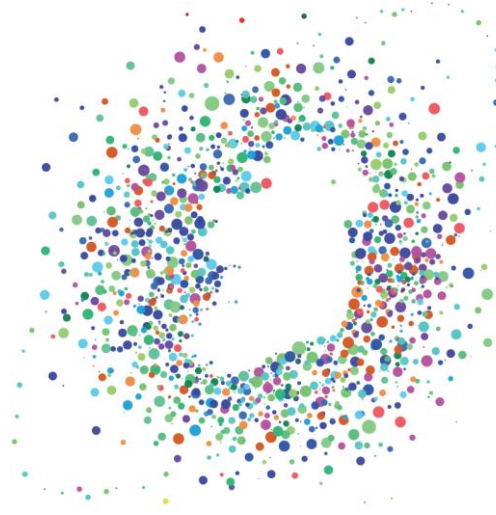




**Rialtas na hÉireann**  
Government of Ireland



## **Mid-term Review of Innovation 2020**

Prepared by the Department of Business, Enterprise and Innovation  
June 2019  
[dbei.gov.ie](http://dbei.gov.ie)

## **Table of Contents**

Executive Summary	3
1. Introduction	6
2. Overview of Performance	8
3. Key Changes in the Policy Environment	17
4. Assessment of Progress on the Implementation of I2020	26
5. Conclusion	41
Appendix 1 - Terms of Reference for the Mid-term Review of I2020	44
Appendix 2 - Overview of Progress to Date	45
Appendix 3 - I2020 Targets	62
Appendix 4 - Meetings with Members of the I2020 Implementation Group	63
Appendix 5 - List of Respondents to the Call for Submissions	64
Glossary	65

## Executive Summary

Innovation 2020 sets the vision for Ireland to become a Global Innovation Leader driving a strong sustainable economy and better society. This mid-term Review of Innovation 2020 (I2020) aims to ensure that the Strategy continues to deliver the vision and objectives for Ireland's Research, Development and Innovation (RDI) system whilst acknowledging the changes in the policy environment, responding to emerging opportunities and delivering enhanced impact. The Review has been carried out by the Department of Business, Enterprise and Innovation on behalf of the I2020 Implementation Group. It covers the first three years of I2020 (December 2015 to December 2018).

Since the launch of I2020, uncertainties in the economic, political and technological environment have increased markedly with the UK vote in favour of Brexit, possible changes in US trade and investment policy and international tax policies, and the ever-increasing scale and speed of technological change. At the same time, the transition to a Low-Carbon and Climate-Resilient Society has become a more prominent policy goal. In response to this changing policy context, national policies have also evolved. Of particular note is the refresh of the 2012 National Research Priority Areas, with a broadening of the ICT theme to reflect the growing importance of technologies such as Robotics, Artificial Intelligence, Augmented Reality and Virtual Reality and a significant broadening of the energy theme to reflect the need to address both climate change and sustainability.

Key to Ireland becoming a Global Innovation Leader was a commitment to increase public and private RDI investment to reach a research intensity rate of 2.5% of GNP by 2020. The data show that:

- Gross Expenditure in Research and Development (GERD), that is public and private expenditure, as published in the R&D Budget 2017-2018, increased significantly from €2.969bn in 2014 (the baseline in I2020) to €3.396bn in 2017, an increase of 14.4%<sup>1</sup>.
- Business Expenditure in R&D (BERD) increased by 31.5% between 2014 and 2017 as per the CSO BERD Survey 2017-18 released in April 2019;
- Government Budget Allocations for R&D (GBARD) increased by 1.7% between 2014 and 2017 (3.4% between 2014 and 2018 based on budget estimates);
- GNP grew by 43.3% between 2014 and 2017.

The growth in GERD between 2014 (the baseline year for I2020) and 2017 is to be welcomed however, it did not keep pace with the strong GNP growth linked to Ireland's economic recovery. As a result, Ireland's research intensity rate expressed as a percentage of GNP declined from 1.81% of GNP in 2014 to 1.46% in 2017 as set out in the R&D

---

<sup>1</sup> GERD was computed in the R&D Budget 2017-2018 and does not reflect the revised BERD data for 2017 published by the CSO on 18 April 2019.

Budget 2017-2018<sup>2</sup>. GERD will be revised later in 2019 once all data are collected and published. The significant increase in BERD in 2017 as outlined in the CSO BERD Survey 2017-18 is expected to have a positive impact on GERD.

Notwithstanding this, Ireland's RDI system continues to perform strongly. Participation in Horizon 2020 is on course to meet the €1.25bn target. Furthermore, the 2018 European Innovation Scoreboard (EIS) shows that Ireland's position in terms of innovation leadership has progressed: Ireland was in 9th position in 2017<sup>3</sup> gaining one place on the 2015 EIS (which corresponds to the 2014 baseline). Ireland remains a Strong Innovator but has not yet reached its goal to become an Innovation Leader.

In brief, the Review found that

- Overall, the implementation of I2020 actions is progressing reasonably well: 22% of actions are complete or nearly complete, 65% of actions are progressing or ongoing, 6% of actions (8 actions) are delayed and 2% of actions (three actions) remain to be initiated.
- Progress on the actions relating to investment in research talent and research infrastructure is recent and gradual. During the consultations, a consensus emerged that increased investment to further develop research talent and research infrastructure is essential if the full potential of I2020 is to be realised.

The Review concluded that reaching the I2020 targets in terms of research intensity as a percentage of GNP and completing the action in terms of research talent and research infrastructure will require a substantial increase in investment.

- Policy developments since 2015 have reaffirmed the relevance of I2020's objectives, in particular, the objective of increasing innovation across Ireland's enterprise base by increasing both the number of R&D performers and the R&D intensity for those who already innovate. The Disruptive Technologies Innovation Fund (DTIF) in the National Development Plan 2018-2027 and the announcements of funding for the Regional Technology and Innovation Clusters associated with the Technological Universities (TUs) and the Institutes of Technology (IoTs) will support this objective.
- Investment in terms of research talent and research infrastructure is required to build and sustain capacity within the public research system that can leverage private and international investment. The National Development Plan 2018-2027 provides for considerable indicative funding to deliver on a range of Strategic Investment Priorities over the ten-year programme which include investment in research infrastructure, a new cycle of PRTL (the Programme for Research in Third Level Institutions), and the funding of SFI Centres for Research Training in areas of future skills need (data, digital and ICT).

---

<sup>2</sup> The R&D Budget 2017-2018 does not reflect the revised BERD data for 2017 published by the CSO in April 2019

<sup>3</sup> The 2018 European Innovation Scoreboard uses 2017 data.

- To maximise the effectiveness of investment in the future, the Implementation Group could examine ways to:
  - Better understand the current level of investment in research infrastructure and the current funding mechanisms in order to assess the needs of the RDI system.
  - Adopt an enhanced coordinated approach to progress the 500 additional postgraduate enrolments and other actions to strengthen Ireland’s research talent pool.
- The Review also identifies areas to further enhance economic and/or social impact:
  - Research in services and business processes including the appointment of “Star” researchers within the HEIs could be reviewed;
  - Interdisciplinary research could be encouraged further to deliver economic and/or societal impact (and with it, participation in European programmes);
  - Coordination between research and innovation performers and policy makers could be explored further; and
  - Further mission-oriented funding to address societal challenges, most notably challenges associated with the pursuit of the UN Sustainable Goals<sup>4</sup>, should be considered with some alignment of this funding with EU Research programmes.
- The goals of I2020 remain relevant and pertinent for its successor. It is important to ensure that public investment in R&D translates into economic and/or societal impact, including the development of research talent within HEIs and Public Research Organisations (PROs) and enterprise. This will allow for the development of Ireland’s skills base - including the skills to develop the next generation of talent. The challenge for the successor of I2020 will be to further mobilise public and private resources to strengthen and expand research talent and research infrastructures.

---

<sup>4</sup> This approach is already adopted by DAFM in its 2019 Research Call.

# 1. Introduction

The Mid-term Review of Innovation 2020 (I2020), Ireland's strategy for research and development, science and technology for the period 2016-2020, was provided for in Action 7.5.a of I2020. The Review has been carried out by the Department of Business, Enterprise and Innovation on behalf of the I2020 Implementation Group.

This section recalls the vision and objectives pursued by I2020. It presents the terms of reference of the Mid-term Review (the Review), the approach followed and structure of the document.

## Innovation 2020: Vision and Objectives

I2020 sets the vision for Ireland to become a Global Innovation Leader driving a strong sustainable economy and better society underpinned by:

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

To deliver this vision, the following goals are pursued through 140 actions (or sub-actions):

1. Increase public and private investment in research and development;
2. Enhance the impact of research and innovation for enterprise;
3. Ensure that education drives innovation;
4. Focus research and innovation activity on social and economic development;
5. Support innovation through the protection and transfer of knowledge;
6. Engage with the rest of the world in becoming a Global Innovation Leader;
7. Effectively implement the strategy to become a Global Innovation Leader.

Responsibility for oversight of I2020 rests with an Implementation Group. The Group meets three or four times a year and an annual progress report has been published since July 2016.

## Terms of Reference of the Mid-term Review

The objective of the Mid-term Review is to ensure that the Strategy continues to deliver the vision and objectives for Ireland's Research, Development and Innovation (RDI) system whilst acknowledging the changes in the policy environment, responding to emerging opportunities and delivering enhanced impact. The Terms of Reference of the Review (see Appendix 1) stipulate that the Review will:

- Assess progress in achieving the targets set out in I2020;
- Assess progress in the implementation of the Strategy based on the I2020 Progress Reports for 2016, 2017 and 2018;
- Identify any changes in the national and international policy environment that impact on the objectives of I2020 and the delivery of the actions; and
- Review the actions as necessary to ensure that they continue to be aligned with the overall vision and objectives of the Strategy.

The Terms of Reference do not provide for any extensive evaluation of the outcomes and the impacts of I2020; these are issues appropriate to a later *ex post* evaluation which is provided for under Action 7.5.b of I2020.

## The Approach and Structure of the Mid-term Review

The Mid-term Review was undertaken by the Department of Business Enterprise and Innovation on behalf of the I2020 Implementation Group. It was informed by

- Meetings with the Members of I2020 (list provided Appendix 4) and
- The 20 submissions (list provided in Appendix 5) received following the Call for Submissions in September 2018.

The Call for Submissions included an overview of progress under each of the chapters of I2020 at the mid-point of the strategy. This overview of progress was updated to reflect the completion of some of the actions between July 2018 and December 2018. It is available in Appendix 2.

This document provides:

- An overview of Ireland's RDI performance at the end of 2018;
- A summary of the changes in the innovation policy environment;
- A review of progress on the implementation of I2020; and
- Conclusions arising from the Review.

## 2. Overview of Performance

This chapter examines progress on the three overall performance indicators (Table 1 below) identified in Chapter 1 of Innovation 2020, namely “Innovation leadership”, drawdown of Horizon 2020, and research intensity. The other I2020 performance indicators will be examined in chapter 4 of this Review.

Table 1 - Overall Performance indicators associated with Chapter 1 - Ireland as a Global Innovation Leader			
Metric	Baseline (2014 unless specified)	Target	Latest data
European Innovation Scoreboard <sup>1</sup> performance relative to EU average:	+9% <sup>2</sup> (10th place <sup>3</sup> )	+20%	+15.9% <sup>2</sup> (9th place 2017 data) <sup>4</sup>
Drawdown Horizon 2020	€620m under FP7	€1.25bn	€632.1m <sup>5</sup>
Research intensity: GERD as % of GNP	1.82%	2.5%	1.46% (2017) <sup>6</sup>

1 In 2015, when I2020 was published, the EIS was the Innovation Union Scoreboard. To compare changes in relative performance overtime, past data were re-casted  
2 Performance relative to that of the EU average that year  
3 The 2015 European Innovation Scoreboard uses 2014 data  
4 The 2018 European Innovation Scoreboard uses 2017 data  
5 DBEI, October 2018  
6 DBEI (2018) The Research and Development Budget 2017-2018

### The European Innovation Scoreboard

The European Innovation Scoreboard<sup>5</sup> is a composite performance indicator for national RDI systems. The 2018 European Innovation Scoreboard (EIS) shows that Ireland’s position in terms of innovation leadership is progressing: Ireland was in 9th position in 2017<sup>6</sup> gaining one place on the 2015 EIS (which corresponds to the 2014 baseline); Ireland remains a Strong Innovator behind the six Innovation Leaders (Sweden, Denmark, Finland, the Netherlands, the UK and Luxembourg) and behind Germany and Belgium but ahead of Austria, France and Slovenia who are also Strong Innovators.

The comparison of Ireland with other EU countries (EU 28) across the 10 sub-indicators of the 2018 EIS shows that, in 2017, Ireland was the best performer for three of the 10 dimensions: innovation in SMEs, level of employment in knowledge-intensive activities and sales impacts. By contrast, Ireland’s performance is below or significantly below the EU average in four dimensions:

<sup>5</sup> The European Innovation Scoreboard provides a comparative assessment of the performance of 28 EU Member States across 10 dimensions.

<sup>6</sup> The 2018 European Innovation Scoreboard uses 2017 data.



- Innovation-friendly environment (Ireland ranks 15<sup>th</sup> whereas it ranked 19<sup>th</sup> position in the 2015 EIS): below average performance is explained by a low score in terms of opportunity driven entrepreneurship<sup>7</sup> and by, the second component of the indicator, broadband penetration, which is above EU average;
- Finance and support (Ireland ranks 14<sup>th</sup> compared to 12<sup>th</sup> in the 2015 EIS): the below EU average performance is explained by low R&D expenditure in the public sector (Ireland ranked 21<sup>st</sup> in EIS 2018, gaining one position compared to 2014) while the second component of the indicator, venture capital expenditure is above the EU average;
- Firm investment (Ireland ranks 11<sup>th</sup>, the same as in the 2015 EIS) with relatively low level of both R&D expenditure in the business sector and non-R&D innovation expenditures. In addition, the third component of the indicator, enterprise training to develop and upgrade ICT skills, is well above EU average.
- Intellectual assets (Ireland ranks 23<sup>rd</sup> when it was 20<sup>th</sup> in the 2015 EIS) with low level of PCT<sup>8</sup> patent, trademark and design applications.

**Figure 1 : Ireland and EU Performance in the EIS 2015 and 2018**



<sup>7</sup> The indicator measures the degree to which individuals pursue entrepreneurial activities as they see new opportunities, for example resulting from innovation.

<sup>8</sup> Patent Cooperation Treaty.

The EIS data<sup>9</sup> show a high correlation between R&D expenditure and overall performance which suggests that an increase in the level of R&D expenditure in the public sector might increase Ireland's performance (currently, Ireland has the lowest level of R&D expenditure in the public sector among the Strong Innovators and Innovation Leaders).

### Box 1: Irish Research Excellence: The Example of Agriculture Sciences

- In 2017, in terms of citations<sup>10</sup>, Ireland's rank was the following:
  - Animal and Dairy: 1<sup>st</sup>
  - Agricultural Sciences: 2<sup>nd</sup>
- Teagasc compared to all EU organisations in terms of citations<sup>11</sup>
  - Agricultural, Dairy and Animal Sciences: 7<sup>th</sup> by number of publications and 4<sup>th</sup> by number of citations
  - Agriculture, Multidisciplinary: 11<sup>th</sup> by number of publications and 19<sup>th</sup> by number of citations
  - Food Science & Technology: 9<sup>th</sup> by number of publications and 7<sup>th</sup> by number of citations
- Teagasc is ranked<sup>12</sup> in the top 6 organisations for agri-food and marine funding under H2020

## Horizon 2020

The success of the Irish research community in securing Horizon 2020 funding (H2020) is an indicator of excellence. With over 1,500 successful participants, Ireland won €632.1m in contracts to October 2018, which is more than the seven years of the previous Framework Programme. Ireland is on track to reach the target of drawing down €1.25bn in funding from H2020. The beneficiaries of Horizon 2020 funding are:

- Higher Education Institutions with a drawdown of €343.6m;
- Research Organisations, Public Bodies and Others (e.g. Teagasc, Marine Institute, etc) with a drawdown of €74.3m;
- Private companies which account for €214.2m of Ireland's drawdown (SMEs have been successful in winning €154m).

