the EPA is actively involved in important work it undertakes through 4 of its 6 Research Groups.

The European Research Area

The European Research Area

The European Research Area (ERA) is based on the 27 national research systems of the Member States funded from national tax revenues. To achieve a globally competitive ERA for Europe to play a leading role in addressing grand challenges and in which all Member States participate, national systems must be more open to each other and to the world, more inter-connected and more inter-operable. Completing the ERA will bring efficiency, quality and impact gains and new opportunities for all Member States. Based on analysis of the strengths and weakness of Europe's research systems and the overall objective of inducing lasting step-changes in Europe's research performance and effectiveness there are five ERA priorities. Actions within these priorities taken by Ireland to complete the European Research Area are as follows:

- More effective national research systems
One of the key aims of the research prioritisation strategy is to reduce the fragmentation and lack of cohesion of public research funding. A competitive funding approach is widely used by research funders involving international peer review. The Higher Education Authority has published national guidelines for access by researchers to research infrastructure hosted by higher education institutions or other research bodies in Ireland.
- Optimal transnational co-operation and competition
The national research prioritisation strategy is aligned with grand challenges identified at

European level to be addressed through optimal transnational co-operation and competition. Through the Research Prioritisation action plans, the strategy seeks to ensure that Ireland optimises research and innovation investment internationally and leverages international infrastructure as appropriate. Ireland is actively participating in the Joint Programming and European Strategy Forum on Research Infrastructures (ESFRI - an EU advisory group tasked with identifying research infrastructures of strategic importance for Europe) processes. SFI has initiated a number of new funding programmes involving international collaboration. The new SFI legislation permits SFI to provide funding in Northern Ireland and, with the consent of the Minister, to participate in international collaborative projects.

- An open labour market for researchers
Ireland is recognised as having a very open and transparent system for recruiting researchers. Irish research funding is very open to access by non-national researchers, subject to the research generally being carried out in Ireland). The Euraxess Office in Ireland provides an advisory service to both inward and outwardly mobile researchers and supports the implementation of the Third Country Researchers Directive including through maintaining a database of Hosting Agreements for third country researchers.
- Gender equality and gender mainstreaming in research
Ireland has a comprehensive employment equality legislation framework. A new SFI Advance Fellowship funding initiative assists female researchers to return to research. SFI has set performance targets for increasing women in research. Universities have gender balanced recruitment committees.
- Optimal circulation, access to and transfer of scientific knowledge including via digital ERA
A Policy Statement on National Principles for Open Access was published in October 2012. This was prepared by a Committee of Irish research organisations working in partnership to coordinate activities and to combine expertise at a national level to promote unrestricted, online access to outputs which result from research that is wholly or partially funded by the State. The Technology Transfer initiatives described above are strongly aligned with the ERA priority on open access and knowledge transfer.

EU Research Framework Programmes

EU Research Framework Programmes

The European Research Framework Programmes have always been an important element in providing international linkages and enhancing the excellence of the Irish R&D system. They have enabled academic and industry research groups to work with their peers in high-calibre research collaborations across Europe and beyond, and to derive the benefits associated with collaborative research, such as access to knowledge networks, sharing of costs and risks and, in particular for industry, the possibility of opening up commercial opportunities.

Ireland has had good success under previous EU Research Framework Programmes. We have exceeded our target of €600m from the current FP7 Programme, with awards totalling some €620m. Horizon 2020, with a budget of almost €80 billion and covering the next seven years is the biggest ever European Research and Innovation Programme and the largest worldwide. Based on national investment in research in recent years, Ireland is participating in the current Framework Programme from a far stronger position than ever before.

Target for Participation

National Horizon 2020

It is estimated that Ireland's average contribution to the EU Budget over the period 2014-20 will be of the order of 1.2%. On that basis a *juste retour* figure of €953m (i.e. €79.4 bn x 1.2%) would represent what

*Targets; ERDF
and other EU
Funding*

would be required to break even compared to Ireland's estimated contribution to the EU's overall budget for 2014-2020 (Multi-annual Financial Framework). However, the *juste retour* figures do not reflect past performance or areas of strength/ weakness.

In contrast, analysis of individual elements of H2020, taking into account the specific circumstances of Irish research strengths and opportunities provides a more realistic view of Ireland's performance by programme area based on knowledge of FP7 history and the national investment in R&D capability.

Taking into account this analysis as well as the value of adopting an ambitious approach to engagement with Horizon 2020, in order to drive the fullest engagement by both the public and private sectors and maximise the benefits for Ireland, a target of €1.25bn for Ireland's drawdown of funding from H2020 has been adopted.

H2020 Strategy

The National Horizon 2020 Strategy approved by Government in December 2013 sets out the challenges and opportunities arising in Horizon 2020 as well as Ireland's strategic approach to maximise our participation, and arrangements for oversight and direction. The strategy has been prepared in consultation with a Horizon 2020 High Level Group, chaired by the Department of Jobs, Enterprise and Innovation. Government Departments and Agencies whose remit includes research and innovation participate in the High Level Group and have inputted into the Strategy. The High Level Group will oversee the implementation of this strategy and securing the maximum benefits for Ireland.

Horizon 2020 represents a substantial budget increase on FP7, of the order of 30%. In FP7, over 8,000 applications were submitted by Irish-based researchers, companies and other entities. However in targeting participation in the next round, it is not necessarily optimum to proportionally increase the number of applications - this represents a substantial effort on the part of applicants. A more strategic approach is required, aimed at participation in larger scale projects as well as playing a larger role on projects generally. The National Support Network will work with research performers to build consortia and partnerships to step up the scale of participation.

Another necessary step in the light of the increased budget is to bring in new participants – existing participants can only manage a certain number of projects at a time. The National Support Network will include a focus on introducing new participants to Horizon 2020 and in particular explaining the opportunities for Horizon 2020 to support the strategies of potential participants. Relevant Departments and their agencies will be asked to do the same with their own client bases. As part of this, the IDA Ireland and Enterprise Ireland will target their client companies through their client support teams to engage with Horizon 2020.

As every country participating in Horizon 2020 will be targeting increased participation and funding from H2020, the level of competition will be intense. Only top quality projects will win funding. This requires that our national research and innovation system performs at a top internationally competitive level. Ongoing and indeed, increased levels of, national funding for research and innovation will be required. As H2020 is a competitive funding process, it will not be possible to use Horizon 2020 funding as an opportunity to reduce national funding, i.e. to substitute Horizon 2020 funding for national investment. However, all available opportunities will be used to leverage national investment to maximise funding from Horizon 2020. National funders are putting significant focus on funding nationally in areas of relevant national economic and societal impact which are also likely to win further funding from Horizon 2020 and other sources.

Strategic Research Proposals Group

An initiative to identify large-scale EU funding opportunities for businesses and researchers in Ireland and nurture applications that will give big wins for Ireland has been introduced, comprising a dedicated team of senior executives and officials from all research funding Government Departments and Agencies to focus exclusively on identifying opportunities and mobilising EU funding applications for **large scale projects of strategic value to Ireland**. The Strategic Research Proposals Group, chaired by the Chief Scientific Adviser to the Government and SFI Director General, complements the ongoing work of Enterprise Ireland. EI coordinates the network of National Contact Points and National Delegates and is tasked with identifying key areas of opportunity, mobilising and engaging all of the research expertise across Ireland's academic and industrial (multinational, indigenous and SME) ecosystem to lead winning applications.

Active participation in EU Advisory Groups such as the Standing Committee on Agricultural Research (SCAR), which DAFM & Teagasc services for Ireland, are also very helpful in influencing the focus on Horizon 2020 Calls in certain areas going forward.

Success to date

While it is still early days in terms of results from the first calls under the programme, there are some very encouraging signs that Ireland will continue to be successful in those areas where we have traditionally performed well in previous Research Framework Programmes, such as Health, ICT, Agri-Food & Marine, Marie Curie and support for SMEs. For example, research collaborations between Irish SMEs and Higher Education Institutions have secured over €9 million in the first outcomes in the area of Horizon 2020 known as the Marie Curie Actions. Irish research performers consistently achieved success rates above the EU average, outperforming organisations from France, Italy, Spain and the UK. In one programme, 57% of Irish participants were selected for funding, with one project ranked top in all of Europe. The funding will support research and innovation projects at 18 Irish research performers including nine SMEs, many of which are spin-outs from HEIs. Also, Ireland had the highest success rate in Europe in the first results under the SME Instrument, with 20% of SMEs who applied being successful. The 10 successful Irish SMEs will receive €50,000 each to finance feasibility studies for their projects and may be considered for further financial support from the Commission worth up to €2.5 million per project.

North-South

North South Cooperation

The importance of North South collaboration in the areas of research and innovation is recognised by both jurisdictions, especially when it comes to collaboration on Horizon 2020. Both jurisdictions on the island are striving to build on the obvious advantages of a shared border between two Member States and there is also the advantage of the same language and the existing strong links between academic institutions and individual researchers as well as the close relationships between the key supporting agencies including the North/South body InterTradelreland, Enterprise Ireland and Invest NI.

It is significant to note that under the FP7 programme (the precursor to Horizon 2020), there was an above average success rate for North/South applications of 23.7% which is above the EU average of 21.3%, as well as the Irish average of 21.9% and the Northern Irish figure of 19.7%.

InterTradelreland, chairs an All-Island Steering Group for Horizon 2020 and this Group launched its All-Island Strategic Action Plan for Horizon 2020 in December 2014. This Plan is a new North South joint initiative and is seen as an important step in building awareness of collaborative elements under the programme. Other significant actions which InterTradelreland has taken to encourage North South collaboration in research and innovation include the publication of a Horizon 2020 Guide, an interactive app and their annual Collaborate to Innovate Conferences. Under the Plan, a specific target of €175 million has been set by relevant Departments for North South collaborative Horizon 2020 projects. This represents approximately 10% of the combined targets of Ireland (€1.25 billion) and Northern Ireland (€145

million) for drawdown from this programme

*European
Regional
Development
Fund (ERDF)*

European Structural and Investment (ESI) Funds

European Structural and Investment (ESI) Funds include: the European Regional Development Fund (ERDF); the European Social Fund; the Cohesion Fund; the European Maritime and Fisheries Fund; and the European Agricultural Fund for Rural Development. Member States are required to draw up and implement strategic plans with investment priorities covering these five ESI Funds. These Partnership Agreements are negotiated between the European Commission and national authorities, following their consultation of various levels of governance, representatives from interest groups, civil society and local and regional representatives. In November 2014, the European Commission adopted a Partnership Agreement with Ireland setting down the strategy for the optimal use of European Structural and Investment Funds throughout the country. Ireland's Partnership Agreement focuses on the Europe 2020 goals of Smart, Sustainable and Inclusive growth. It will support the National Reform Programme targets relating to employment and job creation, research and development, education, poverty and promoting a shift to a low carbon, resource efficient, economy

The ERDF aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. In short, the ERDF finances:

- Direct aid to investments in companies (in particular SMEs) to create sustainable jobs;
- Infrastructures linked notably to research and innovation, telecommunications, environment, energy and transport;
- Financial instruments (capital risk funds, local development funds, etc.) to support regional and local development and to foster cooperation between towns and regions;
- Technical assistance measures.

The focus is on jobs and growth; combating unemployment and social exclusion; promoting research, technological development and innovation and information and communications technology investment and the competitiveness of the business sector; and promoting an environmentally-friendly and resource-efficient economy.

The regulations governing the European Structural and Investment Funds for the period 2014-2020 provide for a number of ex ante conditionalities to be complied with, that is, specified measures to be put in place by certain dates, aimed at ensuring that appropriate institutional and strategic policy arrangements are in place for effective investment. In relation to research and innovation investment supported by the ESI Funds, an ex-ante conditionality is the existence of a national or regional smart specialisation strategy in line with the National Reform Program, to leverage private research and innovation expenditure, and which complies with the features of well-performing national or regional R&I systems. The draft Partnership Agreement submitted by Ireland to the Commission states that Ireland's Research Prioritisation Strategy (see Pillar 2) is in compliance with this conditionality.

Operational Programmes

Member States are required to prepare operational programmes to implement the strategic priorities set out in the Partnership Agreement. Ireland has proposed the following operational programmes for the 2014-2020 round:

- A Rural Development Programme co-funded by the EAFRD and managed by the Department of Agriculture, Food & the Marine;
- A National ESF operational programme co-funded by the ESF and managed by the Department of Education & Skills;
- A Seafood Development Programme co-funded by the EMFF and managed by the Department of

Agriculture, Food & the Marine;

- Cross-border programmes as follows:
 - Northern Ireland PEACE Programme;
 - Ireland/Northern Ireland/Scotland INTERREG Programme;
 - Ireland/Wales INTERREG Programme; and
 - A number of operational programmes focused on EU trans-national cooperation part-funded by the ERDF;
- Two **Regional Operational Programmes** co-funded by the ERDF under the auspices of the Department of Public Expenditure & Reform.

Included in these two Regional Operational Programmes, and under the themed objective of strengthening RTDI, is a total indicative spend by agencies of €376 million specifically aimed at:

- Enhancing research and innovation (R&I) infrastructure and capacities to develop R&I excellence, and promoting centres of competence, in particular those of European interest.
- Promoting business investment in R&I, developing links and synergies between enterprises, research and development centres and the higher education sector, in particular promoting investment in product and service development, technology transfer, social innovation, eco-innovation, public service applications, demand stimulation, networking, clusters and open innovation through smart specialisation and supporting technological and applied research, pilot lines, early product validation actions, advanced manufacturing capabilities and first production, in particular in key enabling technologies and diffusion of general purpose technologies.

INTERREG

INTERREG

The INTERREG Programme is an EU funded initiative to support various cross-border initiatives. A new Programme for the period 2015 -2020 is being finalised and it is likely that there will be a €73m fund to support specific Research and Innovation initiatives, mainly funded by the EU but with the Department of Jobs, Enterprise & Innovation and the N.I. administration also contributing. The Department of Jobs, Enterprise & Innovation will ensure that the projects which emerge have significant participation by Institutions/Bodies based in this jurisdiction and that there will be benefits for Irish companies from the element of the Programme which is designed to assist SMEs to capitalise on Research and Innovation in their operations.

