National Research Prioritisation Exercise: First Progress Report June 2014

Foreword

After much significant work undertaken by research-funding Government departments and Agencies, and many positive developments over the last two years, this first Progress Report marks an important milestone in implementing the *National Research Prioritisation Exercise*, Ireland's *Research and Innovation Smart Specialisation Strategy* (RIS3).

Research Prioritisation reflects the Government's continued commitment to placing science, technology and innovation at the heart of enterprise and jobs policies so that we continue to capitalise on the opportunities that exist in the global marketplace and will expand as the global economy continues to recover.

This Report sets out the excellent progress which has been made to date, with a very strong completion rate of relevant actions, and I am confident that we can retain the impressive pace which has been in evidence in implementing Research Prioritisation.

I would like to take the opportunity to acknowledge the important contribution of all involved in the process of implementing Research Prioritisation, particularly members of the Research Prioritisation Action Group, which I chair, and their respective organisations, as well as the designated Champions for the respective Priority Areas, who have been so central in developing the individual Action Plans.

Over the horizon to 2017, which is the timeframe for the implementation of the *National Research Prioritisation Exercise*, we will continue to drive this important agenda - keeping research centre stage in our economic strategy and growing opportunities for job creation.

Seán Sherlock T.D.

Minister for Research and Innovation

Chairperson, Research Prioritisation Action Group

Table of Contents

Acknowledgements

This report was assembled by Forfás and the Department of Jobs, Enterprise and Innovation. The contributions of the following State agencies and Government departments are gratefully acknowledged.

Department of Agriculture, Food and the Marine
Department of the Environment, Community and Local Government
Department of Health
Enterprise Ireland
Environmental Protection Agency
Health Research Board
Higher Education Authority
IDA Ireland
Irish Research Council
Marine Institute
Science Foundation Ireland
Sustainable Energy Authority of Ireland
Teagasc

1. Introduction

1.1 Background

In February 2012 the Government adopted the recommendations in the Report of the Research Prioritisation Steering Group (RPSG)[1] as part of an overarching strategy aimed at accelerating the economic and societal returns from public investment in research.

The report identified fourteen Priority Areas for future, competitively-awarded investment for economic objectives, in publicly-performed research. Four criteria were used in selecting the Areas:

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

In addition, the Report identified six platform Science and Technologies necessary to underpin research in the Priority Areas. It also identified two categories of research necessary to support policy and practice; and the training and development of young researchers, respectively. The Report also set out thirteen systemic recommendations aimed at improving the efficiency and effectiveness of the Science, Technology and Innovation (STI) system.

Research Prioritisation sets the agenda for the five-year period, 2013-2017 and the Government has declared that the implementation of research prioritisation will be its primary STI policy goal. Implementation is driven under the authority of the Cabinet Committee on Economic Recovery and Jobs.

1.2 Implementation

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

The RPAG is an all-of-Government forum which brings together senior officials from ten State agencies and six Government departments with responsibility for funding research and innovation. It also includes the Department of the Taoiseach; the Department of Public Expenditure and Reform; and the Department of Foreign Affairs and Trade (see Appendix A).

The first task for the RPAG was to oversee the development of an action plan for each of the fourteen Priority Areas. These action plans were agreed by the Government and published in July 2013[2]. The plans set out in considerable detail the steps necessary in order that Ireland can realise the opportunity associated with the Priority Areas. For each action the body with primary responsibility for its implementation is identified (typically a Government department or State agency) and also the timeline by which key milestones are to be achieved.

1 www.forfás.ie/publications/2012/title,9545,en.php

2 www.forfás.ie/publications/2013/Title,11020,en.php

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

A second key task for the RPAG was to devise the indicators to be used to measure the impact of implementation of research prioritisation in the 14 Priority Areas and more generally the impact of public STI investment. This task addresses one the systemic recommendations in the report of the RPSG. To this end, it developed a Framework of Metrics and Targets which was also adopted by Government in July 2013[3].

1.3 Monitoring Progress

Two years have elapsed since Research Prioritisation was adopted by the Government and therefore a stock-check on progress is timely. The Secretariat to the RPAG (Forfás, DJEI) monitors progress on implementing actions against the timeline set out in the action plans and reports back to the RPAG on a quarterly basis. This report, prepared by the Secretariat with significant input from the members of RPAG, presents cumulative progress of NRPE from the inception of the RPAG up to the end of Q1 2014[4].

Section 2 presents an overview of the Action Plans in terms of the timeline and the key actors responsible for implementation. Section 3 presents a high-level statistical overview of progress to the end of Q1 2014.

Section 4 presents a more detailed breakdown of progress for each Priority Area. The statistics are complemented by an overview of progress written by the Champion for the Area, providing a high-level overview of key developments and achievements.

Section 5 summarises important contributions to *Research for Knowledge* and *Research for Policy* over the period, given the acknowledgement by the NRPE Steering Group of the importance of continued investment in these areas to support the eco-system more generally.