Ireland's €632.1m to October 2018 accounts for 1.69% of total funding allocated to date (€35.5bn) under Horizon 2020, well ahead of the "juste retour" of 1.2%<sup>13</sup>. Ireland's success rate in applications at 15% is also higher than the EU Member State average.

---

<sup>9</sup> Data available from: <https://interactivetool.eu/f/extensions/DGGROW4/DGGROW4.html>

<sup>10</sup> Based on InCites from Clarivate Analytics, in 2017.

<sup>11</sup> Based on InCites from Clarivate Analytics, in March 2018 for publications between 2013-2017.

<sup>12</sup> Based on eCorda data.

<sup>13</sup> The "juste retour" corresponds to 1.2% contribution of Ireland's contribution to the EU budget.

## Box 2 : Ireland's H2020 Drawdown (October 2018)

The breakdown of the Irish Horizon 2020 drawdown by funding areas:

- Marie Skłodowska-Curie Actions (all sectors/disciplines): €116m
- European Research Council: €86m
- ICT: €78.4m
- Agri-Food and Marine: €70.3m
- Health: €67.4m
- Nanotechnologies: €50.9m
- Energy: €41.6m
- Environment: €18.1m
- Transport: €17.5m
- Security: €14.7m
- Societies: €10.6m

Notable successes:

- 4 Irish HEIs are in the top 50 HEIs list: TCD, UCD, UCC and NUIG
- 3 private companies are in the top 50 Private Companies list: Glanbia, IBM and Intel
- Ireland has the highest success rate (20%) for the SME Instrument

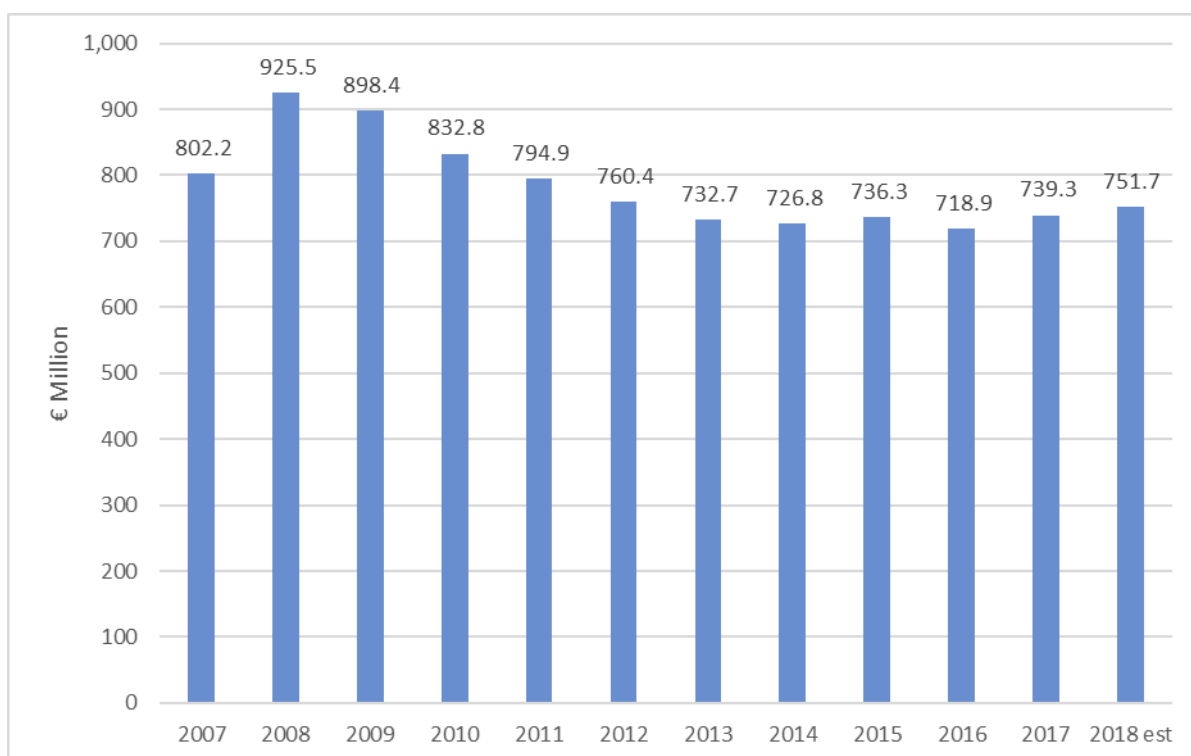
## Research Intensity

Research intensity reflects the propensity of an economy to invest in research and development. Prior to considering research intensity, this section examines the trend in the components of Gross Expenditure in R&D such as Government Budget Allocations for R&D (GBARD) and reported expenditure in R&D by sector (Business, Higher Education and Government). To provide context, data since 2007 are presented.

## Government Budget Allocations for R&D

In the wake of the economic crisis, Government Budget Allocations for Research and Development (GBARD) is recovering slowly: based on Budget 2018 estimates, GBARD was €751.7m in 2018. GBARD had decreased to €726.8m in 2014 from a peak of €925.5m in 2008 as indicated in figure 2 below. Between 2014 and 2017, GBARD increased by 1.7% and between 2014 and 2018, the increase is expected to be 3.4% (based on budget estimates).

**Figure 2 : Government Budget Allocation for R&D 2007-2017**



Source: The R&D budget 2017-2018<sup>14</sup>

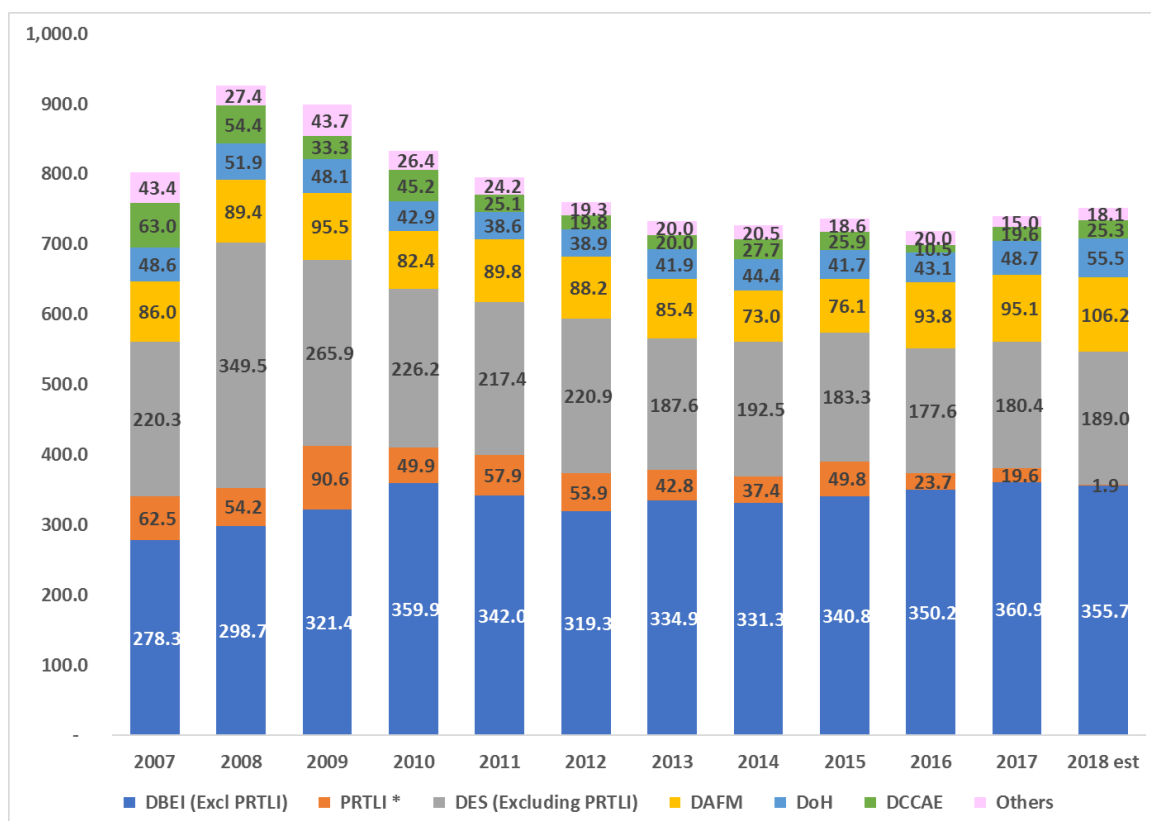
<sup>14</sup> The data presented are based in the data published in the R&D budget 2017-2018 available from <https://dbei.gov.ie/en/Publications/Publication-files/The-R-D-Budget-2017-2018.pdf>.

Figure 3 (below) shows the main drivers of GBARD's growth (based on the 2018 budget estimates) since 2007. Over the period under review (2015 to 2018), the increase in budget allocations was €15.4m: While budget allocations to PRTL<sup>15</sup> declined in the final years of the cycle 5 from €49.8m in 2015 to €1.9m in 2018 (estimates), the budget allocations across key funding Departments increased as follows:

- DAFM: increased by €30.1m;
- DBEI: increased by €14.8m (excluding PRTL);
- DOH: increased by €13.8m; and
- DES: increased by €5.7m.

The 2018 supplementary budget estimates<sup>16</sup> resulted in an additional €10.7m being allocated to DBEI bringing its budget increase to an estimated €25.5m since 2015.

**Figure 3 : Government Departments Budget Allocation for R&D 2007-2018<sup>17</sup>**



Source: The R&D budget 2017-2018

<sup>15</sup> Programme for Research in Third Level Institutions.

<sup>16</sup> Details available from [https://data.oireachtas.ie/ie/oireachtas/parliamentaryBudgetOffice/2018/2018-12-06\\_supplementary-estimates-2018\\_en.pdf](https://data.oireachtas.ie/ie/oireachtas/parliamentaryBudgetOffice/2018/2018-12-06_supplementary-estimates-2018_en.pdf)

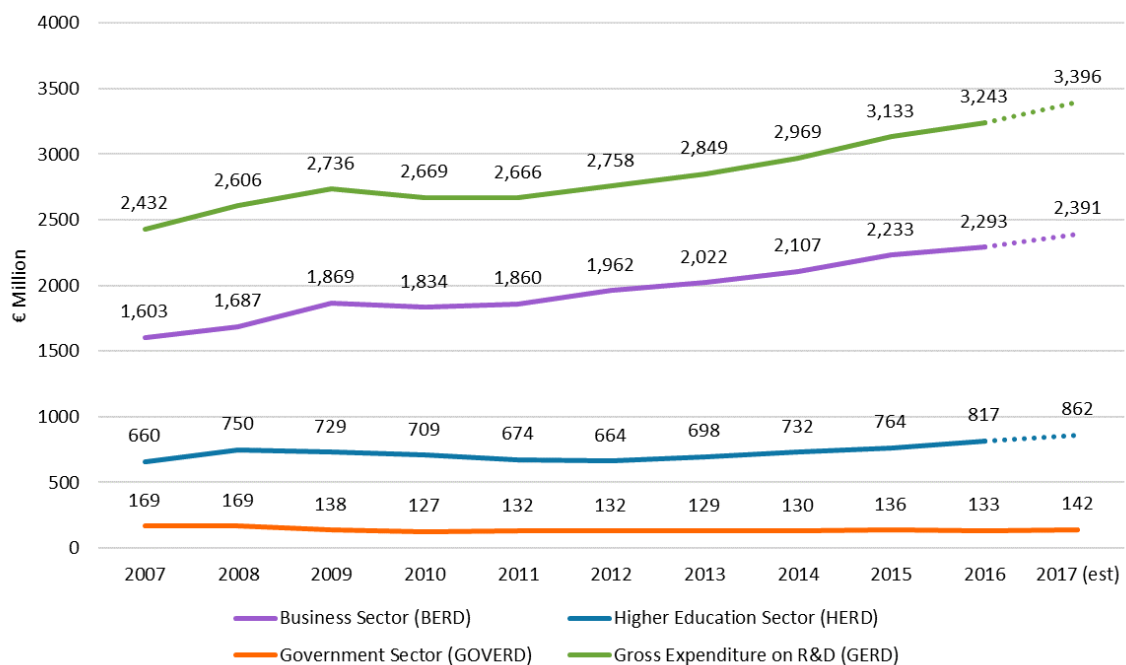
<sup>17</sup> Until 2012 PRTL was included in DES budget and after 2012 PRTL was included in DBEI budget.

## Gross Expenditure on R&D

Gross Expenditure in Research and Development (GERD) as published in the R&D Budget 2017-2018 increased significantly from €2.969bn in 2014 (the baseline in I2020) to €3.396bn in 2017; an increase of 14.4%. This growth is explained by

- An estimated 13.5% growth in Business Expenditure in R&D (BERD).
- A 17.8% growth in Higher Expenditure in R&D (HERD).
- 10.1% growth in Government Expenditure in R&D (GOVERD).

**Figure 4 : Government Expenditure on R&D by Sector 2007-2017**



Source: The R&D budget 2017-2018

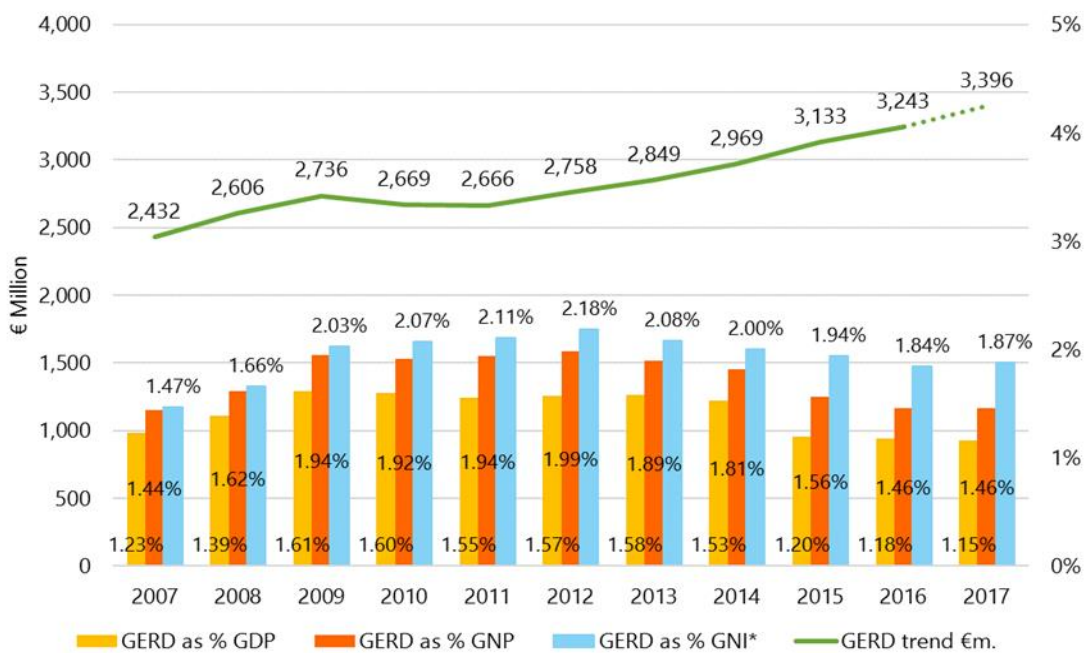
It should be noted that since the R&D Budget 2017-2018 was published, BERD figures<sup>18</sup> have been revised to €2,770m for 2017 and estimated at €2,778 for 2018. With this revision, the increase in BERD between 2014 and 2017 is 31.5% – significantly higher than the estimated 13.5% in the R&D Budget 2017-2018.