Subscriptions to International Organisations

Subscriptions to International Organisations

International linkages are a crucial component of a national innovation system. In this context, membership of international research organisations can play an important role in enhancing and supporting the effectiveness and output of Ireland's innovation system. Ireland's membership of international research organisations must be predicated on whether the benefit of membership, in terms of support to Irish researchers, companies and jobs, justifies the cost involved. The Department of Jobs, Enterprise and Innovation is carrying out a review of Ireland's international engagement on research and innovation, in particular the costs and benefits of membership of international research organisations. The review will take into account both the overall funding available for research and the Government's prioritised areas for investment in research and innovation. In the context of the review, international research organisations can be divided into three broad categories:

- International research organisations of which Ireland is currently a member including the European Space Agency (ESA), European Molecular Biology Laboratory (EMBL), European Molecular Biology Conference (EMBC), EUREKA, European Co-operation in the field of Scientific and Technical Research (COST).
- International research organisations which are currently operating and of which Ireland is not a member:

- CERN – European Organisation for Nuclear Research, operating particle accelerators and detectors in Geneva, Switzerland, enabling the study of the basic constituents of matter
- ESO – European Southern Observatory, with headquarters in Garching, near Munich, Germany, operating a suite of the world's most advanced ground-based astronomical telescopes in Chile
- ESRF – European Synchrotron Radiation Facility, an x-ray light source facility, in Grenoble, France
- ILL – Institut Laue-Langevin, an international research centre, in Grenoble, France operating one of the most intense neutron sources in the world
- A number of other international research projects that are under development including:
 - SKA –the Square Kilometre Array, a very large radio telescope system with facilities being built in Australia, Africa and other locations
 - XFEL – a research facility currently under construction in the Hamburg area, Germany. From 2017 on, it will generate extremely intense X-ray flashes to be used by researchers from all over the world
 - FAIR – an international accelerator facility for research with antiprotons and ions, to be built in Darmstadt, Germany
 - ESS – European Spallation Source, a high-power neutron facility being built at Lund, Sweden
 - LOFAR – Low Frequency Array, an array of radio telescopes being constructed in Europe; an Irish component is being proposed for location at Birr, Co. Offaly.

The findings from the review are expected in Q1 2015.

*Review of
Ireland's
membership
of European
Space Agency*

European Space Agency

Ireland's investment and participation in European Space Agency (ESA) programmes facilitates innovative Irish companies to develop leading edge space technologies and to commercially exploit their ESA participation in global space and non-space markets, leading to increased exports, sales and employment. Investment in key ESA programmes supports an expanding involvement by Irish companies reflecting growth in the capacity of such industries and the research community. Investment is focussed on those ESA programmes which best underpin the national strategy of supporting activities that lead to increased export sales and employment in Irish industry. Annual investment of €17.3m is directly aligned with the objectives of similar Enterprise Ireland investment in the R&D capability of Irish Industry and is also aligned with the Enterprise Ireland and IDA Ireland strategy of supporting high potential start-ups and foreign direct investment. Ireland's ESA membership has contributed to the development of a highly knowledge-intensive industry sector with almost 90 Irish technology companies securing ESA contracts since 2000. At the end of 2014 more than 45 Irish companies will be actively engaged on ESA contracts with turnover in these companies growing from €17 million in to 2008 to a projected €70 million by 2015. Total employment in ESA participating companies is set to grow from 1,300 in 2008 to a projected 2,000 in 2015. The Government's investment in ESA forms part of a wider strategy for Irish industry and research facilities to access opportunities to develop space capabilities under Horizon 2020 and other R&D programmes of the European Union.

Enterprise Ireland has commissioned an evaluation of Ireland's involvement with the European Space Agency (ESA). The objective of the evaluation is to assess the broad economic impact of ESA membership in Ireland, including primarily the impact on industry development and job creation and to identify key issues to be addressed in the further development of Ireland's strategy for membership of ESA. The evaluation is due to be finalised in Q1 2015.

Copernicus

Copernicus is a European space-based and in-situ system for monitoring the Earth. Copernicus consists of a complex set of systems which collect data from multiple sources: earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors. It processes these data and provides users with reliable and up-to-date information through a set of services related to environmental and security issues. The services address six thematic areas: land, marine, atmosphere, climate change, emergency management and security. They support a wide range of applications, including environment protection, management of urban areas, regional and local planning, agriculture, forestry, fisheries, health, transport, climate change, sustainable development, civil protection and tourism. The main users of Copernicus services are policymakers and public authorities who need the information to develop environmental legislation and policies or to take critical decisions in the event of an emergency, such as a natural disaster or a humanitarian crisis. The Copernicus programme is coordinated and managed by the European Commission. The development of the space-based observation infrastructure is performed under the aegis of the European Space Agency and of the European Environment Agency and the Member States for the in situ components.

Key areas to be explored include:

- **How can we further increase/strengthen the effectiveness of our international collaboration and engagement across all areas of STI investment in pursuit of economic and societal goals?**
- **What additional measures can be taken to maximise the engagement of industry as a partner in this regard?**
- **What additional measures could be taken to enhance Ireland's participation in Horizon 2020 and other EU Programmes – industry, academia, SMEs and MNCs?**
- **Are there research policy or programme developments taking place at EU level where enhanced engagement by Ireland could provide opportunities for research collaboration and ultimate economic or societal benefit?**

Pillar 5 Organisational/Institutional arrangements to enhance research excellence and deliver jobs

Organisations

Investment in STI is based on a two pronged approach. Firstly, investing in people, infrastructure and associated facilities to build and maintain the science base and secondly, direct support to the enterprise sector to build and maintain their capacity for research and development.

Three agencies under the aegis of Department of Jobs Enterprise and Innovation (DJEI) Science Foundation Ireland, Enterprise Ireland and IDA Ireland, play key complementary roles in Ireland's STI investment.

Science Foundation Ireland is the national foundation for investment in excellent scientific and engineering research. SFI invests in academic researchers and research teams who are most likely to generate new knowledge, leading edge technologies and competitive enterprises in the fields of science, technology, engineering and maths (STEM). SFI also promotes and supports the study of, education in, and engagement with STEM and promotes an awareness and understanding of the value of STEM to society and, in particular, to the growth of the economy. In order to fully support implementation of research prioritisation the mandate of SFI has been expanded by statute to allow it to fund the full continuum of research (applied as well as basic oriented) across all the priority areas.

SFI is building strategic partnerships to perform cutting-edge scientific research and supports industry-informed research and fosters academic industry interactions to build a competitive advantage for Ireland. SFI engages with industry at many different levels and in various ways, depending on the company's specific needs. Supports include, inter alia,:

- **SFI Industry Fellowships** - facilitates the placement of researchers in industry or academia to stimulate excellence through knowledge transfer and training. Fellowships will enable access for researchers to new technology pathways and standards and will facilitate training in the use of specialist research infrastructure.
- **SFI Partnerships** - provides a flexible funding mechanism intended to support ambitious research projects of scale between industry and academia. The scheme provides an opportunity for industry to engage with world class academic researchers and have access to infrastructure and intellectual property using a shared risk funding model in which SFI matches the investment (50%) made by industry.
- **SFI Research Centres** - world-leading, large-scale Research Centres with a major economic impact for Ireland. They consolidate research activities across public research organisations to create a critical mass of internationally leading researchers in strategic areas which will lay the foundation for effective and productive academic and industrial partnerships. SFI requires a minimum of 30% funding from industry in its Centres' projects and involve circa 300 industry partners from both the multi-national and SME sectors. Approximately 50% of the partners are from the SME sector and 50% from the MNC sector.
- **SFI Research Centre Spokes Programme** - provides a mechanism to allow new industry partners to join the existing SFI Research Centres.
- **SFI Academic Led Programmes** - suite of programmes to support research that has the potential for economic and societal impact. Academic led programmes such as the SFI Investigators Programme address crucial research questions that expand educational projects and career opportunities in Ireland.

Enterprise Ireland plays a key role in commercialisation of research providing a range of supports for both companies and researchers in Higher Education Institutes and Public Research Institutes to develop

new technologies and processes that will lead to job creation and increased exports. EI provides supports for the commercialisation of academic research and collaboration with industry and have a number of supports to directly assist companies with research and innovation activities. EI provides support relevant at all stages of company development, enabling companies to progress from undertaking an initial research project to higher level innovation and R&D activities. Supports include:

In-company supports

- **Innovative High Potential Start-Ups (HPSUs) R &D Equity** - to encourage the establishment, and support the development, of innovation-led high potential start-up companies with a strong export focus.
- **R & D Fund** – Grants to Enterprise designed to support in-company projects which have the potential to develop novel products and services with a clear competitive advantage in their target market.

Collaboration Supports

- **Innovation Vouchers** - designed to facilitate and encourage enterprises, in particular small enterprises, to engage in research or development by availing of the services available from research institutions.
- **Innovation Partnerships** - supports joint R&D projects involving companies and colleges, where the bulk of the R&D is carried out within a third level institute or a public research organisation. Funding is provided to the research performing body, which also receives support from the collaborating company.
- **Technology Centres Programme**- developed to find an effective way of taking industry views more directly into consideration when undertaking publicly funded research. These centres are delivering industry-led research established primarily in Irish universities.
- **Technology Gateways** - a nationwide network of 12 industry focused Gateways seeking to harness the innovation and technological expertise in the Institutes of Technology for the benefit of Irish based Industry on a regional and national basis.
- **New Frontiers Programme** - seeks to raise the number of business start-ups and lay the foundations for a 20% increase in the pipeline of High Potential Start-ups and other sustainable businesses, through unified course structures, rigorous processes both for selection onto the programme, and for the assessment of participants' progress.
- **International Collaboration** – to assist, support and encourage Irish companies to avail of international funding for R&D.

Realising Commercial Potential

- **Commercialisation Fund** – to provide supports for academic researchers to take research outputs with commercial potential and bring them to a point where they can either be transferred into industry or spun out into a new start-up company.
- **Technology Transfer Strengthening Initiative** - to support the 10 Technology Transfer Offices, involving a network of dedicated staff with a commercialisation support remit in Universities and Research Institutions.
- **Campus Incubation centres** - a partnership approach between EI and the higher education sector to promote campus entrepreneurship and to commercialise the research capability in Irish universities and institutes of technology.

IDA Ireland has a key role in seeking to win high-value R&D investments for Ireland, by promoting collaboration between industry, academia, government agencies and regulatory authorities. Foreign Direct Investment (FDI) has played a significant role in advancing Ireland's economic development over

the past decades. The recently published “Policy Statement on FDI in Ireland” (July 2014) finds that, in order to compete effectively for mobile investment, Ireland must not only maintain high performance and compete strongly in traditional areas like tax and cost competitiveness, but crucially differentiate itself in other ways. Among the key areas identified are talent and technology: to genuinely differentiate its offering, Ireland must be recognised as one of the most enterprise aligned science, technology and innovation systems in the world, renowned for excellence in research, connecting and collaborating with enterprise, delivering sustainable economic impact, and attracting investment and exceptional talent.

IDA Ireland plays a leading role in RDI development by providing funding support for suitable projects. It also identifies support opportunities from partner organisations, such as EI, SFI and Sustainable Energy Authority Ireland. It also funds in-company R&D. The R&D fund provides grant aid to support clients in the establishment of major new R&D facilities or in the expansion of existing ones, and in the development of R&D projects.

Ireland’s strengthened national research ecosystem has enhanced IDA’s capacity to attract increased levels of high-value R&D projects which qualitatively transform and deepen the roots of key multinationals here. In 2013 SFI had linkages to 72% of IDA job announcements made which are within SFI’s remit. Of the total of 54 company announcements made by IDA Ireland, 30 of these projects were considered to be within SFI’s remit. The total number of jobs associated with the 30 projects was 1,757 of which SFI had links to 1,265 (72%).

Tyndall National Institute

The Department of Jobs, Enterprise & Innovation also provides funding to the **Tyndall National Institute**, one of Europe’s leading research centres, specialising in information and communications technology (ICT) hardware and systems. Tyndall is focused on developing technology solutions for health, communications, energy, agriculture, food, marine and the environment sectors.

Tyndall has 460 researchers, engineers, staff and postgraduate students (120), interacting with over 200 industry partners and generating over 200 peer-reviewed publications annually. Tyndall works through world-class teams performing ground-breaking R&D and innovation on new materials, devices and systems with a philosophy of “from atoms to systems”, focusing on impact to the Irish economy. Tyndall is globally recognised in its core research areas of photonics and micronano systems. Hosting state-of-the-art semiconductor fabrication facilities and services, Tyndall delivers prototypes and new product opportunities to industry. Tyndall actively develops strong partnerships with other universities and research bodies to provide multidisciplinary solutions, creating breakthrough product technology for industry. Critical to Tyndall’s success is its focus on market-needs-driven research. This distinguishes the Institute from university based research. Tyndall shares many characteristics and performance targets typical of Europe’s leading research technology organisations (RTOs). Tyndall at UCC is host to four industry-focused research centres – IPIC, MCCI, CCAN and IERC.

Department of Agriculture, Food and the Marine (DAFM)

The Department of Agriculture, Food and the Marine (DAFM) is the primary funder of Agri-Food Research. In addition to core funding to Teagasc and the Marine Institute, the DAFM also operates three competitive research funding programmes dedicated to food (FIRM), agriculture (Stimulus) and forestry (CoFoRD). These programmes are open to public research institutions in Ireland including Teagasc and the Higher Education Institutes (HEIs). Most of the projects funded are 3 to 5 years in duration, involve inter-institutional collaboration, range in size from €100,000 to €3 million, and are mainly populated by a mix of Masters and PhD students and early stage post-doctorate researchers on contract. In general these programmes help build and maintain capacity, critical mass and trained human capability in the RPOs whilst also delivering solutions and innovations for practical application at farm and enterprise level across the food chain from farm to fork as well as sound scientific evidence to guide policy formation. Projects funded cover research from basic right through to the pre-commercial

stages and, as such, are intended to provide a pipeline of both product and process knowledge and technologies as well as trained institutional personnel that can be further exploited and developed through the more commercially focused funding programmes operated by EI & SFI.

Teagasc

Teagasc, (the Agriculture and Food Development Authority), and the Marine Institute (the national marine research and development agency) are independent government agencies which operate under the auspices of the Department of Agriculture, Food and Marine. Teagasc has a statutory role in the provision of research for the Irish agri-food sector. To fulfil its mandate to meet the knowledge and technology needs of the entire food chain, Teagasc integrates research, advice and education services to deliver the innovation support necessary to add value to Ireland's agri-food sector. Across its seven centres, it conducts a very significant national programme of research in agri-food areas, comprising animal, crop, food, soils, environment and rural economics and development, which is augmented by research across several Universities and Institutes of Technology, and this is one of Ireland's most internationally recognised research successes. One of the strengths of this research infrastructure is a very high degree of collaboration and joint research planning between RPOs, developed over a decade of funding for collaborative and large scale strategic inter-institutional programmes; a further noteworthy aspect of the agri-food research landscape is the extent to which RPOs are already working closely and in a highly integrated manner with agriculture and food companies, for example as part of the Teagasc programme, and on EI and SFI centres and programmes. Drawing on funding from various public and private sources Teagasc also funds approx. 50 PhD Fellowships per year in Irish and international universities through the long established Walsh Fellowship programme and has collaborative links with many leading international universities and agri-food research institutes.