Section 6 presents each of the thirteen systemic recommendations from the report of the RPSG and outlines progress across the relevant agencies and departments.

Section 7 outlines developments in relation to education and skills, a fundamental prerequisite for successful implementation of research prioritisation in all fourteen Priority Areas.

Appendix B presents updates on the *Framework of Metrics and Targets* for monitoring Public Investment in STI, where available (the metrics are derived from a number of surveys, some of which are only repeated on a biennial, or less frequent, basis).

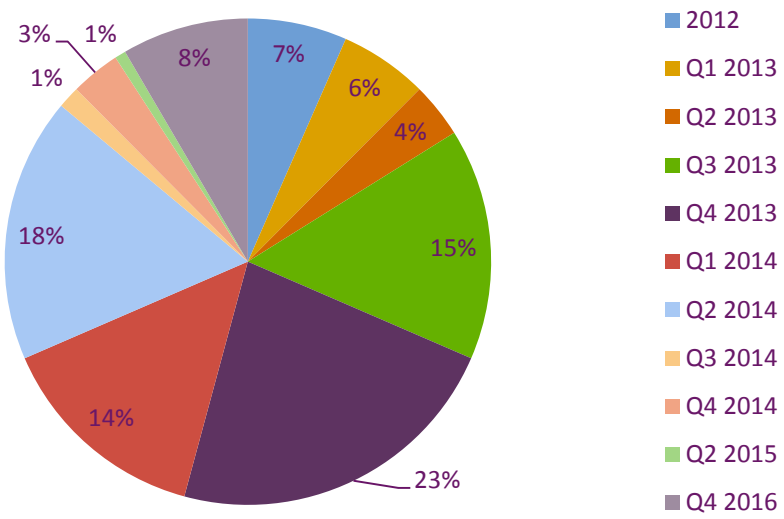
3 "Research Prioritisation: Framework for Monitoring Public Investment in Science, Technology and Innovation and 14 Action Plans", www.Forfás.ie/publications/2013/Title,11020,en.php

4 In accordance with one of the systemic recommendations in the report of the RPSG, an independent assessment of progress will be initiated in Q3 2014.This assessment will be effected via the appointment of an expert panel of distinguished individuals representing enterprise, academia and innovation policy. It will include significant international representation.

2. Overview of Action Plans

There are a total of 274 actions across the 14 Action Plans. For each action there is a specified timeline for implementation (key milestones) and a designated lead agency or department with primary responsibility for reporting on progress against this timeline. The timelines span the period 2012-2016 and the distribution of the actions across the period is illustrated in Figure 1.

Figure 1: Breakdown of reporting dates for all actions (2012 to Q4 2016) as a percentage of the total number of actions



The economic crisis introduced a sense of urgency into the NRPE – the importance of the NRPE for sustainable economic recovery into the medium-term and beyond was widely recognised. Consequently an aggressive timeframe was adopted for the action plans; over 90% of the actions fall due by the end of 2014.

186 (68%) of the actions had key milestones up to the end of Q1 2014. The distribution of these actions across the Priority Areas is shown in Table 1.

Table 1: Breakdown of actions (2012 – Q1, 2014) by Priority Area

	Action Plan	No. Actions
A	Future Networks & Communications	20
B	Data Analytics, Management, Security & Privacy	22
C	Digital Platforms, Content & Applications	20
D	Connected Health & Independent Living	14
E	Medical Devices	13
F	Diagnostics	20
G	Therapeutics – Synthesis, Formulation, Processing & Drug Delivery	13
H	Food for Health	3
I	Sustainable Food Production & Processing	4
J	Marine Renewable Energy	10
K	Smart Grids & Smart Cities	10
L	Manufacturing Competitiveness	14
M	Processing Technologies & Novel Materials	14
N	Innovation in Services & Business Processes	9
Total		186

Table 2 lists the 18 State agencies and Government departments with primary responsibilities for implementing these actions. This illustrates the whole-of-Government approach underpinning the NRPE.

Table 2: Breakdown of actions (2012 – Q1, 2014) by Lead Agency/Dept.