<sup>18</sup> CSO (2019) BERD Survey 2017-2018 available from: <https://www.cso.ie/en/releasesandpublications/er/berd/businessexpenditureonresearchdevelopment2017-2018/>

## Research Intensity

Ireland's Research Intensity rate measured by GERD as a percentage of GNP (or GDP in some EU countries) (presented in Figure 5) stood below the EU average research intensity rate which was slightly over 2%: it was 1.46% of GNP in both 2016 and 2017 based on R&D Budget 2017-2018<sup>19</sup> while it was 1.81% of GNP in 2014 (the baseline in I2020) in Ireland. GERD peaked in 2012 when it reached 1.99% of GNP. Despite the 14.4% increase in GERD between 2014 (the baseline year in I2020) and 2017, the research intensity rate expressed as a percentage of GNP fell as GNP increased at a faster rate (43.3% between 2014 and 2017), reflecting Ireland's strong economic recovery over recent years and the inflation of Ireland's GNP figure<sup>20</sup>. GERD will be revised later in 2019 once all data are collected and published. The significant increase in BERD in 2017 as outlined in the CSO BERD Survey 2017-18 is expected to have a positive impact on GERD.

**Figure 5 : Gross Expenditure on R&D and as a % of GDP/GNP 2007-2017**



Source: The R&D Budget 2017-2018 and Eurostat

In the context of strong growth of GNP in recent years and limited Government funding to significantly increase investment in R&D reaching the 2.5% of GNP research intensity

<sup>19</sup> The R&D Budget 2017-2018 does not reflect the revised BERD data for 2017 published by the CSO in April 2019

<sup>20</sup> Details on the developments underpinning GNP growth are available in Department of Finance (2018) GDP and 'Modified GNI' – Explanatory Note <https://www.finance.gov.ie/wp-content/uploads/2018/05/180504-GDP-and-Modified-GNI-Explanatory-Note-May-2018.pdf>

target within the timeframe of I2020 presents a significant challenge: an effective doubling of public and private investment in R&D would be required to reach the 2.5% of GNP research intensity target (based on GNP growth forecasts)<sup>21</sup>.

---

<sup>21</sup> Assuming GNP growth of 5.6% in 2018, 3.7% in 2019 and 3.1% in 2020 (based on the Economic Outlook published by Department of Finance in April 2018).



### 3. Key Changes in the Policy Environment

Over the last three years, the general focus of economic policy has moved from consolidating economic recovery to adapting to a more volatile international environment. Uncertainties in the economic, political and technological environment have increased markedly with the UK vote in favour of Brexit, possible changes in US trade and investment policy and international tax policies, and the ever-increasing scale and speed of technological change. At the same time, the transition to a Low-Carbon and Climate-Resilient Society in line with the Paris Agreement and the UN Sustainable Development Goals has become a more prominent policy goal. In response to this changing policy context, national policies have evolved. In parallel, European Research and Innovation policy is also evolving, creating both new opportunities and challenges for the Irish research community.

#### Changing Policy Context

Brexit and the need to transition to a low carbon, climate resilient economy are two main features of the changing policy context.

##### Brexit

While the exact form of the future UK-EU relationship is not yet known, Brexit is likely to disrupt the historical patterns of research cooperation, research funding, and training and mobility opportunities. Most significantly:

- If the UK does not participate in future European Funding Programmes relating to Research and Innovation (e.g. Horizon 2020 and the successor to the European Territorial Cooperation also known as INTERREG which funds cross-border cooperation), a significant source of funding for research cooperation with the UK will be lost. To compensate, an increase in bi-lateral arrangements may be needed, which may require additional funding.
- Training and mobility opportunities for postgraduate and postdoctoral qualifications may be reduced. Currently, 50% of the Irish-based successful applications of Marie Skłodowska-Curie research awards choose to go to the UK<sup>22</sup>. Non-Irish researchers based in Ireland may be affected by UK travel and residency restrictions if they wish to attend conferences or conduct research in the UK.

On the opportunity side, Brexit may increase the pool of talent available to Irish research performing organisations as Ireland may become more attractive relative to the UK for international talent seeking training or career advancement opportunities within the EU.

---

<sup>22</sup> HEA (2016) [Brexit and Irish Higher Education and Research: Challenges and Opportunities](http://hea.ie/assets/uploads/2017/06/Brexit-And-Irish-Higher-Education-And-Research-Challenges-And-Opportunities.pdf) available from <http://hea.ie/assets/uploads/2017/06/Brexit-And-Irish-Higher-Education-And-Research-Challenges-And-Opportunities.pdf>.

## Climate Action

Since the launch of I2020, the role of research and innovation in addressing societal and global challenges associated with climate change increased markedly. In 2016, Ireland committed to addressing climate change within the framework of both the Paris Agreement and the UN Sustainable Development Goals.

Ireland's national policy objectives, adopted in 2014, are to reduce emissions of CO<sub>2</sub> from key sources by at least 80% (compared to 1990 levels) by 2050 and achieve carbon neutrality in the agriculture and land-use sector, including forestry, while not compromising the capacity for sustainable food production. The initial step in setting a pathway towards this national position was outlined in the Government's first National Mitigation Plan<sup>23</sup> published in 2017 to reduce carbon emissions in the agriculture, build environment, electricity generation and transport sectors. In 2018 the Government published the National Adaptation Framework<sup>24</sup>, a national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts. Both the National Mitigation Plan and National Adaptation Framework recognise that research, development and innovation will play a key role in achieving Ireland's transition to a low carbon and climate resilient economy and society.

Reflecting the importance of the challenges brought by climate change, a new All of Government Climate Action Plan is being prepared by DCCAE which will set out how this Government intends to make Ireland a leader in responding to climate change and include a range of actions, across electricity, agriculture, transport and buildings, as well as in other key sectors. Research and innovation will play a key role in supporting Climate Action.

### **Box 3 : The Role of the EPA and SEAI in Supporting Research and Innovation Policy Associated with Climate Action**

**The EPA** will continue to fund climate science research in Ireland, recognising the need for research to inform a practical response to, and strategic engagement on, climate change. As part of the implementation of its 2014-2020 Research Strategy, the EPA established a National Climate Research Coordination Group to provide a cross-sectoral, national strategic coordination forum for Climate research in Ireland. The objective is to bring together various actors to coordinate climate and environmental research in Ireland. Under the National Mitigation Plan, the National Climate Research Coordination Group will report annually on its activities and provide an assessment and synthesis of key findings from the research programme and report on wider related research activities every five years.

---

<sup>23</sup> DCCAE (2017) National Mitigation Plan, available from the following website: <https://www.dccae.gov.ie/documents/National%20Mitigation%20Plan%202017.pdf>.

<sup>24</sup> DCCAE (2018) National Adaption Framework, available from the following website: <https://www.dccae.gov.ie/documents/National%20Adaptation%20Framework.pdf>.

**The SEAI** will enhance its role as funder and coordinator of national coordinator of energy Research, Development and Demonstration (RD&D) investments and activities in Ireland over the coming years. The SEAI National Energy RD&D Funding Programme has been revised in 2018 and continues on an upward funding trajectory, offering increased to national support for Ireland's energy and low carbon technology research & innovation sectors.

## Evolving National Policies

Research, enterprise and skills priorities and policies have evolved in the period since the launch of Innovation 2020 to respond to the changing policy context. Funding of investment in many of these areas will now come under the National Development Plan 2018-2027 (NDP 2018-2027) one of the key elements of Project Ireland 2040.

### Developments in Research Policy

New sectoral or thematic research strategies have been developed under the auspices of I2020:

- The National Policy Statement on the Bioeconomy was launched in March 2018 (Action 4.16);
- The National Marine Research and Innovation Strategy (2017-2021) was published in 2017 (Action 4.17);
- The Report of the Energy Research Strategy' Group was published in 2017 (Action 4.21):

I2020 also provided for the refresh of the 2012 National Research Priority Areas (Action 2.3) to reflect the evolving policy context, in particular Ireland's commitments to Climate Action and the Sustainable Development Goals. The objective of the refresh of the Priority Areas was to ensure that the majority of competitive public research investment remains aligned with areas of commercial opportunity that exist for Ireland in the global marketplace, now and in the near future.

The key changes in the refreshed priority areas involved the enhancement or broadening of those priority areas. For example, the ICT theme was broadened to reflect the growing importance of technologies such as robotics, Artificial Intelligence, Augmented Reality and Virtual Reality. The energy theme was also significantly broadened to reflect the need to both address climate change and sustainability and to maximise opportunities for enterprise under this priority.

The refreshed Priority Areas are as follows:

Theme	Priority Area
ICT	Future Networks, Communications and Internet of Things
	Data Analytics, Management, Security, Privacy, Robotics and Artificial Intelligence (including Machine Learning)
	Digital Platforms, Content and Applications, and Augmented Reality and Virtual Reality
Health and Wellbeing	Connected Health and Independent Living
	Medical Devices
	Diagnostics
	Therapeutics
Food	Food for Health
	Smart and Sustainable Food Production and Processing
Energy, Climate Action and Sustainability	Decarbonising the Energy System
	Sustainable Living
Manufacturing and Materials	Advanced and Smart Manufacturing
	Manufacturing and Novel Materials
Services and Business Processes	Innovation in Services and Business Processes

### Updated Enterprise Policy

With Future Jobs Ireland, the Government has set out its ambitions for the future of the economy taking into account both the challenges and opportunities. The objective is to enhance productivity, ensure quality and sustainable jobs and build a resilient and innovative economy. The framework is organised around five pillars:

- Embracing innovation and technological change;
- Improving SME productivity;
- Enhancing skills and developing and attracting talent;
- Increasing participation in the labour market;
- Transitioning to a low carbon economy.

Future Jobs Ireland 2019 was launched in March 2019 and it identifies 7 ambitions in relation to innovation and technological change and 7 deliverables in 2019 to realise them.

Future Jobs Ireland reflects the Government's approach to enterprise strategy as outlined in "Enterprise 2025 Renewed" (published in March 2018) which reaffirmed both the need to

position Ireland as a Global Innovation Leader and to respond to the more volatile international and technological environment. Innovation is seen as key to enterprise growth and diversification and to positioning Ireland at the forefront of disruptive technologies.

Future Jobs Ireland will build on progress made to date by focussing on securing the quantity and quality of skilled workers required in light of the increased automation and digitisation; improving the capacity of enterprise to absorb technology and exploit its advantages and opportunities; and encourage greater R&D among enterprise.

This approach echoed previously stated policies: the Government's Trade and Investment Strategy "Connected: Trading and Investing in a Dynamic World"<sup>25</sup> (published in March 2017), which sees innovation as a differentiator for Ireland on an international stage and "Building Stronger Business"<sup>26</sup> - DBEI's response to Brexit (published in 2017) which reiterates the relevance of I2020's vision and objectives.

### Updated Skills Policy

The National Skills Strategy 2025, published in 2016, supports the development of a well-educated, well-skilled and adaptable labour force, creating and sustaining a strong pool of talented people of all ages living in Ireland. The Skills Strategy is underpinned by the HEIs' ability to create and transfer knowledge through both skills acquisition at undergraduate level and postgraduate level and the development of linkages between HEIs and the enterprise sector. The delivery of a key element of the National Skills Strategy 2025 – a 30%<sup>27</sup> increase in the number of undergraduate places in response to demographic pressure - will depend on their ability to attract and develop excellent research and teaching talent within HEIs.

The National Strategy for Higher Education provides for the progressive transformation of several Institutes of Technology into Technological Universities with a significant research mandate enabled by new legislation. Technological Universities will strengthen the RDI system in two ways:

- The number of postgraduate enrolments is expected to increase as the designation as a Technological University is conditional on an increase in research and innovation capacity, measured by the number of research postgraduate students; and
- A new mandate to increase research output, particularly research funded by enterprise.

---

<sup>25</sup> DBEI and DFAT (2017) Ireland Connected is available from [https://www.dfa.ie/media/dfa/alldfawebstimedia/ourrolesandpolicies/tradeandpromotion/Ireland-Connected\\_Main-Report.pdf](https://www.dfa.ie/media/dfa/alldfawebstimedia/ourrolesandpolicies/tradeandpromotion/Ireland-Connected_Main-Report.pdf).

<sup>26</sup> DBEI (2017) Building Stronger Business is available from: <https://dbei.gov.ie/en/Publications/Publication-files/Building-Stronger-Business-Responding-to-Brexit-by-competing-innovating-and-trading.pdf>.

<sup>27</sup> Government of Ireland (2018) Project Ireland 2040, available from the following website: <https://www.gov.ie/en/campaigns/09022006-project-ireland-2040/>.

## Project Ireland 2040

In February 2018, the Government published the National Planning Framework (NPF), which, together with the NDP 2018-2027, form 'Project Ireland 2040<sup>28</sup>' - the Government's vision for the development of the country over the coming decades. Project Ireland 2040 will shape Ireland's national, regional and local spatial development in economic, environmental and social terms to 2040.

The NPF identifies the development of "A strong economy supported by enterprise, innovation and skills across the country" (Strategic Outcome 5) as one of the 10 National Strategic Outcomes. To enhance Ireland's ability to create "places" that can foster enterprise and innovation and attract investment and talent, the NDP has earmarked an indicative €9.4bn capital allocation for investment by DBEI and DES.

A portion of this capital allocation will directly fund investment in research and innovation to:

- Strengthen the network of Research Centres and Technology Centres in the regions, including significant investment in Advanced Manufacturing and Tyndall<sup>29</sup>;
- Develop a National Space Technologies Programme, and a robust national High Performance Computing programme;
- Fund membership of International Research Organisations; and
- Establish a Disruptive Technologies Innovation Fund aligned with Ireland's Research Priorities 2018-2023 (with an indicative €180m budget to 2022) to stimulate the development and deployment of disruptive technologies (Details provided in Box 6)

Underpinning this direct investment, HEIs and PROs will also benefit from €3.1bn of public investment in research and education facilities (complemented by €2bn private investment) which will include, among others, a successor to PRTLTI to increase research capacity with additional PhD and MSc enrolment in HEIs in all regions and support for the development of Technological Universities.

Another indicative €9.4bn portion of this capital allocation may also fund research and innovation infrastructures and activities through:

- The Regional Enterprise Development Fund (administered by EI) which supports the implementation of the Regional Action Plan for Jobs;
- The Regional Innovation and Technology Clusters Fund (administered by EI) which supports the development of TUs and IoTs into Technology Poles with the increased linking of SMEs with the TUs and IoTs with national and regional actors.

Further investment in research and innovation has been earmarked under other National Strategic Outcomes of the NDP 2018-2027, most notably:

---

<sup>28</sup> Government of Ireland (2018) Project Ireland 2040, available from the following website: <https://www.gov.ie/en/campaigns/09022006-project-ireland-2040/>

<sup>29</sup> Tyndall National Institute in Cork is a stand-alone Research Institute specialised in Information Communication Technology hardware and systems.

- Strengthening the rural economy and communities (Strategic Outcome 3) through investment in research and innovation facilities by DAFM (with for instance, a €5m National Food Innovation Hub and the replacement of a specialist marine research vessel);
- Enabling the transition to a competitive low-carbon and climate-resilient society (National Strategic Outcome 8) through a €500m Climate Action Fund (administered by DCCAE) to fund initiatives that contribute to the achievement of Ireland’s climate and energy targets in a cost effective manner or offer the potential for innovative interventions in these sectors.

In addition, the €2bn Urban Regeneration and Development Fund (URDF) up to 2027 (administered by DHPLG) for regeneration and rejuvenation of strategic and underutilised areas within Ireland’s five cities, key regional drivers and other large towns (National Strategic Outcome 1) may facilitate the development of research and innovation infrastructures and activities.

#### **Box 4 : Example of Research Infrastructure funding under the NDP 2018-2027**

A new 50 metre research vessel to replace the Marine Institute’s Celtic Voyager was announced in 2018. Currently in design, the vessel will come into service in 2022. With its larger sister vessel, the Celtic Explorer, it will enhance the national capacity to support fisheries and oceanographic research, marine data collection and training. Ireland’s advanced research fleet facilitates international cooperation through initiatives such as the Atlantic Ocean Research Alliance and the recently launched, €9.9m Horizon 2020 EurofleetPlus project, coordinated by the MI.

## **Evolving European Research Policy**

The main developments in European research policy are the forthcoming introduction of Horizon Europe, Horizon 2020’s successor, and the “Open Science” agenda which seeks to increase the dissemination of publicly funded research results.