Marine Institute

The Marine Institute is charged, under statute to undertake, to co-ordinate, to promote and to assist in marine research and development and to provide such services related to research and development that, in the opinion of the Institute, will promote economic development and create employment and protect the marine environment. The Institute also conducts a number of national monitoring programmes on behalf of the state which are required to meet national and international regulations. Using data obtained from these programmes and based on its own and national research activity the Institute provides policy advice to government. The Institute operates as a research performer, funder and also seeks to catalyse marine related research activity. A key role in this regard is the provision and operation of national marine research infrastructure, including the RV Celtic Explorer and RV Celtic Voyager, the Newport river catchment facility as well as collaboration in EU networks of marine related research infrastructures. As a research funder, the Institute has in recent years focused on capacity building programmes, in particular the Beaufort Marine Awards and the Cullen Fellowships.

Outcomes arising from several of the investments made under these DAFM, Teagasc & MI programmes over the years have, and continue to have, a significant and meaningful impact on enterprise, economic, policy, knowledge and societal development in a variety of ways both directly and indirectly. Some examples of this include the development and application of genomic technology to cattle breeding which has led to a step change in the heritability of economically valuable traits in Irish dairy and beef herds; major strides towards the sustainable intensification of Irish dairy and beef production thereby providing the essential scientific validation for our 'green' credentials that is so important for the marketing of Irish food especially on exports markets; guaranteeing the safety and constantly improving the healthiness of foods through process innovation and product development; mining agricultural and marine primary and 'waste' materials for bioactives ingredients and new uses, etc.

The Programme for Research in

The Programme for Research in Third-Level Institutions (PRTLII)

Substantial investment in research infrastructure has taken place through programmes such as PRTLII and

*Third-Level
Institutions
(PRTL) -
Infrastructure
and equipment
and human
capital*

SFI programmes. The PRTL supports the provision of top-class research infrastructure (buildings, laboratories and cutting edge equipment) as well as human capital development through Structured PhD/Emergent Technology programmes across Ireland's higher education institutions. A key aim of the PRTL is to develop critical mass in key research areas, thereby enhancing collaboration and coherence across Ireland's research system. The PRTL was launched in 1998 with cycles of expenditure commencing in 2000. The PRTL complements other significant research initiatives that subsequently can flow from funding sources such as SFI, EI, HRB and the Irish Research Council amongst others. Funding is a mixture of Exchequer and private funding. The programme is also EU co-funded under the European Regional Development Fund Regional Operational Programme 2007–13. The 5th Cycle of PRTL funding, initiated in 2011, is advancing towards conclusion with approved projects completed or well underway.

The funding by PRTL of the development of human capital is intended to amplify Ireland's competitive advantage. 15 projects covering Structured PhDs/Emergent Technologies were initiated in early 2011 with the first cohort of Cycle 5 PhD Students commencing in September/October 2011. To the end of 2013 475 students/researcher/other personnel had been appointed on these Cycle 5 related projects.

Developing human capital is addressed in more detail in Pillar 8.

Large Items of Research Equipment (LIRE) database.

Access to research infrastructure, usually hosted in publically funded higher education and research institutions, is an essential element of most modern scientific enquiry. Research infrastructures are at the centre of the knowledge triangle of research, education and innovation: producing knowledge through research, diffusing it through education and applying it through innovation. In the 21st century, the state-of-the-art-research infrastructure required for cutting edge research has become ever more complex and specialised and consequently much more expensive. Frequently, there is a requirement for "suites" of research equipment which need to be operated and maintained by specialised support staff and may require tailored space in which to house them. The costs of establishing and sustaining large items of research infrastructure are often very high.

In Ireland, there has been significant investment in research infrastructure throughout the higher education sector over the last 10 – 12 years. Facilitating the widest possible access to this research infrastructure is essential in order to achieve the greatest return on investment and value for money for the state and for the research community in general. In this context, a database of Large Items of Research Equipment has been developed, with the aim of providing access for researchers and industry, both in Ireland and elsewhere, to these research infrastructures.

A set of National Guidelines for Access has also been developed which sets out for the first time a set of agreed national guidelines that should apply to all items of research infrastructure within institutions. The LIRE initiative complements the MERIL database (Mapping of the European Research Infrastructure Landscape) undertaken at European level. The MERIL portal gives access to an inventory of openly accessible research infrastructures. Irish researchers can also access research infrastructures outside Ireland – from archives and statistical offices to biobanks, satellites and particle accelerators. It is expected that HEIs will develop access policies based on these guidelines – according to the Annual Knowledge Transfer Survey 2013, 3% of commercialisation income to Research Performing Organisations in Ireland came from revenue for use of facilities and equipment on campus.

*Study into
future
investment
needs*

Study into future investment needs

In the light of national research and innovation priorities, a study was commissioned by the Department of Jobs, Enterprise & Innovation in November 2014 to take stock of the investment made to date and identify any future investment needs in the period to 2020 which may be strategically required for the

achievement of national research and innovation goals. The study will consider the need for and scope of funding for research infrastructure and PhD programmes in light of completion of PRTL cycle 5. Specific issues to be examined in the study include:

- Extent to which investments made and committed to date provide the necessary underpinning to enable Ireland's science, technology and innovation objectives to be achieved,
- An assessment of research infrastructure requirements necessary to support science, technology and innovation objectives in the period to 2020, taking into account possibilities for collaboration in relation to infrastructures and facilities that may exist elsewhere in Europe,
- Extent of ongoing need for funded structured PhD programmes, taking into account eventual mainstreaming which was intended to occur following previous funding,
- Identification of any gaps in infrastructure needs over the period to 2020,
- Options to fill any gaps that may be identified, including possibilities for collaboration and EU funding in relation to infrastructures and facilities
 - that may exist or may be under development elsewhere in Europe or
 - of European interest that may be located in Ireland.

Landscape of research centres

Landscape of research centres

The ramp up in expenditure on STI over the last decade and a half has resulted in the build-up of a very strong science base which is yielding results in terms of economic and societal impacts. In building this base the approach taken has been to focus largely on building capacity through the existing Higher Education Institutions and this approach has been successful overall.

The result has also been a sophisticated landscape of research centres supported through competitive calls by SFI and EI. While this was necessary and appropriate at the time the complexity of the landscape can sometimes create its own challenges. It is important to strike the balance between a comprehensive offering of research centres which can support companies along all points of the research continuum from basic to applied while also providing absolute clarity regarding the different types of offering of the different centres.

Over the past number of years a number of measures have been taken to improve the coherence of the research centres landscape.

- SFI is consolidating the number of research centres it is funding. It has done this by introducing a more coherent model for funding its centres – moving from the previous regime of Centres for Science, Engineering and Technology (CSETs) and Strategic Research Clusters (SRCs) to a more simplified hub and spoke model. This will mean a smaller number of centres of larger scale being supported by SFI over time building critical mass across the Institutions in areas of economic and societal importance.
- The Prioritisation Action Group provides a mechanism to ensure a coherent and comprehensive approach across research funders to the provision of publicly funded research to support the 14 priority area. Action Plans developed by relevant research funders for each of the areas identify issues that need to be addressed, by whom and with timeframes for delivery, including in areas such as skills, infrastructure and regulation. Extensive mapping of centres and funding allocated across the priority areas has taken place and intelligence across research funders regarding industry needs across the priority has being collated and validated with input from industry - this provides a solid evidence base upon which research funders can identify existing and future gaps in publicly funded research which can in turn inform the design of open calls in these areas.
- In some sectoral (e.g. agri-food and forestry) and cross-sectoral areas (e.g. food and health),

detailed strategic research and innovation agendas (SRIA), often aligned to relevant European Eragnet and JPI instruments, have been drawn up by multi stakeholder groups which are then used by funders to guide the content of Calls for Proposals thereby ensuring a coherent, efficient and prioritised approach to State RDI investment in these areas. A recent example of this is the *SHARP* SRIA developed by a cross-funder RPAG Working Group covering 2 NRPE priority areas i.e. ‘Sustainable Food Production & Processing’ and ‘Food for Health’.

- A pilot project in the area of therapeutics has been undertaken where all of the research centres supported by Agencies under the remit of DJEI have been working together on a joint branding and marketing initiative. This has resulted in these centres joining forces to present their offering in a coherent way making it easier for companies to find out about and access the key areas of research expertise these centres offer within the therapeutics area. The centres plan further initiatives to deepen collaboration.
- This joined-up approach will enhance the coherence of the research system and the aim is to emulate it across research centres in other priority areas. To support the roll out to other areas a National Innovation Showcase on 2 December 2014 included representatives from all national research centres of scale involved in research across the 14 priority areas as well as showcasing the range of complementary research and innovation supports on offer across the entire public system.
- A National Directory of Research Centres was published on 2 December with details of all of these centres of scale and their key areas of research – this Directory complements the work of Knowledge Transfer Ireland in helping companies to more easily navigate the research system.

Review of Technology Centres

EI/IDA Technology Centres Programme

The Technology Centres programme began in 2008 as a joint initiative of Enterprise Ireland and IDA Ireland to build competitive advantage for industry. The Centres were developed in order to find an effective way of taking industry views more directly into consideration when undertaking publicly funded research. These centres are delivering industry-led research established in Irish universities and public research institutes. €100 million has been approved in funding.

More than 300 companies (approximately 100 EI clients, 100 IDA clients and 100 other companies) are benefiting from Ireland's largest industry-led research programme driving innovation and delivering results in the areas of cloud, analytics and learning technologies; manufacturing and materials; energy, food and health; financial services and business processes.

A 2013 impact evaluation of seven of the current centres that have reached the midterm in their funding has produced some preliminary economic impact data from these investments. The Technology Centre programme has helped to create **€70 million** of turnover to date in participant firms in seven of the centres and this is expected to rise to **€385 million** by 2018. The evaluation recommended that 5 of the 7 centres should be considered for another round of funding subject to new business plans being approved by EI with the remaining 2 of the 7 being “sunset” by 2015. At the end of 2014 15 Technology Centres are being supported across key areas of research relevant to industry as follows:

Table 3: EI/IDA Technology Centres

ARCH Applied Research for Connected Health	GRCTC Financial Services Governance Risk/Compliance	IVI Innovation Value Institute
CCAN Collaborative Centre Applied Nanotechnology	IC4 Irish Centre for Cloud Computing & Commerce	Learnovate
CeADAR Centre for Applied Data Analytics Research	ICMR Irish Centre for Manufacturing Research	MCCI Microelectronics Circuit Centre Ireland
FHI Food for Health Ireland	ICOMP Irish Centre for Composites Research	PMTC Pharmaceuticals Manufacturing TC
DPTC Dairy Processing Technology Centre	IERC International Energy Research Centre	TCBB Technology Centre for Biorefining & Bioenergy

SFI Research Centres

There is also ongoing evaluation of centres to ensure their continuing relevance and impact. It may now be timely to consider the optimum number of Technology Centres which should be funded by a country our size and whether or not the focus should shift to enhancing industry engagement particularly SMEs in existing centres to include the adaption of research agendas to respond to changing industry needs.

The SFI Research Centres programme is aimed at developing a set of world-leading, large-scale research centres that will provide major economic impact for Ireland. A key feature of SFI Research Centres is the consolidation of research activities across higher education institutes and public research institutes to create a critical mass of internationally leading researchers in strategic areas which become a key attractant to industry and lay the foundation for effective and productive academic and industrial partnerships. Seven centres were launched in 2013, with SFI funding of €200 million and €100 million in matching cash and in-kind contributions from over 150 industry partners. A further five research centres were launched in October 2014 with funding of €155 million from SFI, coupled with €90 million in cash and in-kind contributions from more than 165 industry partners. The performance and impact of the Research Centres are subject to ongoing monitoring and evaluation. The SFI Research Centre Spokes Programme provides a mechanism to allow new industry partners to join the existing SFI Research Centres. The 12 Research Centres are as follows:

Table 4: SFI Research Centres

SSPC Solid State Pharmaceutical Cluster	APC Alimentary Pharmabiotic Centre	AMBER Advanced Materials And Bioengineering Research Centre
INSIGHT Ireland's Big Data and Analytics Research Centre	INFANT Irish Centre for Fetal and Neonatal Translational Research	IPIC Irish Photonic Integration Centre
MaREI Marine Renewable Energy Ireland	CÚRAM Centre for Research in Medical Devices	LERO The Irish Software Research Centre
ICRAG Irish Centre for Research in Applied Geosciences	CONNECT The Centre for Future Networks & Communications	ADAPT Centre for Digital Content Platform Research

Institutes of Scale

Institutes of Scale

There are also a number of institutes and facilities of scale that receive recurrent funding from the State to carry out research aligned to priority areas. These include: Teagasc, the Marine Institute, Tyndall National Institute, (details of which earlier in this chapter), the National Institute for Bioprocessing

Research and Training (NIBRT), and the Irish Centre for High-end Computing. Further details of all these Centres/Institutes can be found in the Directory of Research Centres.
(http://www.knowledgetransferireland.com/About_KTI/Find-a-Research-Provider/)

Strengthen applied research capacity and evaluation of research and technology organisations (RTO) characteristics

Applied Research Capacity

At the current stage of development of the Irish innovation system, it is timely to consider the country's research landscape to ensure that Ireland has appropriate translational capacity to bridge research and technology commercialisation and provide Irish enterprise with access to capability and infrastructure to support research and innovation. A study is being undertaken to validate the need for, and recommend possible approaches to, strengthening the market-focussed element of the research Centre landscape in Ireland into the medium term.

Specifically this project seeks to:

- Analyse the market-focussed element of the Irish Research Centre landscape in order to identify gaps and opportunities to ensure an internationally competitive market-focussed research centre landscape.
- Make recommendations on approaches to strengthening the market-focussed research centre landscape in Ireland.
- Propose possible models and governance arrangements to facilitate the approach identified and consider implications on other existing components of the Irish research centre landscape.
- Develop a road map for the development of a competitive market-focussed research centre landscape in Ireland to 2025 and beyond. This will include identification of a thematic area to test any new model proposed in a pilot initiative.