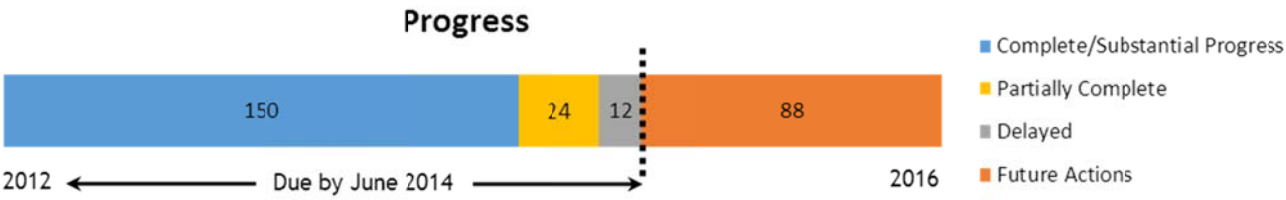
Agency/Dept.	No. Actions
DAFM	7
DCENR	3
DJEI/TI	16
DH	6
DPER	1
EGFSN	5
EI	45
EPA	4
Forfás	7
HEA	13
HIQA	3
HSE	3
IDA Ireland	15
IMB	1
IRC	5
NSAI	4
SEAI	16
SFI	32
Total	186

3. Overview of Progress to Date

3.1 Statistical Overview

Of the 186 actions with key milestones up to the end of Q1 2014, 150 are complete or substantial progress has been recorded. The implementation of a further 24 actions has commenced but has not progressed as quickly as originally envisaged and therefore these actions are deemed to be partially complete. The remaining 12 actions (6.5% of the total due) have been delayed (see Fig. 2).

Figure 2: Progress update for full set of 274 actions



A number of factors have impeded progress on the partially complete and delayed actions, including dependency on external developments and actions proving to be more involved than originally envisaged. A number of these issues are considered in Section 3.3.

In addition, there is significant overlap of actions by virtue of the fact that many actions support several Priority Areas and are therefore replicated across several action plans. Taking this double-counting into consideration means that the effective number of partially complete actions is 5 and the effective number of delayed actions is 10.

3.2 Qualitative Summary of Impact

The individual progress updates on the Priority Areas provide a summary of the key developments relating to specific Priority Areas. This section provides a broader overview of progress across the 14 Priority Areas.

Coherence of the Public STI System

One of the most important impacts of the NRPE, albeit one of the less tangible ones, has been the enhanced coordination and cooperation it has engendered between the State agencies and Government departments funding research.

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

A further impetus for cooperation has come from the cross-cutting Priority Areas, such as Manufacturing Competitiveness and Innovation in Services and Business Processes. As these areas span many sectors of the economy and hence fall within the remit of several agencies and

departments a unified, national approach is required in order to fully exploit the opportunities identified in these areas. Such an approach is now evident in these areas.

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

The following list provides some examples of inter-agency collaborative initiatives:

- Technology Innovation Development Award: Led by SFI in partnership with EI.
- Future Agri-Food: Led by SFI in partnership with Teagasc.
- SFI-HRB-Wellcome Trust Biomedical Research Partnership: Jointly-led by SFI and HRB.
- Employment-based Postgraduate Programme: Led by IRC in partnership with DAFM, EI, MI, SEAI, SFI and Teagasc.
- SFI Smart Futures: Led by SFI in partnership with EI.
- Small Business Innovation Research: (forthcoming) Led by EI in partnership with SEAI.
- IRC Postgraduate Scholarship Scheme – partnerships with a number of bodies including SFI (SFI STEM PhD, SFI Research Policy PhD); Dept. of Foreign Affairs and Trade; Dept. Children and Youth Affairs; and the National Forum for the Enhancement of Teaching and Learning.
- IRC Research Project Grant Scheme – partnerships with a number of bodies including the Dept. of Children and Youth Affairs, Dept. of Social Protection, Dept. of Environment, Community and Local Government, Dept. of Foreign Affairs and Trade, Family Support Agency, HEA, HSE, and SFI
- SFI-NSF-Graduate Research Opportunities Worldwide (HRB, NSF, NIH, Dept. Education and Learning Northern Ireland, InterTradeIreland, Invest NI, HSC).
- HRB-SFI Translational awards.
- SFI Investigators Programme 2014 with DELNI.
- A joint-Agency (SEAI, SFI, IDA Ireland, EI and the HEA) project is currently underway to encourage applications across large research institutes and industry for large H2020 Energy projects.
- An inter-agency advisory group (IDA Ireland, EI, IRC, SFI, Forfás and DJEI) has been established to, inter alia, develop the most appropriate way of incorporating Innovation in Services & Business Processes into the activities of one or more existing research centres.
- The EPA has established distinct co-ordination groups aligned to the three research pillars of its research programme (Climate Change; Water; and Sustainable Environment), comprising Government departments, State agencies and other key stakeholders.

Human Capital

Human capital is the single most important horizontal enabler for the NRPE. The active participation of the Department of Education and Skills, the HEA and the IRC has aligned a number of significant developments with the implementation of the NRPE.