### **Horizon Europe**

The new framework programme, with a proposed budget of €97.6bn (+27% increase on Horizon 2020) will create new funding opportunities for the Irish research community with a three-pillar approach similar to Horizon 2020:

- The “Excellent Science” pillar will continue to focus on supporting excellent science through the European Research Council, Marie Skłodowska-Curie Actions, and investment in research infrastructures, including e-infrastructures;
- The “Global Challenges and European Industrial Competitiveness” pillar will seek to address global policy challenges and develop enabling and emerging technologies with a number of thematic clusters including
  - Health;

- Culture, creativity and inclusive society;
- Civil Security for Society;
- Digital, Industry and Space;
- Climate, Energy and Mobility;
- Food, Bioeconomy, Natural Resources, Agriculture and Environment.
- The “Innovation Europe” pillar aims to make Europe a front runner in market-creating innovation via the new European Innovation Council and the strengthening of the European Institute of Innovation and Technology (EIT) to foster the integration of business, research, higher education and entrepreneurship.

To support excellence, funding will be aligned with the new InvestEU<sup>30</sup> fund (the €15.2bn fund is designed to eliminate the overlap between the myriad of EU investment schemes such as the ESI Funds<sup>31</sup> and ESFI<sup>32</sup>).

Other proposed research funding programmes include Defence (€4.1bn), Euratom (€2.4bn) for nuclear safety, the Digital Europe programme (€9.2bn) for supercomputing, cybersecurity and artificial intelligence and Connecting Europe (€3bn) for digital infrastructures.

With an increased focus on the translation of research into economic and/or societal impact, with mission-oriented funding, the new programme is expected to increase opportunities for interdisciplinary and multidisciplinary research.

## Open Science

The term Open Science refers to ongoing changes in the way research is conducted, with a move towards increased transparency, collaboration, communication and participation. This includes a set of initiatives designed to transition from the standard practice of publishing research results in scientific publications accessible on a subscription basis to increasing the free flow of information across national and international research communities and embed an open research environment at national and international level. It spans open access to publications and data as well as research infrastructure for hosting and diffusing data. The European Open Science agenda has progressed significantly since I2020 was launched:

---

<sup>30</sup> Details on InvestEU are available from [http://europa.eu/rapid/press-release\\_MEMO-18-4010\\_en.htm](http://europa.eu/rapid/press-release_MEMO-18-4010_en.htm).

<sup>31</sup> The European Structural and Investment funds (ESI funds) is a common designation for the European Regional Development Funds (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF), the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF).

<sup>32</sup> The European Fund for Strategic Investment (EFSI) fund is managed by the European Investment Bank to finance strategic projects supporting innovation, SMEs, infrastructure and climate action.



- Following the introduction of Open Access requirements<sup>33</sup> in Horizon 2020 as a pilot, Horizon Europe will require open access for both publications and data; and
- The adoption of Plan S for Open Access publishing by an international consortium of research funders, including the European Commission, the European Research Council and Science Foundation Ireland in 2018<sup>34</sup>.
- The European Commission together with Member States has advanced plans<sup>35</sup> to develop the European Open Science Cloud (EOSC) as a pan-European federation of existing and emerging excellent e-infrastructures.

The European Open Science agenda has three sets of implications:

- Research funders and research performing organisations have to incentivise the adoption of Open Science research practices with new funding, recruitment and recognition procedures.
- Opportunities to enhance data management skills need to be developed; and
- Member States have to ensure that researchers have access to certified repositories (integrated into the EOSC) as recommended in the May 2018 Competitiveness (Research) Council Conclusions on the European Open Science Cloud (EOSC). They are also recommended to create maps of the national research data infrastructures (with current structures, competences and functions).

---

<sup>33</sup> The Open Access requirements seek to ensure open access (free of charge) to the end-user and in a reusable format to all peer-reviewed scientific publications relating to the result of research and to research data with some opt-out possibilities.

<sup>34</sup> Plan S requires that, from 2020, scientific publications that result from research funded by public grants must be published in compliant Open Access journals or platforms, i.e. they should be immediately accessible and not monetised in any way. More details are available from <https://www.coalition-s.org/>.

<sup>35</sup> The plans are detailed in the European Commission's roadmap for the European Open Science Cloud (EOSC). They were endorsed by Member States in the May 2018 Conclusions of the Competitiveness (Research) Council. The Conclusion are available from <http://data.consilium.europa.eu/doc/document/ST-9029-2018-INIT/en/pdf>

## 4. Assessment of Progress on the Implementation of I2020

At the end of 2018, the status of the 140 actions in I2020 is as follows:

Status on the Implementation of the 140 Actions (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
31	93	8	5	3	3.7.b. 3.14. 4.26. 5.8. 5.11. 7.6.a. b. c.

Overall, the implementation of I2020 is progressing reasonably well: 22% of actions are complete or nearly complete, 65% of actions are progressing or ongoing, 6% of actions (8 actions) are delayed and 2% of actions (three actions) remain to be initiated.

None of the delayed actions have a systemic impact. One of the actions (5.11) is delayed for reasons outside the control of I2020 (details are available in Appendix 2 under Goal 5) and the others are likely to be implemented in the short or medium term.

The overview of progress to date (Appendix 2) and the consultations carried out for this Review suggest a number of key areas to focus on for the remainder of I2020. These actions will now be set out under the following headings:

- Innovation in enterprise;
- Research talent and research infrastructures;
- Innovation for social progress and the economy;
- Participation in European programmes and other collaborations;
- Across-the-system policies; and
- Governance of the Strategy.

### Innovation in Enterprise

The stimulation of innovation in enterprise is one of the key objectives of I2020. The aim is to support long term enterprise growth and diversification and improve productivity and competitiveness through investment in innovation.

The objective is largely pursued through actions contained in Chapter 2 – Innovation in enterprise and Chapter 5 – The role of intellectual property in innovation.

## Progress to Date

Over the first three years of I2020, significant investment has been delivered in disciplines aligned with the National Research Priority Areas (refreshed in 2018). Most notably, SFI invested €100m of State<sup>36</sup> (and European<sup>37</sup>) funding which will be matched by €53m of enterprise funding in 5 additional new Research Centres, bringing the total number of SFI Research Centres to 17.

### Box 5 : New SFI Research Centres

Since the launch of Innovation 2020, Science Foundation Ireland has launched a further five world-leading SFI Research Centres bringing its total portfolio of Research Centres to 17 (the first seven Centres were launched in 2013 and a second wave of five began in 2015). The SFI Research Centres focus on strategically important areas of research for Ireland, linking scientists and engineers in partnerships across academia and industry. The new additions will perform valuable work directly related to the research priority areas, including Food, Manufacturing and Materials, Health and Wellbeing, and Energy, Climate Action and Sustainability.

- Confirm – launched 16 May 2018
- I-Form – launched 24 September 2018
- VistaMilk<sup>38</sup> – launched 12 October 2018
- Beacon – launched 19 October 2018
- FutureNeuro - launched 19 November 2018

These developments form part of delivering Project 2040 and Innovation 2020 which aims for 20 SFI Research Centres to be supported in key strategic areas of the economy. SFI Research Centres are based in HEIs with the exception of VistaMilk which is hosted by Teagasc.

Following the Review of Innovation Supports for Enterprise<sup>39</sup>, legislation is being progressed through the Brexit Omnibus Bill<sup>40</sup> to enhance and expand the EI R&D offerings to business. EI has increased overall funding and introduced new supports (e.g. the new Agile innovation fund) and tailored them to the needs of SMEs. Research funders (e.g. SFI, EI, IRC, SEAI, MI and HRB) also reviewed their enterprise funding to stimulate collaborations between enterprise and research performing organisations or enable the

---

<sup>36</sup> €95m of DBEI funding and €5m of DAFM funding.

<sup>37</sup> A portion of the €100m is expected to be reimbursed by the European Regional Development Fund.

<sup>38</sup> VistaMilk is co-funded by DAFM with €5m of DAFM funding.

<sup>39</sup> Indecon Review of Innovation Supports for Enterprises – available from <https://dbei.gov.ie/en/Publications/Review-of-RDI-Supports-to-Maximise-Business-Expenditure-on-RD.html>

<sup>40</sup> The General Scheme of the Miscellaneous Provisions (Withdrawal of the United Kingdom from the European Union on 29 March 2019) Bill 2019

development of test beds and funding under the first call of the Disruptive Technologies Innovation Fund was allocated (details in Box 6). At the same time, the Knowledge Development Box (a tax incentive) was introduced to encourage the development of Intellectual Property from research conducted in Ireland.

#### **Box 6 - The Disruptive Technologies Innovation Fund (DTIF)**

The DTIF was launched as part of Project Ireland 2040 and the National Development Plan, with a resource allocation of €500 million over the period 2018-2027 consisting of an initial Exchequer allocation of €180 million to 2022. As a first tranche, €20 million will be allocated during 2019.

Informed by the Research Priority areas, the Fund is competitive and is seeking investment in the research, development and deployment of disruptive technologies and applications on a commercial basis. It will drive collaboration between Ireland's world-class research base and industry as well as facilitating enterprises to compete directly for funding in support of the development and adoption of these technologies.

The first call attracted 300 applications, demonstrating that there is a significant appetite for funding of this kind. 27 projects have been announced from the first tranche of funding, worth €75m to 2021. All projects include collaborations between start-ups, SMEs, multinationals and academic institutions. Every project involves at least one SME, and many are led by an SME.

To facilitate enterprise engagement with the public research system, the knowledge transfer system has been enhanced with a revised IP protocol and Knowledge Transfer Offices established in all universities, four IoTs and Teagasc through the Third Technology Transfer Strengthening Initiative funded by EI. In tandem, EI introduced pilot IP grants to increase the protection and exploitation of IP by Irish enterprises.

During the consultations, the vast majority of stakeholders acknowledged and valued the contribution of the strategy to Ireland's long term economic prosperity. The support provided by KTI and the Knowledge Transfer Offices to increase collaborations between enterprise and the public research system was commented on positively. Some stakeholders raised concerns about the ability to increase research on Services and Business Process (Action 2.2. a) in the absence of recruitment of "Star" researchers in HEIs in this area. This recruitment remains contingent on increased funding. Other stakeholders suggested that limited funding for research infrastructure will have an impact on the HEI's and PRO's ability to engage in research collaborations with enterprise.

In terms of impact, investment in R&D measured by BERD has increased significantly but it continues to lag behind GNP growth. Overall, data on innovation in enterprise (available in Appendix 3) shows that

- The number of large enterprise R&D performers<sup>41</sup> exceeds the target with 207 large R&D innovators (the target was 200);
- The number of significant enterprise R&D performers<sup>42</sup> decreased from 1040 to 918.
- There has been a 10.2% increase in research personnel numbers between 2013 and 2017 to 27,322 out of a target of 40,000 by 2020.

In addition to the increasing uncertainty associated with Brexit, two factors explain this mixed result: the significant time lag between policy changes (e.g. increase in enterprise supports) and its impact on enterprise investment decisions and secondly, the limited absorptive capacity of many Irish SMEs.

The data suggest that:

- The ambitious target of 73% of innovation active enterprises (the highest rate of innovation active enterprise in Europe is in Germany where just over 67% of German enterprises are innovation active) is unlikely to be met by 2020; and
- The objective of increasing innovation across Ireland's enterprise based by increasing both the number of R&D performers and the R&D research intensity for those who already innovate remains relevant.

Progress on the commercialisation targets (available in Appendix 3) are encouraging: the number of commercially relevant technologies (Licences, options and assignments), the number of HPSU from spin-outs, and the number of collaborations by EI supported enterprise are expected to exceed targets. The number of spin-outs declined from 29 to 21 but, according to KTI, this decline is compensated for by an increase in the quality of the spin-outs<sup>43</sup> as suggested by the increase in the number of spin-outs taken forward as HPSUs by EI. Also, a number of start-ups are created independently from the Research Performing Organisations. This commercialisation record is reflected in Ireland's strong performance in some of the EIS components (e.g. Innovation in SMEs).

## Review Findings

To date, I2020 has been instrumental in encouraging collaborations between public research performing organisations and enterprise, as well as in supporting the commercialisation of research. Research and innovation policy plays a significant role in the Future Jobs Ireland agenda with the objective of further strengthening enterprise competitiveness and productivity. In this context, increasing enterprise capacity to innovate, especially in the indigenous sector, should remain a key priority for the remainder of the strategy and beyond.

---

<sup>41</sup> CSO (2019) BERD 2017-2018 - Large enterprise R&D performers invested over €2m

<sup>42</sup> CSO (2019) BERD 2017-2018 - Significant enterprise R&D performers invested between €100k and €2m

<sup>43</sup> KTI (2018) KTI Review and Annual Knowledge Transfer Survey 2017.

The Indecon Review of Innovation Supports for Enterprises<sup>44</sup> found that large firms, mostly foreign-owned (90%), account for the majority of R&D expenditure and that three-quarters of all R&D expenditure by Irish firms is carried out by SMEs, reflecting the dual structure of Irish enterprise base. As suggested by the Indecon Review, increasing enterprise capacity to innovate involves both growing the number of R&D performers and increasing the R&D intensity for those who already innovate. In addition to the ongoing fine-tuning of innovation supports, further recommendations are expected from the forthcoming OECD led Review of SME and Entrepreneurship Policy.

The announced NDP 2018-2027 funding for the development of the Technology and Innovation Clusters associated with the TUs and the IoTs should offer new opportunities to develop collaborations between enterprise and HEIs and the stimulation of innovation in enterprise. The funding criteria will require specific attention to ensure they enhance research and innovation capacity and capability in the TUs and IoTs and their regional enterprise base.

The approach to public research for services and business process needs to be reviewed pending the recruitment of “Star” researchers by the HEIs in this area (action 2.2.a). The approach to interdisciplinary research (action 2.8) also needs to be reviewed to develop further capacity in the area.

## Research Talent

I2020 recognises that the excellence and impact of Ireland’s research system is underpinned by its ability to develop and attract research talent. The development of the research talent pipeline is mostly pursued through Chapter 3 – Education for Innovation.

### Progress to Date

Progress on increasing the recruitment of **research talent** is recent. The 2017/18 new enrolment numbers for postgraduate students (Research Masters and PhDs) show a small increase compared to the 2013/2014 baseline<sup>45</sup>. This increase is attributable to programmes such as the IRC’s additional funding for postgraduate scholarships and the HRB’s new Collaborative Doctoral Awards and PhD Scholars programme for clinicians<sup>46</sup>.

Progress is expected in 2018/19 with:

- The funding of additional PhDs students with DAFM increased research programme funding; and

---

<sup>44</sup> Indecon (2017) Review of Innovation Supports for Enterprises – available from <https://dbei.gov.ie/en/Publications/Review-of-RDI-Supports-to-Maximise-Business-Expenditure-on-RD.html>.

<sup>45</sup> First year enrolment in STEM related subjects were: 2235 in 2013/14, 2328 in 2014/15. 2318 in 2015/16, 2201 in 2016/17 and 2,243 in 2017/18.

<sup>46</sup> PhD Scholars programme for Clinicians (ICAT) is co-funded with the Wellcome Trust

- SFI committed €23.7m in funding for the period 2018-2022 for the direct recruitment of 110 postgraduates (94 PhDs and 16 MScs) with €5.5m spent in 2018.

Further increases in enrolment are expected in 2019: with an additional €15m allocated, SFI will commence recruitment in the new Centres for Research Training.

### **Box 7: The new SFI Centres for Research Training**

The New SFI Centres for Research Training initiative will provide training for an additional 700 (in 6 cohorts) postgraduate students (with approximately 20% of these funded from other sources such as industry, universities or charitable organisations) in areas of nationally and internationally identified future skills needs of digital, data and ICT. SFI will directly fund 560 of these PhDs. In total, the CRTs will involve an investment of over €100m between 2019 and 2024 (including the €5.5m for recruitment in 2018).

These recent developments will augment the number of early career researchers (Masters, PhDs and post doctorates) already funded through research programme funding (and other instruments).