The findings from the study are expected in early 2015.

EI/SFI dialogue regarding optimum arrangements for institutional organisation

Following the extension of SFI's remit to allow for the funding of oriented basic research and applied research in institutions and, taking account of OECD recommendations regarding governance structures for R&D funding, EI and SFI have been engaging in a dialogue to ensure that their approach to supporting R&D is coherent, coordinated and complimentary. The principles guiding this dialogue are that the agencies should seek an enhancement of the science offering to industry, greater coherence in planning, execution and outward facing packaging and greater overhead efficiencies for greater investment in programmes.

A number of issues are being progressed/considered by the two agencies:

Short-term Issues:

- Coordinated approach to financing
- Coordinated management opportunities
- Joined up thinking on new research centre themes

Medium Term Issues:

- Joint calls
- Joint governance / ownership of research centres
- RTO / Hybrid models

Longer Term Issues:

- Legislative adjustments

Structural / Institutional adjustments.

Key areas to be explored include:

- **What could we do to further enhance our landscape and institutional arrangements to maximise the impact of research excellence and deliver jobs?**
- **Is there a need for a complementary market focused research centre structure in Ireland and how should that be organised?**
- **How can Ireland optimise its strategic advantages of location, scale and environmental quality as a fundamental component of its research infrastructure?**
- **How can we further increase/strengthen the effectiveness of our national collaboration and engagement across all areas of STI investment in pursuit of economic and societal goals?**

Pillar 6 World class IP regime and dynamic systems to transfer knowledge and technology into jobs

Positioning Ireland as a location of choice for IP activity

The importance of a well-balanced Intellectual Property (IP) regulatory regime that protects ideas, allows innovators to flourish and facilitates the effective transfer of knowledge is well recognised. IP policy needs to constantly evolve to meet the changing needs of an economy which is focussed on driving innovation with the ultimate objective of leading to greater growth in employment and economic growth.

The value of IP to the economy is set out in a 2013 study undertaken by the European Patent Office and the Office for Harmonisation of the Internal Market (OHIM), which found that, in Ireland, intellectual property-intensive industries accounted for almost 49% of Irish GDP and 22% of total employment. Compared with other EU Member States, Ireland scored particularly well on value added by patent-intensive and trademark industries. It is well recognised that IP and the existence of a modern regulatory environment are key to creating added value, supporting innovation and growing and sustaining job creation.

Ireland's objective is to provide an efficient and effective system of intellectual property protection that will encourage technological progress and promote enterprise. This is achieved through the protection of intellectual property rights in patents, trademarks and designs, and the dissemination of relevant information in each of these activities.

EU Patent Package

Work on implementing the "patents package" continues both at national and EU level. This package includes a new European unitary patent providing uniform patent cover in 25 EU Member States on the basis of a single application process and on payment of a single set of fees. This is expected to result in significant financial and administrative savings in particular for the SME sector. The enforcement mechanism for the unitary patent system: the Unified Patent Court will provide a streamlined single legal process to decide on the validity or infringement of a patent throughout the participating 25 EU Member States. This too will benefit industry by reducing the cost involved in bringing multiple actions across Europe as under the new process a single court action, with the added advantage of a single outcome, will apply. The Agreement setting up the international Court is not mandated by our EU membership and, as it involves the transfer from the Irish Courts of jurisdiction for patent litigation in the context of the Agreement, a Constitutional Referendum is required as this runs counter to the current Constitutional position. In recognition of the importance that a vibrant IP ecosystem plays in a modern economy focussed on innovation, Government has decided to establish a local division of the UPC in Ireland. This will further enhance our attractiveness for research, development and innovation generally.

Implementation of changes to copyright regime

The Report of the Copyright Review Committee – an independent Committee appointed by the then Minister for Research and Innovation in May 2011 – was published in late 2013. The Report, "Modernising Copyright", was commissioned to examine the Irish copyright framework, in order to identify areas that might be considered as creating barriers to innovation, and to identify solutions that could remove these barriers. The Committee made over 60 recommendations across a wide spectrum of copyright issues including substantive proposals to e.g. introduce the full range of exceptions and limitations that are provided for in the EU governing Directive – the Copyright directive; to introduce a new "Innovation" exception allowing for the development of innovative products without fear of infringing prior acquired rights and, to implement to some extent, the concept of "fair use" which is well-known in the USA but not in Europe. The recommendations contained in the Report are currently being examined in detail and, once the analysis has been completed, and given that changes to the

Copyright and Related Rights Act 2000 are likely to be required, the intention would be to bring a Memo to Government, setting out the Minister's position on the proposals and plans for legislative change arising therefrom.

Separately, the EU Commission undertook a consultation process on copyright issues in late 2013/early 2014, with the objective of setting out legislative and non-legislative initiatives which the Commission considers necessary to modernise copyright and make it a better fit for the digital age. In November 2014, the new EU Commission President, Jean Claude Juncker, took office and has indicated that achievement of the Digital Single market, which includes copyright reform, is one of his top priorities. Copyright is now part of DG Connect which now has oversight for all aspects of the Digital Agenda. In addition, Vice-President of the Commission, Andrus Ansip, has responsibility for the Digital Agenda overall and has stated his objective to take "ambitious legislative steps towards a connected digital single market", in part by "modernising copyright rules in the light of the digital revolution and changed consumer behaviour". Any new proposals from the EU Commission will need to be considered in any potential changes to Ireland's national copyright legislation.

EU Trade Marks reform package

In March 2013 the European Commission presented a package of initiatives to make trade mark registration systems all over the European Union cheaper, quicker, more reliable and predictable. The proposed reforms set to improve conditions for businesses to innovate and to benefit from more effective trade mark protection.

It is 25 years since the harmonisation of Member States' trade mark law and 20 years since the creation of the Community trade mark system. Generally it has been accepted that that EU trade mark systems have stood the test of time and are not in need of any major overhaul, as the foundations of the system still remain solid. Therefore, the main purpose of this reform is to modernise the laws regulating trade mark law across the European Union,

The reform of the current system will in particular:

- improve conditions for businesses to innovate and to benefit from more effective trade mark protection against counterfeits and fake goods in transit through the EU's territory;
- foster innovation and economic growth by improving the accessibility and efficiency of trade mark systems all over the European Union; and,
- improve cooperation between the European Union's Trade Marks Office and the Member States' national offices.

Following months of examination at a technical level and having agreed a common position for the trade mark reform package, the Council of the European Union entered into negotiations with the European Parliament under the co-decision procedure, on the 12th November 2014, in order to conclude 2nd reading of the text and reach agreement concerning the Trade Mark Directive and the Community Trade Mark Regulation.

Trade Secrets

Negotiation and adoption of EU Directive on Trade Secrets: The Commission's 2013 proposal contains new rules on the protection of undisclosed business know-how and commercially sensitive and valuable information or "trade secrets" against their unlawful acquisition, use and disclosure. Trade secrets broadly fall into two categories of information: technical information such as manufacturing processes, recipes, chemical compounds etc. or, commercial information including lists of customers, product launch date, results of marketing studies etc.

The theft of trade secrets is a growing problem with 1 in 4 European companies reporting at least one case of information theft in 2013. Such thefts can seriously harm the capacity of companies to innovate and compete. The aim of the proposal is to boost the confidence of businesses, innovators,

researchers etc. by providing an aligned legal framework that is conducive to innovation and growth by ensuring that if competitors steal or otherwise unlawfully acquire or use this information, the victim will be able to defend his/her rights in court and have ready access to sufficient and comparable redress across the EU.

The proposal sets about harmonising Member States' national civil law around 3 main pillars: definition of trade secrets and misappropriation of trade secrets; a set of civil remedies that trade secret holders can seek when they suffer from trade secret misappropriation; and, a set of measures that courts may use in order to avoid leakage or disclosure of trade secrets that have been submitted to the court in the course of civil litigation on trade secrets misappropriation.

Efficient and effective Knowledge Transfer

Ireland's **knowledge transfer** system has seen substantial investment and focus over the last decade which is delivering dividends. The credibility of the system is well established when benchmarked within the European Union. In the European Commission's Knowledge Transfer Study 2010-2012 (published in June 2013) Ireland is ranked first (out of 23 countries) in terms of knowledge transfer performance of public research organisations in individual countries. Ireland has also been ranked third in the EU, according to the European Commission's "Indicator of Innovation Output", which measures the extent to which ideas from innovative sectors are able to reach the market, providing better jobs and making Europe more competitive. This proves that our research investment is delivering jobs. The study also finds the practice of RPOs in Ireland is aligned to the EU Code of Practice for Knowledge Transfer 'nearly perfectly' and concludes that along with the UK Ireland stands out as having strong Knowledge Transfer policies and good Knowledge Transfer performance. In terms of other indicators of economics impact the study finds Ireland ranks:

- 2nd with an average of 44 invention disclosures per 1,000 research staff;
- 3rd with 13.3 patent applications per 1,000 research staff;
- 3rd with an average of 3.8 start-ups per 1,000 research staff.

At the same time, the system is evolving to embrace a broader range of activities that support companies and enterprises and that stimulate economic development including the provision of advisory/extension services to farmers and micro businesses, contract research, etc.. Ireland aims to maximize exploitation of opportunities to commercialize all forms of intellectual property and facilitate the transfer of knowledge more generally from the public research system to the enterprise base and these objectives formed the rationale for the establishment of Knowledge Transfer Ireland.

Establishment of Knowledge Transfer Ireland

Knowledge Transfer Ireland

The aim of Knowledge Transfer Ireland (KTI), established in 2013, is to make it easier for companies to access and use ideas developed through publicly-funded research to develop new products and services and ultimately create jobs and exports. KTI is operated on a partnership basis with the HEIs and Enterprise Ireland.

Since it was established, KTI has articulated a vision to be recognised and respected as Ireland's central point of reference for business/research based partnership and commercialisation. Its objective is to maximise the economic and societal benefits from State investment in public research by making it easy for business and investors to access the intellectual assets in Ireland's RPOs which will lead to more innovative and competitive companies in Ireland that will create more jobs and lead to more investment in Irish research.

Therefore the underpinning rationale for the approach to KTI is twofold:

- Through accessing research & expertise, companies will be more competitive, can solve problems, will attract more investment and can leverage additional funding

- Through working with companies, research....will be more, competitive, will be more relevant, may be more cited and will result in better trained early career researchers.

Core areas of focus for KTI include increasing visibility of opportunity, ensuring ease of interaction, building confidence in and supporting the knowledge transfer system. Key outputs from KTI to date include an interactive website which acts as a portal for business to access knowledge in the RPOs, a number of guides and model agreements to support companies in their interaction with RPOs, publication of the first Annual Knowledge Transfer Survey and the first Annual Report of KTI. A core function of KTI is also to manage Ireland's Technology Transfer Strengthening Initiative on behalf of Enterprise Ireland. KTI is also the guardian of the Government's Intellectual Property Protocol and has a key role in working with stakeholders to identify ways in which it could be further enhanced.

Technology Transfer Strengthening Initiative

Technology Transfer Strengthening Initiative (TTSI)

The primary funding programme used to support knowledge transfer in Ireland, managed by KTI, is the Technology Transfer Strengthening Initiative (TTSI), which supports a number of Technology Transfer Offices to bring fresh ideas from the research environment to the attention of existing industry in a useable format. We are now into phase 2 of that programme, launched in 2012. Total funding of €22m is being provided for the period of the current phase of the programme - €5.5m per annum from 2013-2016 – and this will significantly boost interaction between industry and higher education institutions. This represents a key part of the process of unlocking the creative potential of our researchers to support innovation in industry, leading to jobs and economic growth. A review of the first phase of the programme, completed in 2014, shows that the initial programme proved to be a very valuable means of developing third level research into new spin-out companies and of enabling the licencing of new technologies for the benefit of industry.

In terms of technologies licensed to industry, which is one of the most relevant indicators of commercialisation performance in the research system, these rose significantly from 12 in 2005 to 87 in 2012. Invention disclosures and spin outs also increased substantially during that period. While there were variations and dips across certain metrics for certain years, overall the programme has delivered significantly above the metrics set at the outset of the programme.

The Annual Knowledge Transfer Survey 2013 - a review of business engagement and commercialisation activity (knowledge transfer) from Ireland's state funded Research Performing Organisations - captures activities relating to the flow of ideas, expertise and technologies from within the RPOs and out to business.

In 2013:

- **Products on the market** – 31 technologies that had previously been licensed out by an RPO became available for consumer or commercial use.
- **License/Options/Assignments** – There was a sharp increase in the number of LOAs signed, up 60% from the previous year, at 139.
- **Research agreements** – 1,598 new agreements (collaborative, formal contract research and consultancy) were signed with companies, representing a 9% increase from 2012.
- **Businesses engaged** – There was a 15% increase over the previous year in the number of external clients with whom the TTOs worked.
- **Company location** – The vast majority (87%) of companies with which the RPOs worked were based in Ireland.
- **Spin-Outs** – The number of spin-outs more than doubled in 2013 vs. 2012 with 37 new companies created.
- **Active spin-outs** – There were 80 active spin-outs that were at least three years post-

incorporation at the end of 2013.

- **Priority Patent Applications** – 123 applications were filed, an increase of 9% on the previous year.
- **Invention Disclosures** – the number of invention disclosures increased 24% from 2012.
- **Internal engagement** – TTOs reported a 21% increase, over 2012, in the number of internal researchers with whom they worked.

Enterprise Ireland/KTI is continuing to prioritise technology transfer activities aimed at licensing technology and improving commercialisation outcomes, as part of TTSI 2 which involves:

- Promotion of behavioural change among researchers, to drive a culture of commercialisation;
- Greater outreach from the Technology Transfer Offices, supported by KTI, to provide an enhanced access and interaction between industry and higher education institutes; and
- Greater focus, through implementation of research prioritisation, on areas which are most likely to deliver economic and societal impact, and jobs.
- Building on the investment to date, the overall objectives of phase 2 of the Technology Transfer Strengthening Initiative are to develop the system such that it will respond quickly and flexibly to industry, where the licensing of technology will bring direct economic benefits, and to radically enhance the culture of commercialisation among researchers in the Irish HEI sector. A new dimension to the initiative has seen the formation of regional clusters of research performing organisations, which will see the sharing of resources and expertise, thereby delivering an enhanced service for industry in Ireland.

Proposals for the continued support and evolution of the Technology Transfer system will be developed and examined during 2015.