Published in 2011, the *National Strategy for Higher Education to 2030* is the roadmap for the future development of the higher education sector. This fundamental reform will see the creation of a more coherent system of institutions, working as a system to deliver on stated national objectives, including the higher education sector's central role in underpinning the implementation of the NRPE. The Higher Education System Performance Framework 2014-16 advances this through a set of system-level objectives and constituent delivery indicators. Key among these is the priority

objective *"To maintain an open and excellent public research system focused on the Government's Priority Areas and the achievement of other societal objectives and to maximise research collaborations and knowledge exchange between and among public and private sector research actors".*

The indicators relating to this Objective are strongly aligned with the NRPE and in particular the *"Framework for Monitoring Public Investment in STI"* and a process of Strategic Dialogue is now in place to monitor institutional progress under the System Performance Framework. DES and the HEA have committed to further development and refinement of the performance template in partnership with the institutions, Quality and Qualifications Ireland (QQI), Knowledge Transfer Ireland (KTI) and the enterprise agencies.

Following a successful pilot in 2012, the Irish Research Council's Employment-Based Postgraduate (EBP) programme was rolled out nationally across all research areas in July 2013. A further call was launched in May 2014. Enterprise Ireland acts as a strategic partner and promotes the EBP Programme to employers across the economy.

Enhancing support for Enterprise in the Public Research System

A key action, common to all action plans, is establishing the current research capacity of the public research system (PRS) relevant to the Priority Area. A second, linked action, again common to all plans, is to determining enterprise needs in terms of research support in the area. This latter question has been addressed through a series of workshops, surveys of enterprise and engagement with enterprise representative bodies.

Comparing these two sets of information has enabled the RPAG to identify gaps between what enterprise needs and what is currently available in the PRS. This analysis is providing valuable guidance to the research funders in shaping their new programmes. For example, the themes specified in the call for the SFI Investigators Programme 2014 have been informed by this exercise.

Practical Manifestations of NRPE

As a result of the aggressive timelines adopted in the action plans, there is clear evidence that public investment in research within the scope of the NRPE (competitive awards, directed at economic outcomes) is already strongly aligned with the NRPE. Some examples of such investment include:

SFI Investigators Programme 2013
Dual call with an *open* component aligned with the 14 NRPE areas and the 6 underpinning Platform Science and Technology areas. The second component of the call has the theme "Future Agri-Food" and is run in association with Teagasc.

SFI Research Centres 2013; SFI Investigators Programme 2014
Theme selection for these calls was based on, *inter alia*, analysis of gaps in SFI's portfolio of awards in the light of the identified research interests of enterprise, sectors of importance to the Irish economy, gaps identified from a mapping of current research centres by Technology Ireland, emerging areas where Ireland has opportunity to lead, Horizon 2020 and SFI's Agenda 2020.

SFI 2013 Awards
Of the €297m awards made in 2013, €279m (94%) fell within the 14 Priority Areas or the 6 underpinning Platform Science and Technology areas.

DAFM 2013 Awards

Of the €32.7m awards made in 2013, €30.7m fell within the 14 Priority Areas or the 6 underpinning Platform Science and Technologies and in particular:

- 'Sustainable Food Production & Processing': €22.8m
- 'Food for Health': €7.9m

Teagasc Funding

93% of Teagasc' funded projects in 2013 were aligned to two of the Priority Areas, namely, *Sustainable Food Production and Processing; and Food for Health*.

Technology Centres

The 7 SFI Research Centres and 15 Enterprise Ireland / IDA Ireland Technology Centres are strongly aligned with the NRPE, as indicated in Tables 3.1 and 3.2, respectively.

Table 3.1: Alignment of SFI Research Centres with NRPE

Research Centre	NRPE Priority Area / Platform S&T (PST)
Advanced Materials And Bio-Engineering Research – AMBER	Processing Technologies and Novel Materials PST: Nanotechnology; Advanced Materials; Biomedical Research
Alimentary Pharmabiotic Centre – APC	Food for Health PST: Biomedical Research
Irelands Big Data And Analytics Research Centre – INSIGHT	Data Analytics; Connected Health
Irish Photonic Integration Research Centre – I-PIC	Future Networks PST: Photonics
Irish Centre For Fetal And Neonatal Translational Research – INFANT	Diagnostics PST: Biomedical Research
Marine Renewable Energy Ireland – MAREI	Marine Renewable Energy; Data Analytics
Synthesis & Solid State Pharmaceutical Cluster – SSPC	Therapeutics

Table 3.2: Alignment of EI/IDA Technology Centres with NRPE

Technology Centre	NRPE Priority Area / Platform S&T
Collaborative Centre for Applied Nanotechnology – CCAN	*Platform S&T*: Nanotechnology
Irish Centre for Composites Research – IComp	Processing Technologies and Novel Materials
Irish Centre for Manufacturing Research – ICMR	Manufacturing Competiveness
Innovation for Ireland's Energy Efficiency – i2e2	
International Energy Research Centre – IERC	Smart Grids & Smart Cities
Microelectronic Circuits Centre Ireland – MCCI	Platform S&T: Microelectronics
Irish Centre for Cloud Computing and Commerce – IC4	Digital Platforms; Future Networks & Communications
Governance, Risk and Compliance Technology Centre – GRCTC	Innovation in Services and Business Processes
Innovation Value Institute – IVI	
Learnovate Centre	Digital Platforms
Applied Research for Connected Health – ARCH	Connected Health
Food for Health Ireland – FHI	Food for Health
Centre for Applied Data Analytics Research – CeADAR	Data Analytics
Pharmaceutical Manufacturing Technology Centre – PMTC	Therapeutics Processing
Technology Centre for Biorefining and Bioenergy – TCBB	Sustainable Food; Marine Renewable Energy