While stakeholders welcomed these developments, some also expressed the following concerns:

- The risk that a two-tier system for PhD training could emerge with the establishment of the CRTs for research areas funded by SFI;
- The balance of funding between frontier and applied research;
- The limited capacity of HEIs to enrol PhDs due to the small pool of Research Master students and/or the limited availability of PhD supervisors, particularly in the IoTs where staff teaching commitments limit their capacity to engage in research activity and PhD supervision.

The number of post-doctoral researchers (Action 3.6) is increasing through the roll-out of new and existing Principal Investigator-led research awards, including the Irish Research Council Laureate Awards and the HRB Emerging Investigator awards. Progress on the Early- or Mid- Career award for independent researchers (Action 3.7.a) took place in 2018 with 20 awards funded under the flagship Starting Investigator Research Grant (SIRG) Programme. SFI anticipates launching a new programme in 2019: Frontier for the Future to replace both the SFI investigators programmes and the SFI Career Development Award Programme. These award schemes contribute to the development of a broad-based research capacity in the system and to catalyse future success in ERC grant schemes and other significant funding opportunities.

## Box 8: New Principal Investigator-Led Research Awards

**The HRB Emerging Investigator Awards** (€8.3m in first round targeted at academia) and **Emerging Clinical Scientists Awards** (€5m in first round targeted at healthcare practitioners) are aimed at enabling excellent early-career researchers to establish themselves as independent Principal Investigators. These awards have emerged from a new HRB Research Career Pathway for healthcare practitioners to complement the already existing awards for health researchers in academia.

**The IRC Laureate Awards** were launched in 2017 to fund frontier research across all disciplines. The awards underpin and support innovation, promoting diversity and strength in the research base. The objective is to promote the development of new ideas and new thinking, engaging leading researchers from both AHSS and STEM, to generate innovative solutions and new ways of approaching complex problems. 36 awards for early and mid-career researchers (€18m) were allocated in 2018 and another 12 awards for Advanced Career stage (€30m) was announced in April 2019 following a 2018 call. The first full cycle of Laureate Awards (Starting, Consolidator, Advanced) will result in the creation of 73 postgraduate and related positions, and 52 post-doctoral research posts in frontier research.

With regards to research leaders, the recruitment of additional world-leading research professors and future research leaders (action 3.9) is underway: in 2018, SFI appointed 4 Future Research Leaders and 3 Research Professorships and more are expected in 2019. The HRB is also expecting to make new Research Leaders Awards<sup>47</sup>.

While many, in the course of the consultations, welcomed the recent positive developments in relation to the CRTs and the IRC Laureate awards, they also noted that the IRC Laureate awards need to be funded on an ongoing basis. Programmes such as these support Ireland's goal of attracting and retaining a renowned pool of research talent, particularly in light of strong international competition.

Welcoming the forthcoming National Policy for Research Careers, a small number of stakeholders commented that the framework should facilitate the recruitment of researchers with industry experience. They also remarked that uptake will depend on research funders adapting their award criteria to reflect the potential contribution of these researchers (despite their potentially reduced publication records) and that HEI and PRO's ability to attract and retain researchers with relevant experience.

---

<sup>47</sup> The planned investment is €7.5m over the next 5 years.



## Review Findings

Meeting the I2020 targets in terms of research talent will require substantial investment. Considerable indicative funding has been identified under the NDP 2018-2027 to deliver on a range of Strategic Investment Priorities over the ten-year programme which include research infrastructures and a new cycle of PRTLTI which is to be welcomed.

In the short-term, the review suggests that the focus should be on progressing further towards the 500 additional new postgraduate enrolments set out in I2020 (Action 3.5) building on the six new SFI Centres for Research Training (€100m investment in total) and the HRB's PhD Scholars Programmes<sup>48</sup>.

The discipline mix should be informed by both the refreshed Research Priority Areas and the need to build capacity in a broad range of disciplines, including humanities and social sciences which are also relevant to economic and/or societal impact.

Developing the talent pipeline through a 30% target increase in the number of post-doctoral places (Action 3.6) and the doubling of Early to Mid-career independent researcher positions (Action 3.7) should also be considered a priority to develop the next generation of Principal Investigators. While there is a long term commitment to the allocation of future funding for the IRC's Frontier Research (Laureate) awards and the commitment of additional resources to Early- and Mid-career programmes (such as SFI's Starting Investigators Research Grant (SIRG) and SFI's Frontiers for the Future Programme), the commitment of additional budgetary resources to the respective agencies would enable these awards to be made annually.

The review stresses the critical nature of the forthcoming National Policy for Research Careers to encourage mobility to and from enterprise. This will not only impact on enterprise's ability to recruit research talent and research support talent in line with technological developments. It will also ensure that HEIs and PROs can recruit research talent with relevant industry experience to enhance the quality and relevance of graduate and postgraduate programmes.

## Research Infrastructure

Complementing investment in people, I2020 recognised the need for strategic investment in research infrastructure. This objective is pursued through Chapter 3 – Education for Innovation and Chapter 4 – Innovation for social progress and the economy.

## Progress to Date

I2020 provides for the strategic development of research infrastructures with the development of a successor to PRTLTI to support investment in research infrastructure in the wider research base and to allow for the maintenance and upgrading of existing

---

<sup>48</sup> ICAT, SPHeRE (Structured Population & Health-Services Research Education) and CDA (Collaborative Doctoral Awards in Patient-focused Research)

facilities and equipment (action 3.16 a). Funding of future PRTL cycles is referenced in the NDP 2018-2027 under National Strategic Objective 5.

In addition to the investment funded by the DES through the HEA's recurrent Core Grant to HEIs, a number of investments in new research infrastructures (equipment) have taken place within HEIs and PROs between 2016 and 2018:

- €80.4m allocated by SFI following its 2016 and 2018 Research Infrastructure Calls;
- €15m allocated by the HRB in 2017<sup>49</sup>;
- €2m allocated by the Marine Institute<sup>50</sup>;
- €1.5m allocated by GSI<sup>51</sup>.

Significant investment is also taking in research facilities between 2016 and 2018:

- The 5 new SFI Research Centres located with the HEIs and Teagasc;
- The SFI Centres for Research Training located within the HEIs;
- The DAFM investment in Moorepark Technology Limited and the Prepared Consumer Foods Research Centre
- The HRB investment in clinical research infrastructure.

Many stakeholders across-the-system raised concerns about the funding of research infrastructure. They underlined the importance of investing in research infrastructure to sustain the capacity of the RDI system into the future. They commented on the need to:

- Support the full breadth of research areas as well as libraries and e-infrastructures and doctoral training;
- Fund hard and soft infrastructures (staff to operate and maintain infrastructures as well as train users); and
- Provide funding throughout the infrastructure lifecycle (establishment, operation, maintenance and upgrading).

Some stakeholders also suggested that the lack of funding may negatively impact on the HEI's and PROs' ability to leverage European funding (e.g. H2020 infrastructure funding).

Importantly, DES announced funding in the context of Budget 2018 and 2019 to address the need for physical space for research in the higher education sector. This included:

- Budget 2018 announcements of €200m for public private partnerships in the Institute of Technology sector and €257m for investment in the higher education sector generally, including for research.

---

<sup>49</sup> In 2017, the HRB approved a second phase of funding of over €15m (including €3.6m co-funding from Wellcome Trust) with additional matched funding of over €3m leveraged from host institutions and other partners. They will fund Clinical Research Facilities in HEIs in Dublin, Cork and Galway.

<sup>50</sup> In 2017, the Marine Institute awarded €2m infrastructure funding to HEIs, Public Research Organisations and SMEs.

<sup>51</sup> In 2017 and 2018, GSI awarded closed to €1.5m infrastructure funding to HEIs.

- Budget 2019 then saw announcements of €57 million to be invested in higher education initiatives in 2019 along with capital investment of €150 million being allocated to the higher education, further education and training and research sectors.

## Review Findings

The review stresses the need to examine a strategic approach to research infrastructure as provided for in Action 3.16. In order to develop this strategic approach, we need to fully understand the current level of investment in research infrastructure, the current funding mechanisms and assess the needs of the RDI system. Such an approach would address some of the recommendations made by the European Commission and ESFRI<sup>52</sup> with regards to the development of research infrastructures in Member States<sup>53</sup>. It would be critical to avoid duplication (and gaps in funding) and ensure coherent development of the research and innovation eco-system. It is also needed to enable effective coordination between national funding streams and European funding, including e-infrastructures for Open Science. This approach would facilitate the implementation of the Competitiveness (Research) Council's recommendation<sup>54</sup> with regard to the creation of a map of national research data infrastructures.

## Innovation for Social Progress and the Economy

The translation of publicly funded research and innovation into economic and/or societal impact is one of the key objectives of I2020. It is mostly, but not exclusively, pursued through Chapter 4 – Innovation for social progress and the economy.

### Progress to Date

The first three years of I2020 have seen a large number of initiatives focused on increasing the economic and/or societal impact of publicly funded research with the development, among others, of:

- Research capability within Government Departments;
- Research funding (or co-funding) streams, including co-funding with H2020's societal challenges for policy relevant research issues;
- Challenged-based public procurement to stimulate innovation;

---

<sup>52</sup> European Strategy Forum on Research Infrastructures

<sup>53</sup> The recommendations comprise the development of: 1) A taxonomy of RIs and relevant research and education facilities, an understanding of their reach (regional, national, European or international) and their life cycle (establishment, operation, maintenance); 2) The identification of funding allocation models (e.g. direct allocation, competitive funding for research and innovation, user charge) and funding sources (specific funds, Departments allocation, research funders); 3) The development of prioritisation criteria for the RI roadmap, including the relevance in terms of National Research Priorities Areas; and 4) An agreed mechanisms to develop the roadmap and updating it.

<sup>54</sup> May 2018 Conclusions of the Competitiveness Council (Research). Are available from <http://data.consilium.europa.eu/doc/document/ST-9029-2018-INIT/en/pdf>.

- New research infrastructures and incubation facilities to increase the translation of research into innovation.

### **Box 9: Examples of New Infrastructures Increasing the Translation of Research Into Economic and/or Societal benefits**

**HRB Clinical Research Coordination Ireland:** The HRB-CRCI is co-funded by HRB, EI and the six Schools of Medicine (via MMI/CRDI). The primary objectives are: to provide a coordination, sign-posting and feasibility assessment service for industry, to maximise the potential for Irish sites to be selected for multicentre clinical studies; and to enhance standards by harmonising processes, guidelines, checklists etc across Ireland.

**Upgrade and Expansion of Moorepark Technology Limited (MTL):** Teagasc is completing a €10m strategic investment to modernise layout, future-proof capabilities and upgrade to the latest processing technologies in its dairy-based pilot plant. The facility offers pre-commercial scale processing facilities to support innovation in dairy manufacturing, nutritional and other food & beverage related sectors. The unique model operated by MTL facilitates the linking of public research to industry whereby customers can interact directly MTL or through partnership with the technical and analytical expertise available at the Teagasc Food Research Centre at Moorepark. The investment will facilitate the expansion of indigenous Irish dairy companies and many food & beverage (including infant formula) multinationals.

**The National Bioeconomy Campus:** The Irish Bioeconomy Foundation (IBF) is developing the National Bioeconomy Campus at Lisheen, Co. Tipperary with a view to producing high value bio-based chemicals from domestically available low value biomass residues. This National Bioeconomy Campus will be a model for rural economic development advancing industrial development, through collaboration between industries and between industry and research performing organisations.

**The Health Innovation Hub Ireland (HIHI):** HIHI is a joint initiative of the DBEI and the DoH, supported by EI, Health Service Executive (HSE) and academic partners including University College Cork (UCC), Cork Institute of Technology (CIT), National University of Ireland, Galway (NUIG) and Trinity College Dublin (TCD). It provides a forum for a wide variety of stakeholders working together with the aim of driving collaboration between the health service and the enterprise sector and the development and commercialisation of new healthcare technologies, products and services emerging from within the health service, and/or the enterprise sector. The HIHI acts as a broker between innovative companies and the health service, facilitating pilot and clinical validation studies that support Irish companies going to market leading to exports, jobs and better outcomes for patients. It also functions as an open door to healthcare staff to assess ideas to solutions they have encountered in their work and has commenced the roll out of a suite of Innovation Workshops for healthcare staff and will be launching a Diploma in Healthcare Innovation with TCD in September.

Stakeholders commented positively on the implementation of Chapter 4 actions, their contribution to increasing research and innovation capacity and impact (economic and/or societal). They noted the contribution of sectoral or thematic strategies to the delivery of I2020. Some stakeholders suggested that:

- In some research areas, input from policy makers into funders' research agenda can be difficult to obtain and research results are insufficiently disseminated or utilised;
- Use of procurement to both enhance service delivery and stimulate enterprise innovation could be more systematic;

## Review Findings

In addition to development of sectoral policies, the implementation and/or development of research strategies will contribute to increasing societal and economic impact, including:

- The forthcoming Health Information Policy and an R&D Strategy for the Health Sector as provided by Sláintecare<sup>55</sup>;
- The bioeconomy policy implementation process supported by the Bioeconomy Implementation Group co-chaired by DAFM and DCCAE;
- The FOOD 2030 Policy Lab developed by DAFM and EI<sup>56</sup>; and
- The research strategy for the defence sector.

To achieve the full economic and social impact of this research further attention on developing pathways between research and innovation and policy making/delivery is required. Instruments to promote interdisciplinary research are also important in this regard.

To address global and societal challenges (action 4.3), including those associated with the UN Sustainable Development Goals and climate action, consideration should be given to providing mission-oriented funding. Consideration should also be given to aligning the funding with Horizon 2020 and Horizon Europe.

## European and International Collaborations

Chapter 5 – Innovating with the EU and the wider world identifies actions designed to influence European research programmes and encourage participation in European and international research collaboration programmes.

---

<sup>55</sup> The Government's ten-year programme to transform our health and social care services

<sup>56</sup> FOOD Lab 2030 is the national research, innovation and investment policy in response to the EU Commission FOOD 2030 Policy framework on Food and Nutrition Security agenda. Details are available from: <https://fit4food2030.eu/call-for-countries-to-run-a-fit4food-2030-policy-lab-for-food-system-transformation/>

## Progress to Date

Ireland's participation in Horizon 2020 is strong, with Ireland accessing more than its "juste retour" (further details are provided in Chapter 2). This performance was welcomed by stakeholders with some suggesting that this success was enabled, prior to the economic recession, by significant investment in HEIs through the HEI core grant and PRTL. Changes in the funding landscape are expected in the short and medium term which will create new funding opportunities at European level:

- In the short term, an EIB Report<sup>57</sup> evaluating new funding models and identifying additional sources of finance is expected shortly; it will enable greater use of EFSI funding and InvestEU – its successor.
- In the medium term, successors to European programmes will be introduced (DBEI is taking an active role in the negotiation of Horizon 2020's successor – Horizon Europe).

In response to Brexit, SFI has appropriate recruitment schemes to facilitate researchers to relocate their research operations to Irish universities with the following options: co-location to Ireland and the UK, joint-professorship appointment or re-locating all or part of the operation to Ireland.

Since 2016 Ireland, through considerable agency supports, has increased its membership of international organisations (Action 6.12, 6.13 and 6.14) and are now members of ELIXIR and the European Southern Observatory (ESO). Discussions regarding potential membership of CERN commenced in 2016 and remain ongoing. In addition, membership to LOFAR (Low Frequency Array telescope), ECRIN (European Clinical Research Infrastructure Network) and a number of ERICs (European Research Infrastructure Consortia) have been secured.

## Review Findings

Ireland's strong performance in Horizon 2020 reflects positively on the excellence of the Irish research community and Horizon 2020 support structures. To continue maximising access to European funding and develop future European research policy, the Horizon 2020 support structures (i.e. the network of National Contact Points and the Programme Committees) will need to be reviewed to reflect the priorities of Horizon Europe.

As membership of international research organisations is recent, the scope or timing of the formal review of membership to international research organisations (action 6.15) planned for 2020 could be reviewed.