Opening up the research system to industry

Technology Gateways

Enterprise Ireland has established within the Institutes of Technology (IoTs) a nationwide network of 12 industry-focused Gateways, in 8 IoTs, representing a €23m investment over 5 years from January 2013 to December 2017. The Technology Gateway Network was created from the EI Applied Research Enhancement (ARE) Programme which ran between 2005 and 2012. The Gateways deliver technology solutions for industry through collaborative innovation based industrial projects. Since 2008 the ARE centres and the Gateways have undertaken 1,000 innovation based industry collaborations with in excess of 450 companies. The total value of these projects is €12.9m (with an industry contribution of €5.4m ≈ 42%). The Gateways provide:

- An open access point for industry providing technology expertise which is industry relevant.
- Technology solutions for the close-to market needs of Irish industry.
- Regionally based Gateways acting as a portal to the nationwide expertise in the Technology Gateway Network and the wider Irish Research Infrastructure.
- Ongoing development of the Gateway's technology offer to industry with the assistance of an industry led steering committee.

Pathways into the Research System/Streamlining of Access Programmes

As referenced in Pillar 5, a National Directory of Research Centres was published in December 2014 with details of research and technology centres of scale and their key areas of research – this Directory complements the work of Knowledge Transfer Ireland in helping companies to more easily navigate the research system. Work is also commencing on a companion text which will clearly show pathways for industry into the research system. Consideration is now been given to the development of an app which would effectively be a dynamic version of both the directory and pathway with a “decision tree” that sorts the centres according to sector of interest and offers the user options for engagement with the

Irish research system.

*Enhancing
Ireland's
Intellectual
Property Protocol*

Intellectual Property Protocol

In June 2012, the Government published the national Intellectual Property Protocol. This sets out the Government's policies to encourage industry – from start-ups and small and medium enterprises to multinational corporations - to benefit from the research and development undertaken in Ireland's public research institutions. It aims to provide clarity and consistency in rules around how IP is handled when it emerges from State-funded research thereby enabling and encouraging the use of State-funded research to drive business, innovation and economic competitiveness. A key recommendation of the report was the establishment of KTI to act as a central reference point for entrepreneurs and industry, signposting them to the wealth of technology opportunities and academic talent that exist in RPOs. KTI also has a key role in acting as an interface with stakeholders in the system to identify areas where the IP Protocol could be improved further into the future. KTI is in the process of engaging with stakeholders with a view to making recommendations to Government in the first half of 2015 on the first set of revisions to further enhance the Protocol.

*Enhancing IP
activities in the
firm base in
Ireland*

Enhancing IP activities in the firm base in Ireland

Internationally there has been an increase in IP related activities with a parallel shift towards increasing importance attributed to IP pursuits. Business sectors that depend on IP protection represent an important and growing part of modern economies, and are substantial drivers of GDP and employment growth. * However, a number of recent reports and indicators have highlighted that Ireland is typically below EU and OECD averages when compared on metrics associated with IP generation. The IP indicators reported for Ireland are at a macro level and so provide little insight as to the IP activity of firms in different sectors, or the IP activity of indigenous vs multinational companies (MNC), etc.

The Department of Jobs, Enterprise and Innovation undertook a study to develop a deeper understanding of the IP activity of firms in Ireland through a review of existing IP generation, IP utilisation and IP trading data and information that was available for Ireland - either published or raw data.

Following on from this quantitative analysis of IP data, the work will now further build on this evidence base. In this second phase of work the research is focused on probing the IP strategies in the firm base in Ireland and the barriers and issues faced by firms to engaging in IP activities. The methodological approach includes firm surveys and interviews, engagement with other stakeholders of relevance to the IP system, and, a review of IP policy and supports in Ireland and a number of comparator countries. The final output will be a series of recommendations as to how Ireland should proceed in seeking to enhance the IP activity in the firm base in Ireland.

This work is due to be completed by end Q1 2015

Introduction of Knowledge Development Box in Ireland

As referenced in Pillar 1, the Minister for Finance announced in the context of Budget 2015 that consideration is being given to the introduction of a Knowledge Development Box – a competitive income-based regime for intangible assets - along the lines of patent and innovation boxes which exist in other countries. A public consultation process has been launched to gather views on how the Knowledge Development Box should operate. The intention is to legislate for it in the 2015 Finance Bill or as soon as EU and OECD discussions conclude.

*Tax treatment of
IP - Knowledge
Development Box*

Key areas to be explored include:

- **The establishment of Knowledge Transfer Ireland has seen an important evolution in our knowledge transfer system but what more can we do to enhance further the transfer of knowledge into jobs?**
- **In terms of Intellectual Property policy, are there specific interventions or supports of a legislative or non-legislative nature that would improve the business environment and act as an incentive to create and sustain an innovative culture?**

Pillar 7 Government-wide goals on innovation in key sectors for job creation and societal benefit

Existing Sectoral RD&I Strategies

Many research funders in the Irish landscape have a mandate to undertake research to support policy and practice. This type of research is determined in the first instance by policy and associated service and system needs rather than by the likely commercial impact of the research. Such research generates economic and societal benefits in areas where there is little commercial incentive and, in addition, there are opportunities to lever this investment in research for commercial impact too. The following material sets out a range of relevant sectoral strategies and programmes.

Research for Health

Meeting Ireland's health needs will require increased innovation in clinical practice and health service design and delivery, underpinned by broad-based science, technology and innovation. Health research and innovation is seen as an important component in the broader national ST&I ecosystem – one which progresses economic, health, educational, agricultural, environmental and related objectives.

The environment within which health research is operating and for which it is working is undergoing significant change. The Government has embarked on a major reform programme for the health system. Future Health: A Strategic Framework for Reform of the Health Service 2012-2015 sets out the main healthcare reforms envisaged for the coming years. The programme involves moving towards a health service that provides access to care based on need rather than income, underpinned by a constant focus on health and well-being, a stronger primary care sector, a restructured hospital sector, and a more integrated social care sector, as well as a more transparent money follows the patient system of funding (activity based funding) supported ultimately by universal health insurance. The system is undergoing significant organisational reform to improve efficiencies and to improve health outcomes. The Department of Health has identified a range of priority actions for the period 2015 to 2017 in six main areas – drive the healthy Ireland agenda, deliver improved patient outcomes, reform operational systems to delivery better outcomes, implement agreed steps towards universal healthcare, introduce innovative funding models, modernise health facilities and ICT infrastructure.

Challenges for the health and social care system include Ireland's high birth rate, an ageing population, increases in chronic disease, and lifestyle factors including tobacco, alcohol and obesity. While providing significant employment in the State, the health system has seen significant reductions in personnel numbers and restricted budgets since the economic downturn. National and international evidence shows that health is an economic good in its own right and is a key factor in employment, earnings, productivity, economic development and growth. It is a demand-led sector, one from which every citizen expects the highest level of service and care.

These challenges and opportunities pose questions for which ST&I can provide potential solutions. The primary focus of health research is to provide the evidence to address key health challenges – it can improve the quality of our health services and the quality of life of many in our society; it will be essential to progress the many facets of the reform programme.

There are a number of key policy and practice developments in health that will inform science, technology and innovation needs in the coming period including:

Healthy Ireland **Healthy Ireland** is the Government's national framework for action to improve the health and wellbeing of the people of Ireland. Its main focus is on prevention and keeping people healthier for longer. It takes a whole-of-Government and whole-of-society approach to improving health and wellbeing and the quality of people's lives. It is designed to bring about real, measurable change and is based on an understanding of the determinants of health – where health and wellbeing are affected by all aspects of a person's life (economic status, education, housing and the physical environment in which people live and work). A research, data and innovation workstream and an outcomes framework to monitoring progress is a part of the approach being taken in the implementation of Healthy Ireland. The Outcomes Framework will provide evidence to support an objective assessment of the impacts of the initiative and will help partners in wider government and society prioritise their actions and focus on the interventions required to improve health and wellbeing.

eHealth Strategy for Ireland The **eHealth Strategy** demonstrates how the individual citizen, the Irish healthcare delivery systems - both public and private - and the economy as a whole can benefit from eHealth. The development of the strategy, including the appointment of a Chief Information Officer in the HSE, and work ongoing to develop 'eHealth Ireland', are steps in developing eHealth as a critical enabler of best-practice health systems and optimum healthcare delivery. In addition to the benefits to population wellbeing and improvements to healthcare system delivery, there are significant potential economic benefits associated with investment in eHealth infrastructure.

Hospital Groups and community healthcare organisations The establishment of seven hospital groups is designed to provide an optimum configuration for hospital services to deliver high quality, safe patient care in a cost effective manner. Hospital Groups will also interact with preventative, primary and social care and in particular with Community Healthcare Organisations (CHOs) to deliver an integrated model of care. A key aspect of the structure of the Groups from an ST&I perspective is that each has a primary academic partner to integrate and embed education, training, research and innovation in the acute hospital service. By successfully developing and fostering these relationships, the potential benefits for patients, for Hospital Groups, for their academic partners and for the wider research / innovation agenda are significant.

Integrated Care Programmes The Health Services Executive (HSE) has identified 5 key priority areas against which Integrated Care Programmes (ICPs) will be developed – older persons, children, maternal health, chronic disease, and patient flow. ICP project teams will work across health and social care services, developing and implementing key priority work streams within each programme. Integrated models of care will improve outcomes for patients and provide access to better, more integrated care outside the hospital setting.

In addition, there are over 30 National Clinical Programmes, some are speciality based and some are process-based programmes. All are aimed at improving processes, while reducing mortality and morbidity, and have been developed by the HSE and are in the process of being delivered.

National Health Innovation Hub The National Health Innovation Hub is a joint initiative of the Department of Jobs Enterprise and Innovation and the Department of Health. The objective of the initiative is to facilitate engagement between enterprise and the health system. More particularly it will facilitate healthcare companies to deliver commercial products and services more quickly by giving them appropriate access to the health service in order to validate and refine products in a real life environment; it will allow the health service to find efficiencies and improvements by

facilitating engagement with innovative companies creating solutions to problems it faces; it will support the adoption/commercialisation of new innovations developed by healthcare practitioners in the healthcare system.

Health Legislation

There are a number of important legislative dossiers which have health matters as their primary focus but which either provide opportunities for, or supports to, the ST&I agenda. These include work that is ongoing in relation to EU legislation in the area of clinical trials and medical devices. The Health Identifiers Act 2014 provides for unique health identifiers for (a) individuals and (b) for health practitioners and health organisations. The new identifier system is not only a patient safety initiative but also an essential underpinning of the eHealth agenda. The Health Information Bill is being developed to include provision for a new streamlined, quality centred national research ethics framework for health research (other than health research already governed by national or EU legislation). The new framework will also allow for a data protection consent exemption in certain defined cases.

Health research

The Health Research Action Plan 2009-2013 and the Health Research Board's Strategic Plan 2010 – 2014 have guided actions in health research in recent years. The Health Research Board (HRB) is a statutory body under the aegis of the Department of Health and is the lead agency in Ireland supporting and funding health research. It provides funding for an array of health sciences research including population health research, health service research, and patient oriented research. The HRB is supporting the development of the right skills, infrastructure and capacity in the health system to improve health, transform care, attract and retain the best health professionals, deliver efficiencies, and also to contribute to the enterprise agenda as appropriate (the HRB's work in establishing clinical research facilities and providing a collaborative framework to link them is one example of the contribution to the enterprise agenda). The HRB is currently preparing its next Strategic Plan for the period 2015-2020.

Many Irish researchers have been successful in achieving funding from international sources, particularly the European Union which, following the Lisbon Strategy in 2000 and the publication of Europe 2020 in 2010 has put research and innovation at the forefront of European social and economic policy. Programmes such as Horizon2020 (and its predecessor FP7), and the EU Health Programme, continue to present opportunities to collaborate nationally and internationally, leverage national funding, and provide opportunities to develop joint working between academia and industry for the benefit of health systems and patient outcomes. Health was one of the areas in which Ireland was most successful in FP7 with above average success rates for EU member states. Between 2007 and 2013 €80 million was awarded to Irish health researchers involved in 111 EU projects (29 of which were Irish-led projects).

Smart Ageing Strategy

The vision of Ireland's national **Smart Ageing Strategy** is that Ireland will be a society for all ages that celebrates and prepares properly for individual and population ageing. It will enable and support all ages and older people to enjoy physical and mental health and wellbeing to their full potential. It will promote and respect older people's engagement in economic, social, cultural, community and family life, and foster better solidarity between generations. It will be a society in which the equality, independence, participation, care, self-fulfilment and dignity of older people are pursued at all times.

There is evidence that innovation, cooperation from all sectors, planning ahead and making evidence-based policy choices will enable countries to successfully manage the economics of

an ageing population. For some Government Departments, the ageing of the Irish population will be a planning and resourcing issue. For others, it will require a fundamental shift in thinking, a reorientation of policy and a re-examination of our systems and structures and how they are organised and resourced.

The National Positive Ageing Strategy will create the conditions necessary to support individuals and families to plan and prepare for older age. Health is a personal, social and economic good, and the health and wellbeing of individuals, and of the population as a whole, is Ireland's most valuable resource. A healthy population is essential to allow people to live their lives to their full potential, to create the right environment to sustain jobs, to help restore the economy and to look after the most vulnerable people in society.

An Interdepartmental Group on Smart Ageing is due to report in early 2015 around actions that may be taken to optimise opportunities in this area.

Harnessing Our Ocean Wealth

Harnessing Our Ocean Wealth is an Integrated Marine Plan, setting out a roadmap for the Government's vision, high-level goals and integrated actions across policy, governance and business to enable our marine potential to be realised. Implementation of this Plan will see Ireland evolve an integrated system of policy and programme planning for our marine affairs.

Our ocean is a national asset, supporting a diverse marine economy, with vast potential to tap into a €1,200 billion global marine market for seafood, tourism, oil and gas, marine renewable energy, and new applications for health, medicine and technology. In 2007, Ireland generated 1.2% of GDP (€2.4bn direct and indirect Gross Value Added) from its ocean economy, supporting about 1% of the total workforce. Our marine resources also provide essential non-commercial benefits such as amenity, biodiversity and our mild climate.

Harnessing Our Ocean Wealth sets out a shared vision: Our ocean wealth will be a key element of our economic recovery and sustainable growth; generating benefits for all our citizens, supported by coherent policy, planning and regulation, and managed in an integrated manner.

Three high-level goals have been developed:

Goal 1 focuses on a thriving maritime economy, whereby Ireland harnesses the market opportunities to achieve economic recovery and socially inclusive, sustainable growth.

Goal 2 sets out to achieve healthy ecosystems that provide monetary and non-monetary goods and services (e.g. food, climate, health and well-being).