Other important developments linked to the NRPE include:

- The Government published the *National Digital Strategy* in July 2013.
- A draft of the *Open Government Partnership* National Action Plan was published in May 2014.
- The *eHealth Strategy* which was published in December 2013. The recruitment of a Chief Information Officer to head the proposed entity called *eHealth Ireland* is currently underway.
- The Department of Communications, Energy and Natural Resources developed a proposal for a *National Collaborative Research Platform* in August 2013. The proposal considers the potential and scope of a national collaborative research platform to integrate and co-ordinate existing and future test-beds.
- The *Health Identifiers Bill* was brought before the *Oireachtas* in January 2014 and is expected to be enacted by Q3 2014.
- The HEA has compiled a national database of existing research infrastructure in the HEIs: *Large Items of Research Equipment* (LIRE)[5]. It has also developed a set of accompanying guidelines for access to the equipment.
- The Expert Group on Future Skills Needs considered the skills needs of the three ICT areas: *Future Networks and Communications*; *Data Analytics, Management, Security and Privacy*; and *Digital Platforms, Content and Applications* areas in their report *Addressing Future Demand for High-Level ICT Skills* (November 2013).
- The specific requirements of the *Data Analytics, Management, Security and Privacy* area were addressed in *Assessing the Demand for Big Data and Analytics Skills, 2013 – 2020* (May 2014).
- A pilot project to develop a consolidated branding and marketing approach for research centres operating in the Therapeutics Priority Area was undertaken during 2013. As a result of this pilot, the research centres involved in this project have enhanced collaboration and co-ordination across a range of areas beyond the original remit of the project.
- In June 2014 SEAI published a comprehensive guide to Irish enterprise opportunities in Sustainable Energy out to 2020, encompassing *Marine Renewable Energy* and *Smart Grids & Smart Cities*. In particular, it identifies potential investment of €100m / year in Design/Development.
- In June 2014 the Department of Agriculture, Food and the Marine published a progress report on implementation of the actions in 'Harnessing Our Ocean Wealth', Ireland's first integrated marine plan. "*Research, Knowledge, Technology & Innovation*" constitute one of the eight enablers to support the vision and goals of the plan.
- While the primary purpose of the EPA Research Programme is support for policy and to develop solutions for environmental challenges, in so far as is possible without compromising its primary mission, it is seeking to lever its investments for economic impact too.
- The regulation and standards bodies, IMB[6] and NSAI, are playing an increasingly important role in supporting enterprise across several Priority Areas:
  - The IMB is leading the development of a model for '*Regulatory Science Ireland*', the aim of which is to promote research-led innovation in regulatory science. The model proposes to link academic researchers with regulators and enterprise to promote research, enhance training and advance regulatory science.

5 www.hea.ie/content/large-items-research-equipment-database

6 from 1 July 2014, the Health Products Regulatory Authority, HPRA

- The IMB is currently drafting regulatory guidance in the area of *Medical Devices* for SMEs and start-ups. There are strong links between the agency and the academic institutes, members of which sit on the IMB Advisory Committee for Medical Devices.
- The NSAI has committed to delivering education and training on compliance with the I.S. EN ISO 13485 Quality Management System standard to an innovation centre carrying out work on *Medical Devices* as part of the Action Plan for Jobs 2014.
- The NSAI is working with EI to progress a number of actions in the three ICT and the *Connected Health* action plans relating to international standards groups.

3.3 Incomplete/Delayed Actions

Informal ICT Standards Groups

The biggest single block of incomplete actions relates to informal international ICT standards groups. These actions involve identifying standards groups and Irish participation, if any, relevant to the three ICT Priority Areas. There are 15 such actions across the three ICT plans.

These groups are typically consortia of firms established for the purpose of developing and promulgating standards to facilitate the interoperability of their products and services. As these groups are informal, tracking them and their membership poses particular challenges as they do not fall within the remit of national standards bodies such as the NSAI. Therefore, these actions have proven difficult to progress on the timeline original envisaged.

However, work is currently underway between Enterprise Ireland and the NSAI to overcome these challenges. This effort will also draw on a European Commission Initiative, *"European Multi Stakeholder Platform on ICT Standardisation"*[7]. Its purpose is to monitor informal or consortia standards. EI also intend to coordinate a survey, with the support of the relevant research funding agencies, of the Irish research system to capture Irish participants and their area of interest.