Depending on the UK's participation in Horizon Europe post-Brexit, funding for bilateral research programmes may need to be reviewed to ensure that the fruitful collaborations between the Irish research community and its counterparts based in the UK can continue. The newly established UK-Ireland Research Funders Forum established by the IRC, SFI and UK Research and Innovation will support this endeavour.

---

<sup>57</sup> The European Investment Bank (EIB) is the long-term lending institution of the EU. It funds investment that contribute towards EU policy goals.

## System-wide Policies

Several of the actions in I2020 provide for the development of new system-wide policies or initiatives.

### Progress to Date

Good progress has been made with regards to the development and implementation of across-the-system issues including: human resources policy and practices (e.g. gender equality, doctoral training education, a Research Career Development and Employment Framework), technology transfer, Research Integrity (including a process for research integrity investigations), and Open Research (which corresponds to Open Science in Ireland).

There have been significant European developments in the area of Open Science over the period under review which have resonated at a national level and impacted on the timing and scope of Action 4.7 relating to Open Access policies and actions 7.6.a, b and c relating to the research information system. There has been good progress in relation to Open Science: most significantly, the National Open Research Forum is developing a position paper on the Transition to an Open Research Environment for consideration by the I2020 Implementation Group. Some research funders have already incorporated Open Access requirements for publications and data while others are examining the introduction of Open Access requirements. The HRB also launched HRB Open Research publishing platform<sup>58</sup>. A significant number of stakeholders commented that responding to the Open Science requirements by the EU will require substantial investment in infrastructure and training and the impact will differ across different disciplines.

Many stakeholders commented that the system-wide approach to policy developments and initiatives have brought coherence to the system and that such an approach could work well in other policy areas, including doctoral education.

### Review Findings

The Research Integrity Forum and the National Open Research Forum provide examples of effective cross-system policy development. Comprising of representatives of research performing organisations and selected experts, the Fora have developed or are developing system-wide policies.

The fast pace of developments on the Open Research agenda remains a challenge for policy makers, research funders and research performers. Increased investment in e-infrastructures and training, as well as investment in information and management systems provided for in Action 4.7 (linked to action 7.6.a.b. and c) will be critical to support the changes in research practices associated with the Open Research Agenda.

---

<sup>58</sup> [The Open publishing platform allows for the linking of data and open peer review.](#)

Finally, the need for dedicated resources to support the implementation of Open Research and Research Integrity policies needs to be addressed.

## **Governance of the Strategy**

Chapter 7 – Innovation Implementation describes the governance arrangements for I2020.

### **Progress to Date**

The Implementation Group is comprised of representatives of the Interdepartmental Committee on STI<sup>59</sup> and the funders groups (it was initially envisaged in I2020 that the successor to the IDC would drive and track the implementation of the strategy while the group including the IDC members and the funders would focus on the implementation of different strands of the strategy). The Implementation Group chaired by DBEI meets three or four times a year and reports on progress to Cabinet on a yearly basis. Key stakeholders from across the research, development and innovation system are regularly invited to provide inputs and updates on proposed policy developments. The Horizon 2020 High Level Group which deals with participation in Horizon 2020 also meets regularly. In addition, as stated above, the Research Integrity Forum and the National Open Research Forum operate as quasi working groups of the Implementation Group.

### **Review Findings**

Based on the consultations carried out for this Review, it can be concluded that the Implementation Group is an effective forum for implementation oversight and information exchange. It also helps to maintain the momentum for the implementation of I2020 through annual reporting to Cabinet.

The Review identifies a number of additional system-wide initiatives to address key issues for the implementation of I2020:

- The need to coordinate across the system to increase the research talent which includes postgraduate students, Early and Mid-career researchers and “Star” researchers and address any emerging challenges relating to mobility to and from enterprise and changes in research career attractiveness; and
- The need to develop a better understanding of the current level of investment in research infrastructure and the current funding mechanisms to enhance the approach to research infrastructures in line with action 3.16.

The timing of the ex-post evaluation of Innovation 2020 provided for in Action 7.5.b may need to be reviewed to allow relevant impact data to become available.

---

<sup>59</sup> Science, Technology and Innovation (the list is available in Appendix 1 of I2020)



## 5. Conclusion

### Investment in R&D

Key to Ireland becoming a Global Innovation Leader was a commitment to increase public and private investment to reach a research intensity of 2.5% of GNP by 2020. The data show that:

- Gross Expenditure in Research and Development (GERD), that is public and private expenditure, as published in the R&D Budget 2017-2018, increased significantly from €2.969bn in 2014 (the baseline in I2020) to €3.396bn in 2017, an increase of 14.4%<sup>60</sup>.
- Business Expenditure in R&D (BERD) increased by 31.5% between 2014 and 2017<sup>61</sup> as per the CSO BERD Survey 2017-18 released in April 2019;
- Government Budget Allocations for R&D (GBARD) increased by 1.7% between 2014 and 2017 (3.4% between 2014 and 2018 based on budget estimates);
- GNP grew by 43.3% between 2014 and 2017.

The growth in GERD between 2014 (the baseline year in I2020) and 2017 is to be welcomed. However, it did not keep pace with the strong GNP growth (43.3% over the same period) linked to Ireland's economic recovery. As a result, Ireland's research intensity rate expressed as a percentage of GNP declined from 1.81% of GNP in 2014 to 1.46% in 2017 (based on R&D Budget 2017-2018<sup>62</sup>). GERD will be revised later in 2019 once all data are collected and published. The significant increase in BERD in 2017 as outlined in the CSO BERD Survey 2017-18 is expected to have a positive impact on GERD.

Overall, Ireland's RDI system continues to perform strongly. Participation in Horizon 2020 is on course to meet the €1.25bn target. Furthermore, the 2018 European Innovation Scoreboard (EIS) shows that Ireland's position in terms of innovation leadership has progressed: Ireland was in 9th position in 2017<sup>63</sup> gaining one place on the 2015 EIS (which corresponds to the 2014 baseline). Ireland remains a Strong Innovator but has not yet reached its goal to become an Innovation Leader.

---

<sup>60</sup> GERD was computed in the R&D Budget 2017-2018 does not reflect the revised BERD data for 2017 published by the CSO in April 2019

<sup>61</sup> Based on the CSO (2019) BERD Survey 2017-2018, BERD data for 2017 was revised and it increased by 31.5% between 2014 and 2017. available from: <https://www.cso.ie/en/releasesandpublications/er/berd/businessexpenditureonresearchdevelopment2017-2018/>

<sup>62</sup> The R&D Budget 2017-2018 does not reflect the revised BERD data for 2017 published by the CSO in April 2019

<sup>63</sup> The 2018 European Innovation Scoreboard uses 2017 data.

During the consultations, a consensus emerged that increased investment to further develop research talent and research infrastructure is essential if the full potential of I2020 is to be realised. In the absence of increased investment, the future ability of Ireland's RDI system to produce excellent and impactful research, to provide the research talent required by public and private research performing organisations, and to participate in European programmes, may be undermined. The 2018 Country Report provided to the European Council<sup>64</sup> supported this concern when it was stated that: "the low level of [public] investment will make it difficult for Ireland to reach its R&D research intensity target of 2.5% of GNP by 2020 and if unreversed, this can have long-lasting negative effects".

This Review concludes that becoming a Global Innovation Leader and reaching a research intensity rate of 2.5% of GNP within the timeframe set will be challenging for two reasons:

- The limited increase in public investment in RDI (measured by GBARD) to date will make it difficult to deliver fully on the actions that require significant levels of public investment;
- The leveraging effect of public investment in RDI on private investment (measured by BERD), in particular by Irish-owned firms, is slower than envisaged in I2020. Leveraging private investment remains critical however for the Future Jobs Ireland agenda. Intensifying innovation is essential to support long term growth and diversification of Ireland's enterprise base and to improve productivity and competitiveness.

To progress further towards the realisation of the vision of I2020, investment in National Research Priority Areas must continue for the remainder of I2020. Investment across the eco-system is also required to build and sustain capacity within the public research system that can leverage private and international investment and develop Ireland's skills base, including the skills to educate the next generation of talent. As noted in Innovation 2020, Innovation Leaders have a balanced innovation ecosystem with a high level of public investment that delivers high overall economic and/or social impact. To maximise the effectiveness of investment in the future, the Implementation Group could examine ways to:

- Better understand the current level of investment in research infrastructure and the current funding mechanisms in order to assess the needs of the RDI system.
- Adopt an enhanced coordinated approach to progress the 500 additional postgraduate enrolments and other actions to strengthen Ireland's research talent pool.

## Further Facilitating the Implementation of I2020

Policy developments since 2015 have reaffirmed the relevance of I2020's objectives, in particular the objective of increasing innovation across Ireland's enterprise base by increasing both the number of R&D performers and the R&D intensity for those who

---

<sup>64</sup>SWD (2018) 206 final. Commission Staff Working Document (2018). "Country Report: Ireland" available from: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0206&from=GA>.

already innovate, as well as increasing recognition of the societal importance of research. The resilience of Ireland's economy will depend on broadening the cohort of firms for whom innovation is a core activity and our ability to develop the talent – at all levels in higher education: undergraduate, postgraduate and researcher – required to meet future skills needs.

The announcements of funding for the Technology and Innovation Clusters associated with the TUs and the IoTs and the DTIF in the NDP 2018-2027 will support this objective.

The Review also identifies areas to further enhance economic and/or social impact:

- Research in services and business processes including the appointment of “Star” researchers within the HEIs could be reviewed;
- Interdisciplinary research could to be encouraged further to deliver economic and/or societal impact (and with it, participation in European programmes);
- Coordination between research and innovation performers and policy makers could be explored further; and
- Further mission-oriented funding to address societal challenges, most notably challenges associated with the pursuit of the UN Sustainable Goals<sup>65</sup>, should be considered with some alignment of this funding with EU Research programmes could be considered.

The Review also identifies possible changes to support or enhance the implementation of the strategy:

- If, post-BREXIT, the UK does not participate in Horizon Europe, bilateral research programmes with the UK could be increased both East-West and North-South;
- The Horizon 2020 support structures (in a broad sense - the network of National Contact Points and the Programme Committees) could be reviewed to reflect the priorities of Horizon Europe and the development of mission-oriented funding which implies an increase in interdisciplinary research;
- The scope and timing of the review of membership to International Research Organisations could be reviewed; and
- The timing of the ex-post evaluation of Innovation 2020 provided for in Action 7.5.b could be reconsidered to ensure that the relevant impact data are available for the evaluation.

Finally, the Review found that the goals of I2020 remain relevant and pertinent for its successor. More needs to be done to ensure that public investment in R&D translates into economic and/or societal impact, including the development of research talent within both HEIs and PROs and enterprise to allow for the development of Ireland's skills base. The

---

<sup>65</sup> This approach is already adopted by DAFM in its 2019 Research Call.

challenge for the successor of I2020 will be to mobilise further public and private resources to strengthen and expand research talent and research infrastructures.

## Appendix 1 - Terms of Reference for the Mid-term Review of I2020

Innovation 2020 (I2020) is Ireland's strategy for research and development, science and technology for the period 2016-2020. The vision for the Strategy is for Ireland to be a Global Innovation Leader, driving a strong sustainable economy and better society. Reflecting the cross-Government approach of innovation policy, oversight of the Strategy rests with the Cabinet Committee and the Innovation 2020 Implementation Group (I2020 IG) – the interdepartmental group responsible for the implementation of the Strategy's 140 actions (including headline actions and sub-actions).

The Strategy provides that I2020 IG will lead a mid-term evaluation of this strategy so that "relevant adjustments can be made in a timely manner to ensure successful delivery on the vision and objectives" (action 7.5). The underlying objective of the mid-term review is to ensure that the Strategy adapts to changing circumstances and continues to deliver the vision and objectives for Ireland's research and innovation eco-system.

The Review will be carried out by DBEI on behalf of the I2020 IG.

### The Objectives

The Review will inform the 2019 and 2020 workplans for the I2020 IG. The review will:

- Assess progress in achieving the targets set out in I2020;
- Assess progress in the implementation of the Strategy based on the I2020 Progress Reports for 2016, 2017 and 2018;
- Identify any changes in the national and international policy environment that impact on the objectives of I2020 and the delivery of the actions; and
- Review the actions as necessary to ensure that they continue to be aligned with the overall vision and objectives of the Strategy.

### Methodology:

The Review will include the following tasks:

- Assessment of progress against I2020 targets and other relevant benchmarks,
- Review of progress reports for 2016, 2017 and 2018,
- Identification of significant policy developments at national and EU levels,
- Consultation with the members of I2020 IG, and
- Online public consultation based on a Call for Submissions.

## Appendix 2 - Overview of Progress to Date

This overview of progress to date is based on the information provided in the Call for Submissions<sup>66</sup>. The information was updated when a delayed action was completed between July 2018 and December 2018.

### Goal 1: Ireland as a Global Innovation Leader

The five actions under Goal 1 set the strategy's vision and the objective of reaching the target of 2.5% of GNP research intensity with a number of sub-indicators relating to the number of significant<sup>67</sup> and large<sup>68</sup> R&D performers, objectives in terms of private (enterprise) funding of publicly performed R&D and drawdown of Horizon 2020 funding. Progress on these actions is ongoing as outlined in table 1 below:

Status on the Implementation of the 5 Actions under goal 1 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
0	5	0	0	0	

The objectives are reviewed in Chapter 2 of this Review.

### Goal 2: Innovation in Enterprise

One of the key objectives of I2020 is to drive innovation in enterprise with new or improved products, processes or services to ultimately grow and diversify Ireland's enterprise base and improve its productivity and competitiveness. The objective is pursued with 26 actions to:

- Align innovation investment with enterprise opportunities;
- Tailor supports to meet enterprise needs;
- Develop an ecosystem of research and technology centres;
- Develop Ireland as a test-bed location;
- Promote interdisciplinary research;
- Promote innovation-driven entrepreneurship<sup>\*69</sup>;

<sup>66</sup> The Call for Submissions is available from: <https://dbei.gov.ie/en/Consultations/Consultations-files/Call-for-Submissions-Mid-term-Review-Innovation-2020.pdf>

<sup>67</sup> Significant enterprise R&D performers invested between €2m and €5m

<sup>68</sup> Large enterprise R&D performers invested over €5m

<sup>69</sup> The actions with "\*" are grouped under the heading "Framework Conditions".

- Enhance access to finance for innovation\*;
- Develop collaboration within the public research system and between it and enterprise;
- Promote design-driven innovation\*;
- Promote standards and regulation as source of competitive advantage\*.

An overview of the actions is presented below.

Status on the Implementation of the 26 Actions under goal 2 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
4	20	0	2	0	

### Align innovation investment with enterprise opportunities

I2020 seeks the alignment of investment with enterprise opportunities with 4 actions. One action is complete and three actions are ongoing:

- The new cycle of research prioritisation (Action 2.2) was put in place in Q1, 2018. It targets competitive public investment to priority areas that are favourably positioned to benefit from global opportunities and support enterprise policy.
- The targeting of competitively awarded research investment in support of enterprise towards the revised priority areas (Action 2.1.a, 2.1.b and 2.3) by funders is on-going.
- Funders are carrying out a number of initiatives to stimulate public research on Services and Business Processes and Manufacturing Competitiveness (Action 2.2.a and Action 2.2.b). For example, SFI has invested in FinTech research through its Research Centres Spokes programme. Further investment is required through the HEA's foundation investment in research capacity.

### Tailor supports to meet enterprise needs.

The four actions tailoring RDI supports to enterprise needs are progressing:

- Two actions are nearly completed: the review of RDI support conducted by DBEI (Action 2.4.a) and the directory of innovation supports compiled by DBEI and hosted on KTI website (Action 2.5).
- Two actions are progressing: the review and streamlining of enterprise RDI supports (Action 2.4.b) to increase private investment (Action 2.4.c) with the introduction of

EI's Agile Innovation fund, the Business Innovation Initiative, the €500m Disruptive Technologies Innovation fund<sup>70</sup> and the Enterprise Innovation Vouchers.