Goal 3 aims to increase our engagement with the sea. Building on our rich maritime heritage, our goal is to strengthen our maritime identity and increase our awareness of the value (market and nonmarket), opportunities and social benefits of engaging with the sea.

A number of actions are specified under Harnessing Our Ocean Wealth, including the a report to be prepared by a Development Task Force, which will in turn inform the preparation of a new Strategic Research and Innovation Strategy for Ireland (2014-2020) to be prepared by the Marine Institute.

Food Harvest 2020

Agri-food and fisheries is Ireland's largest indigenous industry, a sector with a long historic provenance and one which, today, collectively employs some 170,000 people with a significant weighting of activity in rural and coastal communities and whose food and beverage processing component has a turnover of more than €26 billion per annum. It

operates to world-class standards in the areas of food safety and animal welfare. It has built a multi-billion-export industry by engaging with the diverse demands of consumers and consistently meeting the exacting specifications of some of the world's most prestigious retailers and food service providers.

This acknowledged, the sector operates in an environment of considerable challenge. For farmers and fishermen, the disparity between the cost of production and remuneration is a critical issue for ongoing viability. At the processor and manufacturing level, a perceived lack of scale, fierce international competition, international retail consolidation and changing consumer demands are challenges which require concerted action.

However, while the years leading to 2020 will see a continuation of some of these challenges, the most compelling picture that emerges of the decade ahead is one of opportunity. In particular, the opportunity for the Irish agri-food industry to grow and prosper sustainably through the delivery of high quality, safe and naturally based produce.

Food Harvest 2020 is the strategic vision for the agriculture, food and fishing sector developed by the industry in 2010 in conjunction with DAFM and relevant state agencies. Since then it has been actively implemented by a High Level Implementation Committee chaired by the Minister for Agriculture, Food and the Marine. FH2020 foresees a sector that acts 'smartly' to achieve a competitive critical mass in the international marketplace and targets those consumers in key markets who recognise and reward Ireland's food producers for their 'green' output. This will require:

- The adoption of new technologies at primary producer level;
- Developing new working relationships within the food production chain;
- Piloting new product streams;
- Targeting resources at new markets;
- Enhancing levels of productivity and competitiveness; and,
- Developing production and management skills across the sector.

Investment in research and development is essential to meeting changing consumer demands and realising new growth opportunities. To deliver on the industry's growth potential, R&D must be targeted at areas such as functional ingredients, prepared consumer foods, value-added meats, genomics, environmental sustainability and the speciality sector. Strategies to reduce sectoral greenhouse gas emissions can also be seen to link the R&D remit with environmental concerns and a focus on the consumer. In a climate of decreased resources, a smart R&D approach must also involve an increased commitment to strategic collaborative partnerships and a focus on stimulating and mentoring innovation and entrepreneurial activity to increase employment creation.

Work on the development of a new strategy to succeed Food Harvest 2020 has just commenced under a broad stakeholder committee.

Dairy 2020

The **dairy sector** is a critical pillar of the Irish agri-food sector, accounting for more than 30% in value of agri-food exports in 2013. World dairy consumption is projected to rise considerably over the next 10 years and much of this will be driven by developing markets in Asia, the Middle and Far East, and Africa. The abolition of dairy quotas will be a key driver of the 50% dairy volume growth envisaged in Food Harvest 2020, and an associated increase in jobs and exports. Since the introduction of the EU milk quota regime in 1984, Ireland has

experienced a significant reduction in dairy farm numbers, dropping from 68,000 in the early eighties to just under 18,000 in 2013. This reduction reflects the reality that current and historic milk production in Ireland is, and was, curtailed by the milk quota regime and is artificially low for a country with vast dairy potential.

At the end of 2013 there has been an increase of 42% in the output value of the milk sector to €2.05 billion, from the baseline years of 2007 – 2009 resulting from an increase of just 10% in volume terms. The 2010 - 2012 trend of growth in the value of milk output continued in 2013 driven by global dairy market demand outpacing supply and commodity prices rising accordingly, however more recently the reverse has occurred with a significant weakening in international dairy commodity prices. Dairy is the main sector with a specific volume target (50% growth) set by Food Harvest. It is anticipated that from 2015 onwards the Irish dairy sector can achieve its full potential when the shackles of the quota regime are removed. Significant inroads can be made towards the 50% volume target in Food Harvest, buoyed by favourable medium term prospects in future global dairy product consumption growth and the comparatively low cost base profile of Irish milk producers. However, significant challenges remain arising from world market price volatility (which may be particularly acute in 2015), seasonality of production, over-reliance on commodities and related need to develop novel high value products, production/processing competitiveness, environmental impact, etc.

Beef 2020

The **beef sector** is a major component of the agri-food sector. Ireland is the 5th largest net exporter of beef in the world with 85% of our beef exported. Harvest 2020 set a target for the beef sector of a 20% increase (about €300m) in the value of output by the end of this decade. The Beef 2020 Activation Group report, produced in 2011, showed that a coordinated approach to the development of the beef sector, which firstly and most importantly aims to maximise beef output from an expanding suckler herd while additionally optimising the beef output potential from the forecasted expansion in dairy sector, can result in growth in the value of all beef output which significantly exceeds that targeted in Harvest 2020. By the end of 2013 there was in fact a 39% growth in the value of output from the baseline years of 2007 – 2009 which is well in excess of the 20% Food Harvest target. Notwithstanding this, however, the sector continues to face a number of challenges not least the sharp decline in beef prices experienced throughout 2014 from the all-time price highs achieved in 2013 and strong prospects of increasing low cost global competition. It is essential that the reputation and competitiveness of the beef sector is maintained and enhanced in future to allow it to benefit from forecasts of increasing global demand and rising affluence.

Although the recently opened US market and the possibility of gaining access to other emerging markets is hugely significant, the beef opportunity principally derives from the capability of the sector to market beef to EU retail markets where beef production is forecasted to decline. The Beef 2020 Activation Group report showed that there is market demand to support growth in the suckler and dairy herds to increase annual national cattle slaughterings from 1.5 million cattle in 2011 to more than 1.8 million cattle by 2020. This increase exceeds 120,000 tonnes of beef annually. The EU beef deficit was recorded at 480,000 tonnes in 2011 and estimated to be in excess of 700,000 tonnes by 2020. The increased beef exports value to the economy of the additional cows, plus other improvements recommended in this report, should result in additional export value of up €550 million in 2020, and a much higher cumulative addition over the period.

The Government's overriding **energy** policy objective is to ensure competitive, secure and sustainable energy for the economy and for society. This energy imperative is fundamental to economic recovery and wellbeing. Renewable energy, allied with energy efficiency, is crucial to our goals of secure sustainable and competitive energy supplies reducing dependency on expensive fossil imports and underpinning the move towards a low carbon economy. Energy Policy has a pivotal role to play in creating the conditions for job creation and a return to economic growth.

The development of **renewable energy** is central to overall energy policy in Ireland. Renewable energy reduces dependence on fossil fuels, improves security of supply, and reduces greenhouse gas emissions creating environmental benefits while delivering green jobs to the economy, thus contributing to national competitiveness and the jobs and growth agenda. Climate change, energy security and competitiveness are inter-related challenges that will be addressed through the transforming of Ireland's economy from one based on a predominantly import based fossil fuel dependence to a more indigenous low carbon economy based around energy efficiency, renewable energy and smart networks.

In implementing the policies set out in this Strategy, the renewable energy sector affords a major opportunity for growth and employment creation in Ireland. Employment opportunities in relation to renewable energy will also arise in the areas of manufacturing and assembly, services (including ICT) and the supply chain. Ireland can also become a global leader in research and development in renewable energy and related technologies, including Smart Grids.

The Department of Communications, Energy and Natural Resources (DCENR) is responsible for the development of energy policy in Ireland. Global, environmental and economic realities mean that a sea change is required in the energy landscape over the next 20-30 years and Ireland's energy policy will need to be adapted to reflect this. Ireland's **energy research strategy** should feed into this policy and be of sufficient breadth to contribute towards ensuring that Ireland can meet its future national and international obligations within the energy sphere. The research strategy must help ensure a healthy, sustainable, affordable and cost effective energy landscape. In this context, DCENR has established an Energy Research Strategy Group to inform and drive energy research in Ireland. The Group is to:

- Develop a national strategy and roadmap for energy research in Ireland, encompassing elements from pure research to commercialisation;
- Oversee the implementation of this strategy;
- Ensure buy-in from the wider energy research sector – academics and industry.

EPA Research Strategy 2014-2020

The EPA has the statutory responsibility for the overall coordination of environmental research in Ireland. A major emphasis of the EPA research programmes, since their commencement in 1994, has been to support the implementation of EU and national environmental legislation and to provide essential support for environmental policy and decision-making at national and local level.

This research, primarily conducted in Irish institutions, has greatly assisted Ireland in meeting and addressing obligations at EU and international levels in the areas of climate change, water quality, waste, air quality and biodiversity. Since 2007, the EPA has supported over 500 research projects which have a value of approx. €74million including desk studies, individual scholarships and large interdisciplinary collaborative projects.

In 2014, the EPA published its Research Strategy (2014–2020) which is targeted to address the needs of key governmental and non-governmental stakeholders. The strategy was informed by the EPA’s own strategic goals, the environmental analyses it provides, such as Ireland’s Environment 2012, and its specialist knowledge. It is also informed by national, EU and global environmental policies and sustainability goals and the work of research platforms such as Future Earth. At an EU level the 7th Environment Action Programme (7th EAP) provides the key strategic framework for achievement of “living well, within the limits of our planet”. In finalising the strategy, the EPA undertook extensive stakeholder consultation and hosted seven workshops in 2013.

The programme is structured around the three key pillars of Climate Change, Water and Sustainability. The Agency has established research co-ordination groups comprising key stakeholders in the three priority areas to improve the coordination of EPA-funded research, share data and communicate research outputs to policy-makers and decision-makers.

A number of key priority areas requiring concerted national action have been identified in the strategy including:

- Informing Ireland’s transition to a low-carbon climate-resilient environment, society and economy and meeting national and international targets in this process.
- Supporting water protection, conservation and management obligations under the Water Framework Directive, Marine Strategy Framework Directive and Floods Directive.
- Reducing waste generation and treating waste as a resource in line with national and European waste policies.
- Furthering the knowledge base on the role of the natural environment, its resources and ecological limits, and our understanding and protection of ecosystems and their role in sustaining the economy and human wellbeing.
- Understanding the environmental impacts of unconventional gas exploration and extraction.
- Understanding environment-health interactions, including risks from emerging chemicals and novel materials, while highlighting the benefits to human health of a clean and well managed environment.
- Developing a better understanding of how individual and collective behaviour can either help or hinder progress towards a low-carbon, resilient, resource-efficient economy and society.
- Developing integrated approaches and growth opportunities through management of the challenges that arise from climate change, water quality and other environmental issues

Environmental policy supporting research plays a vital role in ensuring that EU and national policies and legislative requirements are implemented in the most cost-effective manner through providing an authoritative scientific basis for decision-making, thus minimizing the burden to the State and to business. In addition, such research has been critical in improving Ireland’s ability to negotiate successfully on international agreements and EU legislative developments, and has produced significant direct savings. For example, the economic returns for investment in research were well demonstrated through an estimated cost saving of €50m arising from analysis of greenhouse gas emissions from landfills and the avoidance of ECJ fines in some infringement cases against Ireland. While the primary purpose of the EPA

Research Programme is support for policy and to develop solutions for environmental challenges, in so far as is possible without compromising its primary mission, the EPA collaborates with enterprise agencies to lever its investments for economic impact too.

The EPA supports Ireland's engagement with Horizon 2020 (H2020) through its participation in the Advisory Group of Experts for Societal Challenge 5 (SC5), as National Delegate and National Contact Point for this Challenge, and as a member of the H2020 National Support Network led by Enterprise Ireland. In addition, the EPA participates in both the Climate and Water Joint Programming Initiatives, and as task force members on two European Innovation Partnerships (Water and Raw Materials), which could offer potential opportunities for increased engagement with H2020. It also supports engagement with ESFRI on development of environmental research infrastructures. The EPA Director General (Laura Burke) is the Chairperson of the Advisory Group of Experts under SC5.

Eco - Innovation

The term *Eco-Innovation* is used to describe innovation striving for significant and demonstrable progress in sustainable development, through reducing impacts on the environment, enhancing resilience to environmental pressures, or achieving a more efficient and responsible use of natural resources.

In 2011, the European Commission launched Innovation for a Sustainable Future – The Eco-innovation Action Plan (EcoAP) (this succeeded the Environmental Technologies Action Plan (ETAP)). The EcoAP is a broad policy framework. It provides directions for eco-innovation policy and funding. From 2014 to 2020, an important source of support will be Horizon 2020 which has for example set aside €3.16 billion for climate action and resource efficiency initiatives, which include eco-innovation. In 2016-17, under Horizon 2020's Societal Challenge 5, there will be a strong focus on large-scale pilot/demonstration projects (technological and non-technological), in the following areas:

- Systemic eco-innovation for a circular economy;
- Climate services;
- Nature-based solutions;
- Water.

By building on the national supports currently available, Irish researchers will be well placed to compete strongly for funding in the next period. There are also synergies with other sources of EU funding such as European Structural and Investment Funds and the LIFE Programme, the EU funding instrument for the environment and climate action.

In Ireland, 80% of investment under the European Regional Development Fund will be concentrated on four key priorities: innovation and research (including eco-innovation); the digital agenda; support for small and medium-sized businesses; and the low-carbon economy (e.g. energy efficiency, renewable energies, smart distribution grids, sustainable multimodal urban transport). The last of these, the low-carbon economy, will see a minimum contribution of 20% of ERDF resources applied.

One objective of the LIFE Programme is to contribute to the shift towards a resource-efficient, low-carbon and climate-resilient economy. For example, within the priority area Environment and Resource Efficiency, the LIFE Programme supports projects that develop, test and demonstrate policy or management approaches, best practices and solutions, including development and demonstration of innovative technologies, to environmental challenges, suitable for being replicated, transferred or mainstreamed. This includes projects that address

the link between the environment and health, and in support of resource efficiency-related policy and legislation, including the Roadmap to a Resource Efficient Europe. The Programme "provides the platform for developing and exchanging best practices and knowledge, improving catalyzing, and accelerating changes in the implementation of the acquis, and building capacity, supporting private actors, in particular SMEs".

LIFE is complementary to research focused actions, as well as the SME instrument, funded under Horizon 2020. In its role as LIFE National Contact Point, DECLG aims to promote the programme as widely as possible in this funding period, to engage all stakeholders and facilitate potential applicants from concept through to application stage.