Health Information Bill

A further example of a replicated action relates to the Health Information Bill. The publication of this bill is an action in 3 action plans and consequently accounts for 3 of the incomplete actions. It was proposed that the Health Information Bill would provide for a range of matters: including an enabling legal framework for the introduction of unique identifiers for patients[8] and health service providers. It was also envisaged that it would, *inter alia*, streamline the ethics approval process for health research not governed by statutory regulation and EU law.

As a result of the urgency associated with a Troika commitment, the identifier provisions were decoupled into a separate Health Identifiers Bill which was published in December 2013. That Bill is due to be enacted in Q3 2014. It is expected that the Health Information Bill (which will contain the provisions relating to ethics approval) will be published by end 2014.

7 http://ec.europa.eu/digital-agenda/en/european-multi-stakeholder-platform-ict-standardisation

8 Individual Health Identifiers (IHIs) are primarily about patient safety and ensuring that the right information is associated with the right individual at the point of care. The identifier system will also help in managing our health service more efficiently and will be a building block for health reform initiatives including Money Follows the Patient and the eHealth Agenda.

Energy Research Map

A block of four actions across the Marine Renewable Energy and the Smart Grids & Smart Cities action plans relate to research mapping, both in terms of existing activity in the public research system and enterprise needs. While progress is being made in relation to these actions, further development of the SEAI Research Database / Portal is required to facilitate their full implementation. This work is due for completion in Q3 2014. Data from the Annual Energy R&D Inventory will then automatically feed into the Research Database / Portal.

Diagnostics Development Centre

Three actions in the Diagnostics action plan relate to the possible establishment of a Diagnostics Development Centre. Diagnostics was one of the themes for the SFI 2013 Research Centres Call, which was opened in September 2013. The deadline for submission of the proposals was April 2014 and the international peer review process is currently underway. The decision on the successful proposals will be announced in September 2014. The three actions are on hold pending the outcome of this process.

Within the diagnostics space, SFI funded the Irish Centre for Fetal and Neonatal Translational Research (INFANT) as part of the SFI 2012 Research Centres Programme. INFANT is Ireland's first centre for perinatal research and will develop screening and diagnostic tests and methods for monitoring pregnancy and new-borns, specifically identifying risk factors and facilitating early treatment and intervention. A submission from INFANT to the SFI Spokes 2013 programme was funded in Q2 2014 and will consolidate a new partnership between INFANT and Waters Corporation to develop a novel biomarker test for spontaneous preterm birth.

4. Priority Areas

A - Future Networks and Communications

Focus: This Priority Area is focused on the challenges of scalability, capacity, throughput, mobility and trust of the internet, including:

- Network and Service Management – how to best manage and serve the network given new demands from devices and applications;
- Internet Technologies – the software and protocols to support the network;
- Fixed, Mobile and Wireless Communications – enabling connection and collaboration.

Vision: To focus on Future Networks and Communication to further develop Ireland's global positioning in the ICT field, by building on existing research strengths and well established indigenous and FDI sectors, to enhance human capital and research capacity to address the current and future needs of this rapidly moving sector and to underpin Ireland's global reputation through active participation in the development of technology and regulatory standards.

Progress on Implementation of Action Plan

Total Number of Actions: 20

Number with milestone to end Q1 2014: 20

Number complete or substantial progress recorded: 13

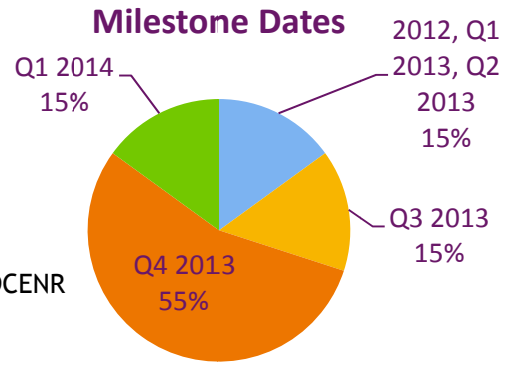
Champion: Gearóid Mooney, Enterprise Ireland

Participating Agencies / Government Departments:

EI, IDA Ireland, SFI, Forfás, DJEI (via TI), HEA, EGFSN, NSAI, DCENR

First Milestone Date: Q1 2012

Final Milestone Date: Q1 2014



B - Data Analytics, Management, Security and Privacy

Focus: This Priority Area is focused on turning data into information and ultimately knowledge that can be exploited for both economic and social benefit ("Smart Data"). It has two major components:

- Data Analytics and Data Management – managing data as a resource and converting it into useful information; and
- Security and Privacy – protection of information and regulation of data.

Vision: To focus on Data Analytics, Management, Security and Privacy to further develop Ireland's global positioning in the ICT field, by building on existing research strengths and well established indigenous and FDI sectors, to enhance human capital and research capacity to address the current and future needs of this rapidly moving sector and to underpin Ireland's global reputation through active participation in the development of technology and regulatory standards.