### **Develop an ecosystem of research and technology centres**

The ecosystem of research and technology centres is progressing with 5 ongoing actions:

- The optimisation and enhancement of the Network of Technology Centres with the review of three Technology Centres (Action 2.6.a) and the increase in funding for two Technology Centres;
- The allocation of EI funding for 15 Technology Gateways for the period 2018-2022 with two new clusters (Applied Internet of Things and Engineering, Materials and Design Cluster) and the federation of 7 existing Technologies Gateways into a Food Tech Cluster (Action 2.6.b);
- The launch of five new SFI Research Centres and the announcement of a 5th new centre (Action 2.6.c) with a commitment of €100m of State and European funding<sup>71</sup> matched by €53m from enterprise.
- The opening of the first Research Technology Organisation (the Irish Manufacturing Research Centre funded by EI and the IDA) and the announcement of a second (the Fraunhofer Project Centre at DCU being established in Ireland with funding from SFI and Fraunhofer-Gesellschaft<sup>72</sup>) (Action 2.6.d);
- The completion of the standardisation of performance indicators for Technology Gateways, Technology Centres and Research Centres (Action 2.6.e).

### **Promote Ireland as a test-bed location**

The promotion of Ireland as a test-bed location is progressing with two ongoing actions:

- The funding of facilities for innovative technologies and therapies (Action 2.7.a) by HRB, SFI, MI and SEAI;
- The development of transparent protocols to facilitate and encourage enterprise access to the test-beds (Action 2.7.b) by SFI.

### **Promote interdisciplinary collaborations**

Interdisciplinary collaborations (Action 2.8) are enabled by the HEA core-grant and stimulated by an increase in co-funded programmes.

---

<sup>70</sup> The fund is one of four funds in the National Development Plan 2018-2027. The fund, administered by EI, will drive collaboration between Ireland's world-class research base and industry as well as facilitating enterprises to compete directly for funding in support of the development and adoption of these technologies.

<sup>71</sup> With €95m funded by DBEI and €5m co-funded by DAFM for VistaMilk and a portion of €100m to be reimbursed by the European Regional Development Fund.

<sup>72</sup> Fraunhofer-Gesellschaft – is the largest applied research organisation in Europe with 72 institutes and research units in Germany.

## **Develop collaborations**

The five actions encouraging collaborations within the public research system and between it and enterprise are progressing with:

- The research funders reviewing their programmes to incentivise collaborations within the public research system (Action 2.11.a) and to identify complementarities (Action 2.11.b);
- The establishment of new enterprise liaison positions for KTI (Action 2.12.a), the expansion of SFI Strategic Partnership and Spokes Programmes (Action 2.12.c), and the promotion of the Innovation Partnerships (Action 2.12.c) with, for instance, the Technologies Gateways funded by EI.

## **Enhance framework conditions**

Four actions seek to enhance the framework conditions for Innovation. They are all progressing:

- The action promoting innovation-driven entrepreneurship (Action 2.9) is progressing with the initiation of a OECD “Review of SME and Entrepreneurship Issues and Policies in Ireland” in Q2, 2018;
- The action developing access to finance (Action 2.10) is progressing with new Finance for Growth Initiatives such as the Credit Guarantee Scheme 2017 and the Brexit Loan Scheme;
- The action promoting design-driven innovation (Action 2.13) was initiated with the establishment in May 2017 of the National Design Forum – a key action of the Design Strategy;
- The action promoting standards and regulations as a source of competitive advantage (Action 2.14) has been initiated by NSAI.



### Goal 3: Education for Innovation

I2020 contains 24 actions focusing on the needs of the Irish RDI system in terms of research talent and research infrastructure. These actions seek to:

- Ensure that the higher education sector drives innovation;
- Continue to develop the pipeline of talent;
- Increase the pipeline of PhDs, post-doctoral researchers and principal investigators;
- Promote “Frontier Research” across all disciplines;
- Create opportunities for world-renowned research professors;
- Develop a clear career structure for researchers involved in innovation;
- Create opportunities for improved research mobility;
- Promote gender equality in research careers;
- Further develop our research infrastructure.

Further details on the progress to date are presented below.

Status on the Implementation of the 24 Actions under goal 3 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
3	19	2	0	0	3.7.b and 3.14

#### Continue to develop the pipeline of research talent.

I2020 seeks to increase interest in RDI careers and develop awareness of RDI activities with four actions. They are all in progress with:

- The publication by the Department of Education and Skills of the “STEM Education Policy Statement and Implementation Plan” (Action 3.1.);
- A range of initiatives (by SFI, the HEA, HRB, EPA and the IRC) to encourage young people and the wider population to participate in STEM disciplines (Action 3.2.a) and to engage the broader Irish Public in STEM (Action 3.2.b). To date, the impact on the profile of students choosing STEM subjects at third level has been minimal (Action 3.2.c);
- An increase in the number of new apprenticeship and traineeship programmes since 2015 to respond to employers’ needs in terms of STEM/RDI related know-how (Action 3.3).

#### Ensure that the higher education sector drives innovation

To drive innovation, I2020 seeks to develop a world-class standard for postgraduate education and training (Action 3.4). The National Advisory Forum for Ireland’s Framework

for Doctoral Education, co-chaired by the HEA and QQI, is supporting the implementation of this National Framework.

### **Increase the pipeline of PhDs, post-doctoral researchers and principal investigators**

Five actions seek to increase the number of researchers across the pipeline with limited progress on the first four actions and a delay on the action aiming to facilitate the recruitment of applicants with industry linkages:

- Progress on the recruitment of 500 new postgraduate (Action 3.5) is slow. After an initial reduction in number of first year enrolment in 2016/2017 compared to 2015/2017<sup>73</sup>, numbers are increasing; and a number of initiatives were introduced in 2018: the IRC funded new postgraduate scholarships, the HRB launched new collaborative doctoral awards and a PhD scholars programme for clinicians and SFI directly funded 110 postgraduate students with a commitment of €23.7m and also launched a new €100m postgraduate students funding programme with the new SFI Centres for Research Training (CRTs).
- New initiatives have increased the number of career opportunities for Young Researchers (Action 3.6) as well as Early- and Mid-career independent Researchers (Action 3.7.a). Reaching the 30% target is contingent on additional budget for the IRC, HRB, SEAI, SFI.
- The development of metrics to score applicants for academic positions with industry linkages is expected to be delivered in 2019 (Action 3.7. b).

### **Promote “Frontier Research” across all disciplines**

The establishment of a new IRC “Laureate Awards” programme was completed with the first call for “Laureate Awards” in 2017 (Action 3.8). Additional funding was committed in 2018 and 12 new Advanced Laureate Awards were made in April 2019.

### **Create opportunities for world-renowned research professors**

Two actions aim at creating opportunities to recruit world-renowned professors:

- The recruitment of new research talent (Action 3.9.a) has been initiated by SFI but meeting the targets (10 Future Leaders and 3 to 5 Research Professorships per annum) will require significant funding;
- The provision of support by the Embassy Network of research, innovation and education opportunities for researchers in Ireland (Action 3.9.b) is on-going.

### **Develop a clear career structure for researchers involved in innovation.**

The two actions seeking to develop a clear career structure for researchers are progressing:

---

<sup>73</sup> First year research masters and PhD enrolments were: 2,235 in 2013/14, 2,328 in 2014/15, 2,318 in 2015/16, 2,201 in 2016/17 and 2,243 in 2017/18.

- The national policy on structured progression for researchers (Action 3.10) is almost complete;
- Improvements in the provision of career advice, including in terms of non-academic career path and support (Action 3.11) continue to be made by HEIs and PROs and research funders.

### **Create opportunities for improved researcher mobility**

Six actions aim to improve researcher mobility. The four actions relating to mobility between academia and industry are progressing with:

- An increase in the number of researchers with supported appointment in industry (Action 3.12.a) with SFI Industry Fellowships (from 21 in 2015 to 41 in 2017 and 42 in 2018) and new IRC Employment based Postgraduate and Enterprise Partnership Programmes (76 awards in total in 2017);
- An increase in the flow of researchers from SFI Centres to industry (Action 3.12.b) from 24% in 2015 to 29% in 2017 (the I2020 target is 35% by 2020);
- An improvement of researcher mobility tracking (Action 3.12.c) with a range of initiatives by the HEA and other funders;
- The ongoing support by DBEI of the EURAXESS Ireland Office to facilitate the international recruitment of researchers (Action 3.12.d);

The action relating to the development of innovation and entrepreneurship skills (Action 3.13) is completed with initiatives from SFI, DAFM and EI<sup>74</sup>.

The action relating to access to the EU RESAVER Pension Scheme (Action 3.14) is delayed: an exemption from membership of the State Single Pension Scheme is required to introduce the scheme.

### **Promote gender equality in research careers**

The action seeking to promote gender equality within research careers (Action 3.15) is progressing with a number of institutions (HEIs and PROs and Research Funders) taking a range of initiatives to address gender bias in recruitment and award selection. This will be further accelerated with the publication of a Gender Equality Task Force Action Plan 2018-2020<sup>75</sup>.

### **Further develop our research infrastructure**

I2020 provides for the strategic development of research infrastructure (Action 3.16.a) and access policies that maximise enterprise use of the infrastructures (Action 3.16.b). Both are progressing but significant development of research infrastructure is constrained by limited available funding:

---

<sup>74</sup> The EI initiative is a TechStart / GradStart Programme. It is not reported in the third Progress Report but in the Action Plan for Jobs 2018 progress reports.

<sup>75</sup> The Task Force was appointed by the Minister of State with responsibility for Higher Education, Mary Mitchell O'Connor TD, in November 2017.

- To address some of the current infrastructure needs within HEIs and PROs, SFI has funded €58m of research infrastructures in the 2016 Research infrastructure Call and €22.4m in the 2018 Research infrastructure Call.
- In the health sector, HRB has invested €41.7.5m in clinical research infrastructure between 2016 and 2018.
- Planned investment (€200m investment in the Institute of Technology sector through Public Private Partnership and €278m investment in the higher education sector) will impact positively on RDI infrastructure capacity.

## Goal 4: Innovation for Social Progress and the Economy

I2020 contains 39 actions to promote innovation for social progress and economic impact. They seek to create a coordinated innovation and public research system and

- Promote innovation in the public sector;
- Facilitate access to scientific publications/research;
- Promote innovation in health, agri-food, marine, environment, the digital society, energy, natural resources, and defence.

The status of these actions is provided in the table below. The progress to date is then summarised.

Status on the Implementation of the 39 Actions under goal 4 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
10	26	1	2	0	4.26

### To increase innovation in the Public Sector

One of the objectives of I2020 is to increase innovation in the public sector. The seven actions are progressing as outlined below:

- The use of scientific evidence by policy makers (Action 4.1.a) is increasing with, for instance, the new “Evidence Generation and Knowledge Dissemination” Unit in the HRB and HRB funding of a new initiative to build capacity in evidence synthesis;
- The number of evaluations of funding programmes (Action 4.1.b), including research programmes, is increasing;
- There is regular engagement by Government Departments with the annual Estimates process and Cabinet (Action 4.2);
- A number of competitive funds for global and societal challenges (Action 4.3) have been launched (the IRC COALESCE Programme - Collaborative Alliances for Societal Challenges, the SFI Future Innovator Prize and the Disruptive Technologies

Innovation Fund managed by EI) and European Joint Programming Initiatives are co-funded;

- There are a number of targeted supports to cultivate interdisciplinary research (the IRC COALESCE Call) and increase engagement of public entities with civic society (Action 4.4) with, for instance, the funding of Patient and Public Involvement by the HRB co-funded with the IRC;
- The increase in supports for collaborations across sectors (the public and private) with intensified collaborations between research funders and not-for-profit entities and with EI's Small Business Innovation Research (SBIR) initiatives (Action 4.5);
- The development of public service innovation to deliver better outcomes for users of public services (Action 4.6) with "Our Public Service 2020" – the Government public service innovation and development framework.

### Support Open Access

The implementation of the Open Access agenda is building momentum (Action 4.7):

- The National Open Research Forum co-chaired by the HEA and HRB (as a successor to National Steering Committee on Open Access Policy) is developing a National Policy Statement on the transition to Open Research (publications and data principles) which reflects the developing European Policy and the principles of Plan S<sup>76</sup>;
- The HEA is leading a review of the services provided by the national research e-library (IReL) and coordinating a review of bibliometric analytical tools nationally<sup>77</sup>;
- Other initiatives such as requirements by Research Funders, the HRB Open Research Publishing Platform and data stewards training are on-going.

### Sector Specific Actions

To promote innovation in **health**, the actions involve developing a coordinated approach to research management (Action 4.8), support for exceptional researchers, talent and leadership in health research (Action 4.9 with 5 sub-actions) and support for collaboration between the health system and enterprise to develop and commercialise new healthcare technologies and enhance efficiencies (Action 4.10 with 2 sub-actions). The most significant developments are:

- The Department of Health has established a new Research and Development and Health Analytics Division within the Department;
- The funding and development of new health research infrastructure (the Health Innovation Hub Ireland, the Clinical Research Facilities and Clinical Research Co-ordination Ireland (HRB-CRCI), the national bio-banking system);
- The publication of the HRB Strategy 2016-2020 and the development and roll out of a Research Funding Evaluation Plan (2017-2020);

---

<sup>76</sup> Details on Plan S are available from: <https://www.coalition-s.org/implementation/>

<sup>77</sup> These initiatives have been launched since the completion of the third Progress Report.

- The membership of JPI AMR (Anti-Microbial Resistance) bringing Ireland Membership of JPIs to 8 (out of 10);
- A Research Lead has recently been appointed in the HSE whose role is to assist in improving the co-ordination and delivery of health research in Ireland.

Actions promoting innovation in **agri-food** are in line with FoodWise 2025 – the ten-year strategy for the agri-food sector. They involve better access to consumer insight research (Action 4.11), funding of research in line with SHARP (the Sustainable Healthy Agri-food Research Plan) to improve the productivity and sustainability of production (Action 4.12). They also involve improving the coordination between industry, State agencies and research institutions to enhance commercial benefits (Action 4.13) and the research absorption capacity of agri-food companies (Action 4.14). Finally, they provide for RDI investment in bio-based economy, rural development and along the food chain (Action 4.15) and the development of a bioeconomy strategy (Action 4.16). A number of milestones have been achieved:

- The establishment of a high-level Innovation Team that will review the agri-food sector innovation capacity and capability and report to FoodWise High Level Implementation Group by Q2 2019;
- The launch of the Bord Bia Consumer Research and Market Insight Centre, the development of Teagasc’s Food Innovation Hub and the expansion of Teagasc’s Moorepark Technology Ltd and the launch of a new SFI-DAFM funded VistaMilk Research Centre;
- The launch of the National Policy Statement on the bioeconomy and the establishment of a High-Level Bioeconomy Implementation Group (co-chaired by DAFM and DCCA).

With one headline action to promote innovation in the **marine sector**, I2020 supports the implementation of the national strategy for the sector “Harnessing Our Ocean Wealth” (Action 4.17). The strategy provides for the publication and implementation of a national Marine Research and Innovation Strategy to 2021 (Action 4.17 a) and the implementation of the recommendations of the Interdepartmental Marine Coordination Group and the Development Task Force focusing on research translation and development (Action 4.18.b). In this regard, the announcement of a new Marine Innovation Park (Páirc Na Mara) by Údaras na Gaeltachta to complement the national aquaculture research cluster is a key development.

Progress is being made to promote innovation in the **environment** and **energy** sectors, the development and/or implementation of the research strategies for the sectors: the EPA Research Strategy 2014-2020 (Action 4.18) and the Energy Research Strategy (Action 4.20). Both are progressing. SEAI has significantly revised its National Energy Research, Development & Demonstration Funding Programme during 2018. The increase in support for Ireland’s energy/low carbon technology research & innovation sectors is substantial.

The actions relating to the **natural resources** sector involve the implementation of the Geoscience Research Strategy (Action 4.21), the strengthening of a network to support

researchers and business partners in addressing economic and societal challenges in the field (Action 4.22) and the completion of the INFOMAR (Action 4.23) and TELLUS (Action 4.24) programmes. They are all on course. A noticeable development is the strengthening of links between publicly funded research and the geoscience business cluster.