Eco-Innovation & the Green Economy

"Our Sustainable Future – a framework for sustainable development in Ireland" was launched in June 2012 and establishes a holistic government policy framework for sustainable development. Notable actions completed include publication of "Green Tenders: An Action Plan on Green Public Procurement" (DECLG, January 2012); development of a national policy on waste management "A Resource Opportunity" (DECLG, July 2012), a green economy policy statement "Delivering Our Green Potential" (DJEI, November 2012), and the establishment of Irish Water. The Green Economy has the potential to be a key driver of economic growth and job creation in Ireland. In 2010, the Expert Group on Future Skills Needs estimated that ca. 18,750 were employed in the green economy. It was further considered that the sub-sectors analysed (including renewable energies; efficient energy use; water and waste water treatment; waste management, recovery and recycling; environmental consultancy; and 'Green' ICT) offered significant potential for creating additional 'green collar' employment. Additional potential is envisaged in emerging 'green' areas within the tourism and agriculture sectors and other areas where sustainable products or services have become key selling points for Ireland. Research, development and innovation underpin the development of the Green Economy as constant improvement and innovation in technology and products will be demanded globally.

The quality of Ireland's research base, the innovation of our enterprise sector, and our ideal location for test-bedding will place Ireland at the forefront of breakthroughs in research in areas such as energy efficiency, marine renewable energy, smart grids and smart cities and sustainable food production. Eco-innovation in companies leads to reduced costs, improves capacity to capture new growth opportunities and enhances their reputation among customers. In recent years, eco-industries have emerged as an important segment of the European economy. This sector has an estimated turnover of around €227 billion, corresponding to 2.2% of EU GDP, and employs 3.4 million people directly. Eco-innovation is therefore a powerful instrument, combining reduced negative impact on the environment with a positive impact on the economy and society.

Since 2001, EPA has operated a grant scheme to encourage Irish companies and organisations to implement cleaner, greener work practices. Over seven phases, the EPA has supported over 100 demonstration projects using a co-funding model. Originally known as the Cleaner Greener Production Programme, in 2013, the programme was rebranded as Green Enterprise to emphasise that the programme supports projects in services and institutional organisations as well as industrial production. The philosophy of the programme remains that prevention is better than cure and this change underlines the linkages with the other activities in the EPA National Waste Prevention Programme. Green Enterprise challenges organisations & companies to produce goods and provide services in more environmentally friendly ways and

to minimise emissions through cleaner production methods. The objective is to achieve a balance between economic activity and environmental protection.

The Report of the Research Prioritisation Steering Group recognises that research for policy plays an important role in helping Government to achieve its policy objectives and to design the associated systems and services needed to realise these policy goals. It facilitates in meeting objectives at minimum cost, encourages innovation, and supports productivity and fiscal integrity by minimising the resources we have to spend on achieving objectives by actively encouraging new and better ways of doing things. Research programmes designed to inform the policy process play a vital role in agenda setting and increase the likelihood of translating important findings in relation to health, education, environment and other research domains into feasible and implementable services and systems.

Research for Policy and Practice

Research for Policy and Practice not only informs national policy but also national positions and responses at international level. In many areas, policy is negotiated within the EU context, out of which emerge obligations, regulations and income transfers. The quality of our negotiating effort is directly shaped by the quality of the evidence-based research that we bring to the negotiating table. Key examples of achievements in Research for Policy and Practice include:

- Provision of support, under the auspices of the European Joint Programme 'A Healthy Diet for Healthy Life, for Irish researchers to participate in a Knowledge Hub to develop a research agenda on Determinants of Dietary and Physical Activity
- Publication of a report, Environmental Protection through Research in 2013 that outlines the vital role that EPA-funded research evidence has played in helping to identify and tackle environmental challenges in the areas of climate change, water and sustainability; in developing novel solutions to protect Ireland's environment; and in ensuring that EU and national environmental policies are implemented in the most cost-effective manner.
- Completion of a Department of Agriculture, Food and the Marine supported study, under the CoFoRD forest research programme, to identify the factors that influence farmers' decision-making processes with respect to afforestation, which identified a number of key issues and generated a suite of recommendations for policy-makers which could help increase afforestation levels.
- Policy simulation models developed by Teagasc have been used extensively to provide evidence to inform negotiating positions by the Irish Government in international policy negotiations. These include the Common Agricultural Policy, International trade agreements, Rural Development policy, Climate Change agreements and EU Environmental Directives.
- The DAFM funded Ag Catchments programme is providing the evidence base for implementation of the Nitrates Directive and Water Framework Directive in relation to agriculture, and has already allowed Teagasc to provide the scientific evidence for some significant science-based adjustments to Ireland's Nitrates Action Programme.
- The report of the Commission for Economic Development of Rural Areas which was underpinned by research evidence, is supporting the medium-term economic development of the Rural Areas for the period.
- The Government's Integrated Marine Plan for Ireland (Harnessing Our Ocean Wealth), published in July 2012, sets out three over-arching goals for, and implementation of, a new Strategic Marine Research and Innovation Strategy for Ireland (2014-2020), which seeks to identify, initiate and support the research

priorities needed to achieve the Integrated Marine Plans objectives (see later in chapter for further information).

- The publication of an independent study of recommendations from Inquiries into events in families and their interactions with State services, and their impact on policy and practice.
- SFI's Policy PhD Fellowship programme provides postgraduates with a research experience that focuses on various aspects of RD&I investment and its impact in small advanced nations such as Ireland.
- SFI's PhD Fellowship programme in Science Technology Engineering and Maths Education (STEM) is designed to support the requirement for fourth level professionals in STEM education to educate and prepare teachers at all levels but especially in primary and postprimary schools. This will include the effective implementation of STEM education and evidence-based research into teaching and learning in the STEM disciplines.
- SFI is participating in the Small Advanced Nations Initiative involving New Zealand, Singapore, Israel, Finland, Denmark and Ireland. This initiative was established in 2012 to explore possibilities for collaboration in an increasingly inter-connected and competitive global economy.

Key areas to be explored include:

- **What steps need to be taken to further the translation of investments in STI into the achievement of stated public policy goals? How can the Strategy enable research programmes to optimally support policy development and actions to address key national challenges in areas such as environment, health, etc.**
- **What are the synergies between Government's goals in building a better society and the goal of creating jobs and economic growth?**
- **How can we address national challenges and also provide economic opportunities through development of new products, processes, systems?**
- **How can we address local and national challenges that are also regional and global challenges - how can Ireland through its research turn national challenges into global opportunities in areas such as sustainable land use, urban and rural development, and vulnerabilities to global trends and changes?**
- **How can Ireland harness the opportunities presented by the major developments on observation systems, including the analysis and use of Earth Observation data by a wide array of sectors and users?**

Pillar 8 Research for knowledge and developing human capital

Developing Human Capital

The successful realisation of all aspects of a new Strategy will depend on people and will recognise the role of education to Ireland's research and innovation performance. Human capital is both a critical component of Ireland's innovation infrastructure and a key output of investment across all the activities considered in earlier chapters. It is about the quality of the people who conduct research and who improve scholarship in our educational institutions and enhance Ireland's reputation for research excellence and those who start up and work in companies to drive innovative performance and who create new innovative companies.

The first progress report (June 2014) on Research Prioritisation notes that "human capital is the single most important enabler for the National Research Prioritisation Exercise". The Action Plan for Jobs 2015 advises that "Ireland's competitive advantage in international markets [...] will increasingly be driven by the availability of world-class skills at all levels" and that "the OECD has called skills the new global currency of 21st century economies [...] It is against this global background that Ireland will compete to develop and attract talent in the coming years". Ireland's science and innovation can only be as good as the people that it can educate, train, attract and retain.

Ireland has the most youthful population in the EU with one quarter of the population aged 16 and under. This is the reservoir of talent that has the capacity to transform Ireland's national economic and societal development in the future. A sustainable supply of future skilled researchers and innovators requires an effective education pipeline (at primary, post-primary as well as higher level) that equips students at all levels with the right mix of skills and knowledge.

The Action Plan for Jobs 2015 highlights that "key to innovation are people and the number of researchers in foreign owned and indigenous firms in Ireland has increased by 15% and 18% [...] and further progress is needed to get to international benchmarks". Recent evidence of declining PhD numbers is a cause of concern for Ireland and for its future international competitiveness. Success in initiatives like Horizon 2020 will require researchers to be supported systematically from early-stage and onwards to improve their capability to grow their (and with that, Ireland's) research performance.

As acknowledged in the Strategy for Science, Technology and Innovation (SSTI) 2006 – 2013, "world class research and world class people are at the heart of national system of innovation." Furthermore, the SSTI recognises that "higher education (together with key public research institutes such as Teagasc) is the engine of Ireland's system of innovation." According to the OECD, "human capital, especially in science and technology, is of growing importance for innovation and technology-led economic growth. In the new economy where knowledge is the source of wealth creation, human capital becomes as important as financial capital."

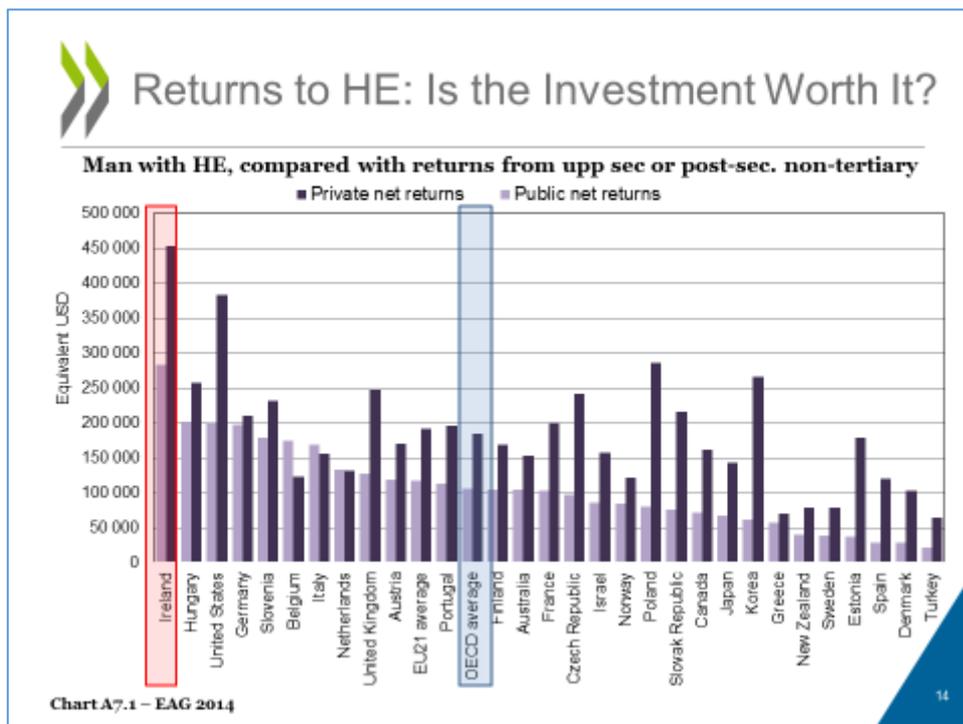
The growing interdisciplinary nature of research and the role of the humanities in societal challenges as illustrated, for example in Horizon 2020, mean that support for such areas must be protected and enhanced if Ireland is to succeed in the global arena. If graduates are to be best equipped to enter the labour market, then they need to be educated across all disciplines by staff who are in tune with the latest research in the particular field. The connection between research and education within a higher education environment is of integral national importance. It exposes our ~200,000 students to cutting-edge research techniques and practices that they can then use in later employment, many for which will be in industry. This calibre of education will prove pivotal to Ireland's future economic

success, as highlighted for instance by the IDA in Q1 2014 (“What makes Ireland great, makes Ireland great for business”).

In order to deliver jobs through innovation, Ireland must have:

- Successful innovative companies that can offer jobs;
- Graduates and researchers with the right skills to take up employment in these companies;
- Entrepreneurial individuals that can create innovative companies.

Job creation will only work if those seeking work are sufficiently and appropriately skilled. Work undertaken by the OECD demonstrates the significant public and private returns from higher education:



OECD Presentation, IUA Symposium 29 September 2014.

The availability of researcher skills is critical to attracting globally mobile R&D investment and to developing an innovative indigenous sector. Trinity College Dublin, in partnership with LinkedIn, recently carried out an analysis of 11,000 PhD graduates in Ireland over the last 20 years. It shows the doubling of PhD graduates working in industry over the period 2000 to 2010. It also finds that PhD graduates have a broader technical skillset and take up relatively senior positions within companies. The HEA’s 2014 Higher Education System Performance report noted the unemployment rate for university graduates in 2012 was 7%, roughly half the overall national average at the time of 14.7%.

The Programme for Research in Third-Level Institutions was established to strengthen national research capabilities via investment in physical infrastructure and human capital. The aim of the PRTL is to establish Ireland internationally as a premier location for carrying out world class research and development. SFI was established to undertake and support strategic research of world class status in key areas of scientific endeavour which would underpin economic development. The Irish Research Council provides opportunities for researchers at different stages of their careers, particularly those at an early stage.

Research Prioritisation recognises that research for knowledge is an important part of a sustainable, well-functioning STI system. Together with research oriented towards the Irish enterprise base and research for policy, it helps to develop the human capital that is required for a sustainable, competitive STI system including postgraduate and post-doctoral training of researchers and the recruitment and retention of world class senior researchers.

SFI's role in developing human capital

One of the primary reasons that the Government invests in scientific research is to upskill the nation's human capital. People with high levels of training and skills are an ingredient in ensuring innovation is delivered, leading to higher value products and services, and improved living standards. SFI investments deliver 4th level graduates, the majority of whom are expected to secure/establish employment in high-tech companies and, to a lesser extent, in the public service, while a significant minority will stay within the system to support and refresh the academic community.

An internationally competitive academic research base, together with the training of high quality researchers, particularly PhD graduates, is at the core of SFI's activities to drive sustainable economic growth. In 2013, SFI teams supported 1,610 early and mid-career researchers (584 Postdoctoral researchers, 955 PhD students, 56 MSc students and 15 Undergraduate Students). SFI research groups are playing a key role in supplying highly skilled researchers to enterprise. As part of SFI's strategic plan – Agenda 2020, SFI aims over the next decade to ensure that half of the human capital it develops is employed within the private sector and non-academic public sector.