Progress on Implementation of Action Plan

Total Number of Actions: 22

Number with milestone to end Q1 2014: 22

Number complete or substantial progress recorded: 17

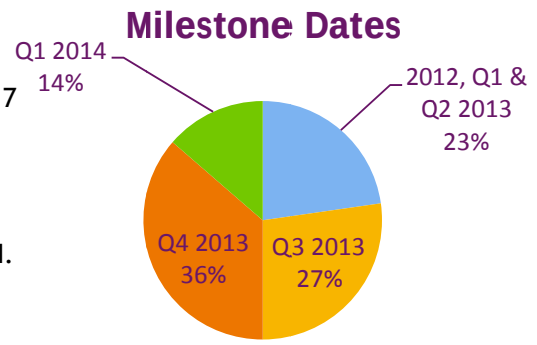
Champion: Gearóid Mooney, Enterprise Ireland

Participating Agencies / Government Departments:

EI, IDA Ireland, SFI, Forfás, DJEI (via TI), HEA, IRC, NSAI.

First Milestone Date: Q1 2012

Final Milestone Date: Q1 2014



C - Digital Platforms, Content and Applications

Focus: This Priority Area is focused on the development of platforms that enable the commercial exploitation of ICT research and the development of ICT based public services. It includes:

- Digital Content and Applications – content development and the development of applications in areas such as eGaming, eEnvironment, eLearning and eTourism;
- Human-Machine Interface, multi-media, multi-modal service creation environment.

Vision: To focus on Digital Platforms, Content and Applications to further develop Ireland's global positioning in the ICT field, by building on existing research strengths and well established indigenous and FDI sectors, to enhance human capital and research capacity to address the current and future needs of this rapidly moving sector and to underpin Ireland's global reputation through active participation in the development of technology and regulatory standards.

Progress on Implementation of Action Plan

Total Number of Actions: 21

Number with milestone to end Q1 2014: 20

Number complete or substantial progress recorded: 14

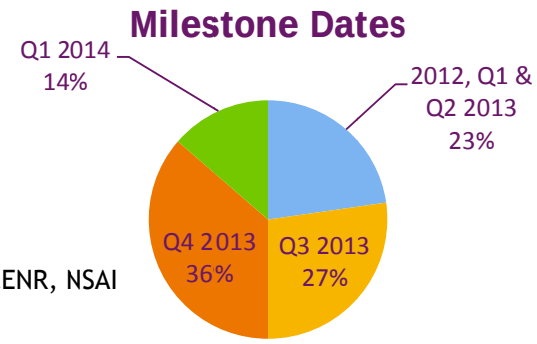
Champion: Gearóid Mooney, Enterprise Ireland

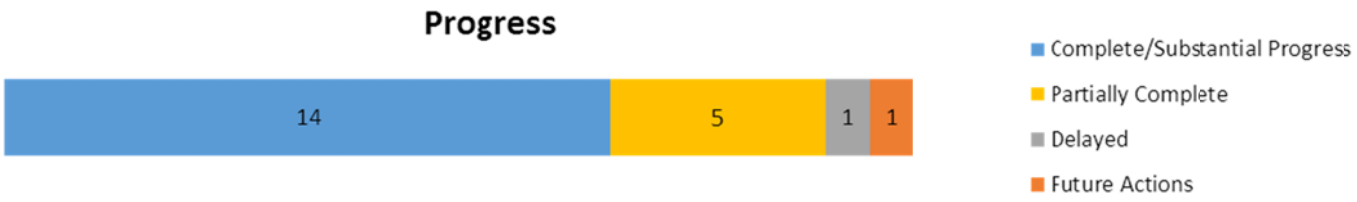
Participating Agencies / Government Departments:

EI, IDA Ireland, SFI, Forfás, DJEI (via TI), HEA, IRC, EGFSN, DCENR, NSAI

First Milestone Date: Q1 2012

Final Milestone Date: Q2 2014





Progress on implementation of Action Plans for Priority Areas A, B, C [Future Networks and Communications; Data Analytics, Management, Security and Privacy; Digital Platforms, Content and Applications]

The value of the global ICT market was estimated at €4.6 trillion in 2009 with an annual growth rate of 5.5 per cent up to 2013 anticipated. Currently, there are over 400 enterprises in Ireland within the telecommunications sector employing c. 15,000 people and generating revenues of over €6 billion.

Ireland has a strong representation of market leaders within its enterprise base for each of the sub-markets associated with *Data Analytics, Management, Security and Privacy*. Leaders in the data analytics market include: Oracle, SAP, IBM, SAS and Microsoft. Leaders in the cyber-security market include Symantec, McAfee, Trend Micro and Computer Associations. Ireland is also fast becoming recognised for its strength in cloud computing with a strong multinational and indigenous base of companies engaged in this space.