To promote innovation in **digital society**, I2020 supports the development of high impact digital enterprises (Action 4.19). DCCAE funds the National Digital Research Centre and its accelerator programme.

In the defence sector, actions are progressing. The IP policy for (national) Defence Organisations (related to Action 4.25.b) is finalised and the Defence Enterprise Initiative will soon be developed. The initiative will support the engagement of Ireland’s enterprise base with the European Defence Agency and Horizon 2020 (Action 4.25.a). To implement this strategy a Security and Defence Enterprise Group will be established (Action 4.26) in collaboration with EI in 2019.

## Goal 5: The role of Intellectual Property in Innovation

With 13 actions relating to Intellectual Property, I2020 supports the creation of an intellectual property regime that encourages the creation of proprietary knowledge and its diffusion. It commits to

- Strengthen knowledge transfer for innovation;
- Promote more extensive commercialisation of public research;
- Seek to improve IP exploitation by Irish Enterprise;
- Position Ireland’s IP framework to encourage innovation.

The status these actions is outlined below. Subsequently, progress is reviewed in greater details:

Status on the Implementation of the 13 Actions under goal 5 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
8	3	2	0	0	5.8 and 5.11

### Strengthen knowledge transfer for Innovation

The following actions are completed:

- The publication of a revised IP Protocol (Action 5.1);
- The development of additional sets of resources and tools to encourage industry-academic collaborations (Action 5.2).

### Promote more extensive commercialisation of public research:

The commercialisation targets (Action 5.3) are on course and one is already exceeded:

- 164 Licenses Options, Agreements and Assignments (the I2020 target is 175);
- 22 Spin-out (the I2020 target is 40);
- 15 High Potential Start-ups (the I2020 target is 16);
- 1,078 Collaborative Research Projects between enterprise and the public research system (the 2020 target is 920).

The actions relating to the new targets for the commercialisation of research for (Action 5.4) and the launch of a third Technology Transfer Strengthening Initiative (Action 5.5) are completed with the allocation of €34.5bn for the period 2017-2021.

### **Improve IP exploitation by Irish Enterprises**

To increase the exploitation of IP by Irish enterprises, I2020 seeks to raise awareness and build the IP protection of capability of Irish enterprises with four actions. Two of these are progressing with:

- A range of initiatives to increase IP awareness among the broad public and entrepreneurs (Action 5.6);
- EI's pilot grants "IP Start" and "IP Plus" (Action 5.7).

The new indicators of IP activity in firms (Action 5.9) were finalised in the second half of 2018. One action is delayed: the review of the opportunity to include modules on IP management in relevant courses in higher education (Action 5.8).

### **Position Ireland's IP framework to encourage innovation**

The action relating to the Knowledge Development Box (Action 5.13) is completed.

The two actions relating to the modernisation of copyright legislation and its enforcement regime (Action 5.10 and 5.12) are nearly complete: the Copyright and Other Intellectual Property Law Provisions Bill 2018 is progressing through the Houses of the Oireachtas. Enactment is expected in Q2, 2019.

The action designed to improve the patenting options for business (Action 5.11) is stalled: progress on the implementation of the European Unitary Patent system depends on the outcome of a German constitutional challenge.



## Goal 6: Innovating with the EU and the Wider World

Under Goal 6, I2020 seeks to facilitate, develop and exploit global research cooperation and reinvigorate our networks with global partners. With 22 actions, I2020 outlines that we will engage with the rest of the innovation world and:

- Deepen Ireland's engagement in the EU, in particular through the Horizon 2020 programme;
- Deepen our engagement with the European Fund for Strategic Investment;
- Optimise European Structural Funds;
- Optimise our engagement in the European Research and Innovation Area;
- Work with other countries to develop our innovation system;
- Participate in International Research Organisations;
- Benchmark our innovation system against comparator countries.

The status of the actions is presented below. The progress to date is subsequently reviewed.

Status on the Implementation of the 22 Actions under goal 6 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
3	17	0	0	2	

### Deepen Ireland's engagement in the EU, in particular through the H2020 Programme.

Ireland's engagement in the EU is progressing with four actions to:

- Secure €1.25bn funding from Horizon 2020 (Action 6.1) as the Irish research community obtained a €630.4m drawdown (November 2018 data);
- Catalyse the creation of and participation in consortia to bid for large-scale Horizon 2020 projects with the support of the Strategic Research Proposals Group (Action 6.1.a) and the Horizon 2020 National Support Team (Action 6.2.b);
- Influence the EU Commission in formulating the work programme and represent Ireland's interests (Action 6.3).

### Deepen our engagement with the European Fund for Strategic Investment

The action providing for the assessment of the EFSI<sup>78</sup>'s potential for research and innovation (Action 6.4) is progressing. DBEI anticipates receipt of a report by the EIB

<sup>78</sup> The EFSI fund is managed by the European Investment Bank to finance strategic projects supporting innovation, SMEs, infrastructure and climate action.

evaluating new funding models and identifying additional sources of finance by the end of the year.

### **Optimise European Structural Funds**

The action seeking to ensure full participation in the European Regional Development Fund (ERDF) and the European Territorial Cooperation (known as INTERREG) programmes is progressing:

- SFI<sup>79</sup>, EI<sup>80</sup> and MI<sup>81</sup> providing co-funding for the European Structural Investment Funding programme (2014-2020);
- DBEI<sup>82</sup> and DOH<sup>83</sup> are providing co-funding for European Territorial Cooperation (ETC) programme (also known as INTERREG)

### **Optimise our engagement in the European Research and Innovation Area**

The pursuit of this objective is progressing with two actions: the coordination and oversight of participation in Joint Programming Initiatives (JPIs) (Action 6.6) and the involvement in the Joint Programming Initiatives (JPIs) and the Joint Technology Initiatives (JTIs) and ERA\_NET initiatives (Action 6.7).

### **Work with other countries to develop our innovation system.**

The following 9 actions are progressing the international collaboration agenda:

- The HRB-SFI-Wellcome Trust co-funding for biomedical and clinical research in Ireland (Action 6.8.a);
- The SFI-Royal Society fellowship for early stage researchers based in Ireland (Action 6.8.b);
- A range of initiatives strengthening collaborations with major UK funders (Action 6.8.c);
- The development of Horizon 2020 proposals with UK research team, including teams based in Northern Ireland (Action 6.8.d);

---

<sup>79</sup> Under the European Regional Development Fund, the EU co-funds 50% of the salary costs associated with SFI two programmes: 1) in the Border Midlands and Western region, co-funding is awarded to two Research Centres Insight and Curam and their spokes awards as well as all Investigator awards made to the HEIs in the region; 2) in the South and Eastern Region, co-funding is awarded to CONNECT/ADAPT/LERO and ICRA, to the 5 new SFI Research Centres (iForm, VistaMilk, Confirm, FutureNeuro, and Beacon), and to Research Centre spokes from any SFI Research Centres in the Region. By the end of 2018, it is expected that the EU's contribution will be €32m, rising to a total of €87m over the life of the scheme 2020.

<sup>80</sup> The EU co-funds with EI (50/50) three programmes with a RDI focus: the Industry RDI fund, the Commercialisation Fund and the Innovation Partnership. They are worth €42m for the Border Midlands and Western region and €60m for the South and East region.

<sup>81</sup> It is expected that the EU will co-fund with MI (50/50), €2.4m for an industry-led call followed by €6m for post-doctoral fellowships, capacity-building research projects and networking/technology transfer activities in 2019/2020.

<sup>82</sup> A total of €71,3m will be provided for 8 cross-border projects under the ETC with co-funding from DBEI.

- The increased collaborations between the 5 Irish and UK environmental agencies (Action 6.8.e);
- The development of joint funding opportunities with Northern Ireland, including with the support of the US-Ireland R&D Partnership programme (Action 6.9);
- The broadening of the remit of the US-Ireland R&D Partnership (Action 6.10.a);
- The support to NSF Graduate Research Fellow visiting Ireland (Action 6.10.b);
- The new support for research collaborations with China (Action 6.11).

### **Participate in International Research Organisations**

The three actions relating to membership of key international organisations are completed:

- CERN membership discussions took place in 2016 (Action 6.12) and formal application for membership depends on the availability of funding in the future;
- Ireland became a member of the European Southern Observatory (ESO) in October 2018 (Action 6.13);
- Membership of ELIXIR was secured in 2016 (Action 6.14).

The review of the membership of International Organisations (Action 6.15) will start in 2020.

### **Benchmark our innovation system against comparator countries**

The benchmarking exercise (Action 6.16) has not yet been initiated but membership of the Small Advanced Economies Initiative (SFI, DBEI), Science Europe (SFI, IRC, HRB) and Global Research Council (SFI, IRC, HRB) provide opportunities to “Learn from, and adopt best known practice, policies and initiatives”.

## Goal 7: Innovation Implementation

Goal 7 sets the framework for the implementation of this whole-of-Government Strategy with 11 actions:

- The I2020 Implementation Group;
- Links between the I2020 Implementation Group and other relevant groups;
- Independent advice and stakeholder input;
- Research Integrity;
- Measuring success;
- Standardised classification of public investment in research.

Progress on the actions is summarised below and reviewed in greater details.

Status on the Implementation of the 11 Actions under goal 7 (December 2018)					
Completed or nearly completed	Progressing / On-going	Delayed	Initiated	Not yet Initiated	Delayed actions
3	3	3	1	1	7.6.a, b, c

### The I2020 Implementation Group

The action relating to the establishment of the Implementation Group (Action 7.1) is completed.

### Links between the I2020 Implementation Group and other relevant groups

Engagement between the I2020 Implementation Group and other groups in the science and innovation area (Action 7.2) is ongoing.

### Research integrity

Through the Research Integrity Forum, one action is still in progress: a range of initiatives have harmonised policy and practices for handling of research misconduct and provided national training (Action 7.3.a) in all areas except data storage where work is still ongoing.

The following two actions are completed or near completion:

- The standardisation of the process and format for the publication of outcomes of research integrity investigations (Action 7.3.b);
- The development of a national shared audit (assurance) scheme based. SFI developed a pilot (Action 7.3.c).

### Measuring success

Three actions relate to the evaluation of the strategy. Their status is as follows:

- Reporting to the Cabinet Committee on the implementation of the Strategy (Action 7.4) is ongoing. I2020 and the third progress report were most recently discussed at Cabinet in July 2018;
- The mid-term evaluation of the strategy (Action 7.5.a) has been formally initiated and is the subject of this Call for Submissions;
- The retrospective evaluation of I2020 (Action 7.5.b) will be initiated at the term of I2020.

### **Standardised classification of public investment in research**

The completion of three actions relating to the classification of public investment in research (Action 7.6.a, 7.6.b and 7.6.c) is delayed. Completion of the project is contingent on resources. At a sectoral level however, there has been some progress with the publication by HRB in 2018 of a classification of national health research investment across seven funding agencies and two government departments.

## Appendix 3 - I2020 Targets

I2020 Targets (December 2018 unless specified)			
Metric	Baseline (2014 unless specified)	2020 Target	Latest data
European Innovation Scoreboard <sup>1</sup> performance relative to EU average:	+9% <sup>2</sup> (10th place <sup>3</sup> )	+20%	+15.9% <sup>2</sup> (9th place <sup>4</sup> )
Drawdown Horizon 2020	€620m under FP7	€1.25bn	€632.1m <sup>5</sup>
Research intensity: GERD as % of GNP	1.82%	2.5%	1.46% (2017) <sup>6</sup>
Increase private (Irish and foreign business) business funding of R&D performed in Higher Education sector	€24m	€48m	€32m (2015) <sup>7</sup>
New post-graduate enrolment (Research Masters and PhD (first year) enrolment)	2,235 (2013/14)	+500	2,243 (2017/18) <sup>8</sup>
Increase in the proportion of innovation active enterprise	58%	73%	57% (2016) <sup>9</sup>
Increase (+15%) in the number of - Significant enterprise R&D Performers* - Large enterprise R&D Performers**	1,040 170	1,200 200	918 (2017) <sup>10</sup> 207 (2017) <sup>10</sup>
Research Personnel in enterprise (research, technicians and support staff)	24,785 (2013)	40,000	27,322 (2017) <sup>10</sup>
Commercialisation targets			
- Commercially relevant technologies	124	175	164 (2017) <sup>11</sup>
- Spin-outs	29	40	21 (2017) <sup>11</sup>
- HPSU from Spin-outs	11	16	15 (2017) <sup>11</sup>
- Collaborative research (EI supported enterprise and Public Research Organisations)	878	920	1078 (2017) <sup>11</sup>
<p>1 In 2016, when I2020 was published, this indicator was included the Innovation Union Scoreboard. To compare change in relative performance overtime, past data were re-casted</p> <p>2 Performance relative to that of the EU average that year</p> <p>3 The 2015 European Innovation Scoreboard uses 2014 data</p> <p>4 The 2018 European Innovation Scoreboard uses 2017 data</p> <p>5 DBEI October 2018</p> <p>6 DBEI (2018) The Research and Development Budget 2017-2018</p> <p>7 DBEI (2017) HERD Survey 2014-2015</p> <p>8 DBEI based on HEA enrolment data for 2017/2018</p> <p>9 CSO (2018) Innovation in Irish Enterprise 2014-2016</p> <p>10 CSO (2019) Business Expenditure on R&amp;D 2017-2018</p> <p>11 KTI (2018) KTI Review and Annual Knowledge Transfer Survey 2017</p> <p>* Significant enterprise R&amp;D performers invested between €100k and €2m</p> <p>** Large enterprise R&amp;D performers invested over €2m</p>			

## **Appendix 4 - Meetings with Members of the I2020 Implementation Group**

Department of Education and Skills

Department of Agriculture, Food and the Marine

Department of Health

Department of Communications, Climate Action and the Environment

Environmental Protection Agency

Enterprise Ireland

Geological Survey Ireland

Health Research Board

Higher Education Authority

Irish Research Council

Knowledge Transfer Ireland

Marine Institute

Science Foundation Ireland

Sustainable Energy Authority of Ireland

Teagasc

## **Appendix 5 - List of Respondents to the Call for Submissions**

American Chamber of Commerce Ireland

UCD Conway Institute of Biomolecular and Biomedical Research

Dublin City University

Mr De Menezes

Department of Education & the Higher Education Authority

Environmental Protection Agency

Geological Survey Ireland

IBEC

Irish Research Council

Irish Universities Association

National Research Integrity Forum

Members of Irish ESFRI Projects/ERICs and International research infrastructures

Royal Irish Academy

Science Foundation Ireland

Technological Higher Education Association

Trinity College Dublin

University College Cork

University College Dublin

University Limerick

Waterford Institute of Technology



## Glossary

BERD	Business Expenditure on Research and Development
DAFM	Department of Agriculture, Food & Marine
DBEI	Department of Business, Enterprise and Innovation
DCCAE	Department of Communications, Climate Action and Environment
DES	Department of Education and Skills
DOH	Department of Health
EDA	European Defence Agency
EFSD	European Fund for Strategic Infrastructure
EIB	European Investment Bank
EI	Enterprise Ireland
EPA	Environmental Protection Agency
ERDF	European Regional Development Fund
ESFI	European Fund for Strategic Investments
ETC	European Territorial Cooperation
ESI Fund	European Structural Investment Fund
ESO	European Southern Observatory
GBARD	Government Budget Allocations for Research and Development
GERD	Gross Expenditure on Research and Development
GSI	Geological Survey Ireland
GNP	Gross National Product
HEA	Higher Education Authority
HEI	Higher Education Institute
HRB	Health Research Board
IP	Intellectual Property
IDA	IDA Ireland
IRC	Irish Research Council
KTI	Knowledge Transfer Ireland
MI	Marine Institute
NSAI	National Standards Authority of Ireland
PRTL	Programme for Research in Third Level Institutions
PRO	Public Research Organisation
QQI	Quality and Qualifications Ireland
RDI	Research, Development and Innovation
RTO	Research Technology Organisation
SBIR	Small Business Innovation Research
SEAI	Sustainable Energy Authority of Ireland
STEM	Science Technology Engineering and Mathematics
SFI	Science Foundation Ireland