SFI launched a number of programmes in 2014 aimed at enhancing the migration of researchers to the private sector through the provision of industry relevant training and experience. The SFI Industry Fellowship Programme aims to facilitate exchanges between academia and industry to stimulate excellence through knowledge transfer and training. The Advance Programme was launched in February and seeks to fund women returning to, or wishing to remain in, high quality research careers and to undertake industry-facing research projects in eligible research bodies.

SFI is committed to supporting and developing early and mid-career researchers with the greatest potential to become excellent, fully independent research leaders. A key development has been the support and development of excellent early career researchers through the SFI Starting Investigator Research Grant (SIRG) and Career Development Awards (CDA). SFI also continues to support excellence in early career development through the prestigious SFI President of Ireland Young Researcher Award (PIYRA) programme – which is also aimed at attracting leading young researchers to Ireland. Taken together, this suite of programmes offers a range of career broadening opportunities for both developing and early career researchers.

Examples of actions taken in 2014:

- A total of €23 million has been allocated to the SIRG and CDA Programmes to fund 40 awards.
- A total of €1.75 million was allocated to the Advance Award to fund 10 awards providing early career and established female researchers with an opportunity to remain in or return to high-quality research and in particular, to undertake further industrially relevant training.
- €2.2 million was allocated to the SFI Industry Fellowship Programme to fund 27 new industry-academia partnerships facilitating exchanges in both directions between academia and industry to stimulate excellence through knowledge transfer and training, thus building critical mass in areas of strategic importance for Ireland and enabling economic and societal challenges to be tackled.

- SFI hosted a conference for early-career researchers to explore career opportunities and promote connections with industry.
- DAFM award of €874,350 under its FIRM/Stimulus/CoFoRD programmes towards the continuation of its long running *Agri-Food and Forestry Graduate Development Programme* operated on a collaborative, inter-institutional basis and designed to provide training in transferable business-oriented skills for post-graduate and early stage contract researchers engaged in publicly funded agri-food, forestry and marine research projects.

Sectoral research support for human capital development

Through their own operations and that of their agencies, a number of government departments and agencies have identified and supported the development of key research capacity. These include FIRM/Stimulus/CoFoRD (DAFM), the Beaufort awards (DAFM/Marine Institute), the Griffith Awards (GSI/DCENR) and the Parsons Awards (SEAI/DCENR). These awards have led to the development of research expertise that supports enterprise and policy in the agri-food & forestry, marine, geosciences and energy sectors respectively. The development of this capacity is now continuing through the EI FHI & DPTC centres and the SFI funded APC, iCrag (Geosciences) and MarEI (Marine and Energy) research centres.

Higher Education Reform

The comprehensive reform and structural reconfiguration of the Irish higher education sector, envisaged in the National Strategy for Higher Education to 2030 and now underway, will ensure that, through the consolidation of programme provision, the generation of critical mass in research, and the sharing of resources and pooling of expertise across all areas of the higher education mission, Ireland emerges as a strong player in the global higher education landscape of the future. The National Strategy for Higher Education reaffirmed the fundamental importance of excellent teaching and learning, quality in research and knowledge transfer, and effective engagement between higher education and society. The National Strategy identified a comprehensive policy and development framework for higher education, recognising the central role of Irish higher education institutions in the future development of Ireland, socially and economically, and some structural changes that need to be made in Irish higher education. The Higher Education Authority (HEA) prepared a report for the Minister for Education and Skills setting out how key elements the National Strategy can become a reality. The HEA's report called for consolidation of the Institute of Technology (IoT) sector; the creation of a small number of technological universities; the formation of regional clusters between universities and stronger IoTs; implementation of recommendations to rationalise teacher education; as well as increased sustainability and capacity in the higher education system.

Higher Education System Performance

A new steering and performance framework was put in place to increase the transparency and accountability of institutions for delivery of agreed performance outcomes. The framework contains four National Objectives:

1. Economic Renewal and development at national and regional level
2. Social cohesion, cultural development and equity at national and regional levels
3. Public sector reform towards greater efficiency and effectiveness
4. Restoration of Ireland's international reputation

There are seven System Objectives:

1. To meet Ireland's human capital needs across the diverse spectrum of skills by engaged HEIs
2. To promote access for disadvantaged groups and improve pathways from 2nd level, FE and other routes
3. To promote excellence in teaching and learning to underpin a high quality student experience
4. To maintain an open and excellent public research system focussed on priority areas,

societal objectives, collaboration and knowledge exchange

5. To ensure HEIs are globally competitive and internationally oriented and Ireland is a world class centre of international education
6. To reform practices and restructure the system for quality and diversity
7. To increase accountability of institutions for public funding and against national priorities

Each institution has now entered into a compact with the HEA, outlining how it will contribute to national objectives from the position of its particular mission and strengths. The compacts provide for how performance is to be measured and a proportion of funding will, in future years, be contingent on performance. The initial focus in strategic dialogue has necessarily been more on planning and establishing baselines, than on performance and outcomes. The HEA has tested the plans submitted by the higher education institutions against previous institutional performance, national targets and policy. In this first year of strategic dialogue, the HEA withheld €5 million in funding for the institutions, contingent on satisfactory engagement with the dialogue process. Following a review of engagement, all institutions were judged to have met the required standard and the funding was released. Progressively, over further iterations of strategic dialogue, the HEA will move to a stronger focus on performance against agreed targets, with funding implications.

The first report of the HEA on the performance of the higher education system was submitted to the Minister for Education and Skills in 2014. The report addresses three high level issues:

- The performance of the higher education system to-date.
- The future performance of the system by reference to stated national objectives.
- Key conclusions and policy issues emerging.

The key conclusions from this first engagement with strategic dialogue and related implications for policy include:

- Irish higher education is competitive internationally and performs well against international benchmarks in tertiary attainment, STEM graduates, and student engagement and employer satisfaction.
- Against a background of economic crisis, a resilient system has provided significant extra capacity to meet increased demand for higher education and to address areas of specific skills needs as well as providing capacity for labour market activation programmes.
- Ireland needs higher education capacity to grow both to support demographic growth and also to meet increased demand for graduates, as demand for Irish graduates bounces back and economic recovery continues.
- The Irish higher education system is engaged in and committed to reform. Public service reforms and the restructuring and strategic refocusing of Irish higher education institutions are providing opportunities to improve and monitor quality and performance.
- Success in implementing the reform programme, in maintaining and enhancing the quality of outcomes and in meeting other national objectives is dependent on a number of enablers:
 - The leadership capacity of the institutions themselves, empowered by an appropriate toolkit for managing human resources
 - The capacity in the HEA, working with the institutions, to develop further the capacity for setting performance metrics and performance evaluation
 - The implementation of a comprehensive funding policy.
- Failure to meet national objectives will have a direct, and negative, impact on economic recovery and development.

Consolidation

As part of the implementation of the Strategy, the HEA published a four stage process and set of

*and
establishment of
Technological
Universities*

criteria for applicant groups of Institutes of Technology who wished to apply to become Technological Universities. The reconfiguration within the higher education sector will allow a pathway of evolution for consolidated institutes of technology to allow them to demonstrate significant progress against stated performance criteria and to apply to become Technological Universities. Three groups of Institutes of Technology are progressing towards attaining Technological University status. The three are:

- The Dublin Institute of Technology, the Institute of Technology Tallaght and the Institute of Technology Blanchardstown;
- The Cork Institute of Technology and the Institute of Technology Tralee; and
- The Waterford Institute of Technology and Carlow Institute of Technology.

In addition, regional clusters of institutions have been established in identified regions as follows:

- South/South East - University College Cork, Cork IT, IT Tralee, Waterford IT and IT Carlow;
- West/North West, - Galway-Mayo IT, IT Sligo, Letterkenny IT and NUI Galway (St Angela's and Shannon College incorporated into NUI Galway);
- Mid-West - - University of Limerick, Limerick IT, Mary Immaculate College
- Dublin/Leinster Pillar I – University College Dublin, Trinity College Dublin, National College of Art and Design, Marino Institute of Education, Dun Laoghaire Institute of Art, Design and Technology;
- Dublin/Leinster Pillar II – Dublin Institute of Technology, IT Tallaght, IT Blanchardstown, Dublin City University (and incorporating linked colleges, National College of Ireland, Dundalk IT, NUI Maynooth, Athlone IT and Royal College of Surgeons in Ireland.

Clustering will result in the elimination of unnecessary duplication of provision and the establishment of clear pathways of transfer and progression for students in the region. Alliances between Universities and Institutes of Technology will be strengthened and promoted - developing critical mass and centres of excellence in undergraduate, postgraduate and research provision.

*Researcher
Careers*

Researcher Careers

One of the systemic recommendations in Research Prioritisation is that innovation activity should be recognised by the system for career progression for academic staff within HEIs and public research organisations.

The Performance Framework gives visibility to research and knowledge transfer with metrics which are and will remain aligned to those used by the enterprise agencies. This emphasis on performance in research and innovation at institution level is intended to, and expected to, impact on performance appraisal at individual level.

Contract and collaborative research with industry, provision of specialist services and expertise by researchers to industry and ensuring research has an industry impact is actively promoted within Teagasc and is an important factor in promotions, although there have been no promotion rounds since the moratorium came into place.

The Irish University Association (IUA) are to set out the various elements/challenges involved in the issue of researcher careers as seen by the IUA including the issue of reward and recognition for time spent on innovation and commercialisation activity by researchers.

*Irish Research
Council*

To address the broad skills and research needs within society, the **Irish Research Council** supports excellent researchers in all disciplines from Arts to Zoology. An agency of the Department of

Education and Skills, the Council primarily funds early stage career researchers: namely, postgraduate students and postdoctoral researchers. Diverse career opportunities are enabled through a suite of programmes which partner with employers.

The other key area of activity for the Council is the funding of research projects with a societal focus; the Council has established partnerships across government and civic society. The Council represents Ireland in particular dimensions of Horizon 2020 and, by providing supports for Horizon 2020 applicants, enhances opportunities for the Irish research community.

The Council provides up to four years of funding for PhD students where it can be shown that the student is getting a quality experience and is developing additional knowledge and competencies beyond the core research work. The Council is strongly supportive of structured degrees and programmes, seeing those as a means to ensure the best student experience and to maximise career options.

In line with this, for those who wish to consider careers outside academia, the Council has established a number of programmes in partnership with employers – specifically the Enterprise Partnership Scheme, the Employment Based Postgraduate Programme and the ELEVATE Postdoctoral Programme. These programmes allow researchers to experience the realities of the workplace for themselves. Up to 225 companies have worked with the Council on these initiatives, and many other employers are eligible as partner organisations from within the public, voluntary and NGO sectors.

In addition to the major funding programmes, the Council offers a number of research development grant schemes which include interdisciplinary and multidisciplinary options. Combining expertise and knowledge from different disciplines is important both for national and international research.

The Council is very focused on enhancing opportunities for researchers through European and international engagements. Through its function as the representative body for Ireland across a number of different aspects of Horizon 2020, the Council strives to ensure that the work of the European Research Council, the Marie Curie programme and other facets of Horizon 2020 serve the needs of the Irish research community. On the international stage, in addition to its representational roles in Europe, the Council has become the national agent and academic partner for the Lindau Nobel Laureate Prizewinners Meeting.

Chief Scientific Adviser

The post of **Chief Scientific Adviser** (CSA) to the Government was established in 2004 to provide the Government with independent, expert advice on issues related to public science policy. The current incumbent, Prof Mark Ferguson, Director General of SFI, was appointed CSA to the Government in October 2012.

The duties of the CSA are to:

1. To provide high level advice on specific scientific issues of concern to the Government, as required;
2. To provide such scientific input into the work of any relevant body or advisory group as the Minister for Jobs, Enterprise and Innovation may from time to time reasonably require;
3. To fulfil, on behalf of Government, a representational / ambassadorial role in the science field;
4. To attend, as may be required, Cabinet or Cabinet Committee meetings and Houses of the Oireachtas Meetings; and
5. To report periodically to the Minister for Jobs, Enterprise and Innovation, or as may be requested by the Minister.

Science, Technology, Engineering and Maths (STEM) education

STEM education is the preparation of primary and post primary in competencies and skills in the four disciplines (science, technology, engineering, and math). A successful STEM education is recognised as providing students with science, math, and engineering/technology in sequences that build upon each other and can be used with real-world applications. In 2013, SFI's remit was broadened to provide funding to promote the study of, education in and awareness of STEM. SFI launched the SFI Discover Programme which includes education and public engagements and competitive, internationally reviewed funding calls to support STEM engagement projects. SFI Discover continues to address the need to increase the number of students studying STEM at primary and secondary level. The programme also works towards having the most engaged and scientifically informed public through its activities and events.

In November 2013, the then Minister for Research and Innovation announced the launch of a STEM Education Review Group. Work on this is coordinated in the Department of Education and Skills. The review group aims to map existing initiatives in STEM education in Ireland and review aspects of teacher training, approaches to learning and assessment, the use of technology and encouraging wider engagement with STEM, mainly at primary and secondary level.

Key areas to be explored include:

- **What more can we do to best harness the potential of our knowledge base for sustainable economic and social well-being?**
- **What additional steps can government take to ensure the development of human capital across the population to ensure the success of the new Strategy?**
- **How can we ensure that the requisite links between research and scholarship are maintained across all RPOs?**
- **In order to achieve a sustainable research capacity, are the outputs of our research system at doctoral and postdoctoral level the right ones in terms of volume, quality and relevant discipline?**
- **How can the new Strategy support and strengthen the reforms taking place under the Higher Education Strategy and align with the new National Skills Strategy and develop capacity to enable Ireland to deal with new and emerging challenges across the full breadth of government strategies?**
- **How can we better leverage our research talent into the economy? How can those individuals active in research (and those seeking to be), both in the public and private sectors, be best supported to perform and progress including through optimum researchers' careers, recognition and mobility mechanisms.**
- **How can gender equality in publicly funded research activity be further enhanced?**
- **How can the Action Plan for Jobs 2015 objective to increase the number of researchers in enterprise be fulfilled?**
- **Should research and innovation performers be supported to engage citizens more actively in the innovation process to achieve optimal outreach to the public?**

Interdepartmental Committee on Science, Technology and Innovation

Department of An Taoiseach

Department of Jobs, Enterprise and Innovation (Chair)

Department of Education and Skills

Department of Finance

Department of Public Expenditure and Reform

Department of Agriculture, Food and the Marine

Department of Environment, Community and Local Government

Department of Communications, Energy and Natural Resources

Department of Health

Department of Foreign Affairs and Trade

Higher Education Authority

Chief Scientific Adviser to the Government

List of Acronyms

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