The digital media global market which includes education, entertainment, consumer information and infrastructure was estimated at $258 billion in 2010. Between 2005 and 2010, the sector experienced a CAGR of 11.7 per cent. Within the overall sector, sub-markets such as eGames have experienced rapid growth (currently worth $52.5 billion with an expected CAGR of 10.6 per cent between 2009 and 2014). It is estimated that the eLearning market will be worth $107.3 billion in 2015. Ireland has good representation of leading players from both the eGames and eLearning sectors with a solid indigenous base being built up in these areas. In tourism, the digitising of content, development of linked data and e-readiness of tourism companies is critically important to the Irish economy. In addition, indigenous firms have been particularly successful in eLearning, animation and in the enabling wireless infrastructures and middleware (Jam Media, Nooked, and Skillsoft Ireland). Furthermore, there is a strong dynamic emerging in eGames development (Open Emotion, Digital Sideburns).

Good progress has been made to date in relation to the three ICT Priority Areas: *Future Networks & Communications*; *Data Analytics, Management, Security & Privacy*; *and Digital Platforms, Content & Applications*.

A collaborative exercise has been undertaken to map projected enterprise needs against relevant current research activity. For each of these three areas an up to date picture of the enterprise and research ecosystem has been developed. That exercise has identified some research capacity gaps that SFI are currently in the process of addressing though their funding call mechanisms. The ability to identify those gaps and have the national system respond is a key benefit of the NRPE process and therefore this exercise should be repeated annually.

The current research funding mechanisms are fit for purpose in each of these three areas and there are sufficient targeted funding mechanisms available to encourage collaboration with enterprise at all levels of "technology readiness".

The *Expert Group on Future Skills Needs* and the HEA have taken the feedback on-board and are working on the key inhibitor for these 3 areas, namely, availability of skills. This issue will require close monitoring at a national level given the crucial role skills availability plays in the industrial development in these 3 areas.

Science Foundation Ireland funded the *Irish Photonic Integration Research Centre* (I-PIC) and *Research Centre for Data Analytics* (INSIGHT) as part of the SFI Research Centres Programme 2012.

I-PIC is located at the Tyndall National Institute (TNI) in Cork and is a collaborative initiative bringing together researchers from University College Cork (UCC), Cork Institute of Technology (CIT) and Dublin City University (DCU), in addition to approximately 16 industry partners. I-PIC will align internationally recognised Irish research capabilities to focus on the development of photonic science and technology for applications in communications and biomedicine.

INSIGHT, the largest investment in any single research centre in the history of the State, is a multiparty initiative bringing together over 200 researchers from UCD, National University of Ireland Galway (NUIG), UCC and other institutions, in addition to approximately 40 industry partners. The primary aim of the INSIGHT Centre is to develop novel data analytics technologies in a number of key application areas, thereby combining the expertise of Ireland's research community with the requirements of industry and enterprise. Specifically, INSIGHT will be focussed on harnessing Big Data to address research topics in areas that include chronic disease management and rehabilitation, novel personal sensing, connecting health and life sciences, smart enterprise, the future of news and media, the analytical society and also discovery analytics. In addition to creating 300 jobs over 6 years, INSIGHT is expected to generate 12 new spin-out companies, approximately 50 patent filings and over 50 technology licenses, thus indirectly creating new job opportunities in the data analytics sector.

To address research gaps and build capacity, Science Foundation Ireland launched the SFI Research Centres Programme 2013 and the SFI Investigators Programme 2014 as *Themed* Calls. Theme selection was based on an analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has an opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and wider stakeholder consultation.

Following a review of the above criteria, area A; *'Future Networks and Communications'* and area C; *'Digital Platforms, Content and Applications'* were selected as themes in the SFI Research Centres Programme 2013 call. Pre-proposals were invited to proceed to the full proposal stage in January 2014, following positive evaluation by a joint scientific and impact panel. A funding decision on these applications is expected in Q4 2014.

Furthermore, *'Parallel Computing'; 'Software Defined Networking'* and *'Cyber Security and Digital Forensics'* were selected as themes in the SFI Investigators Programme 2014 call.

Finally, a significant component of the SFI Research Centre MaREI (primarily aligned with NRPE Area J) is also focused on '*Data Analytics, Management, Security and Privacy'*, thereby further strengthening Area B.

D - Connected Health and Independent Living

Focus: This Priority Area is focused on technologies that facilitate remote delivery of healthcare and assisted living, moving the emphasis of care to the patient in their own home. Connected health and independent living technologies have the potential to transform healthcare and service delivery, thereby reducing burdens on health systems and improving the quality of life and independence of our ageing populations. This is an emerging area and there is an opportunity to position Ireland as a 'proving ground' for connected health solutions.

Vision: Ireland as a unique environment for the development, validation and implementation of connected health solutions

- Building on research strengths in ICT and the life sciences
- With engagement of all relevant stakeholders (healthcare professionals, patients, enterprise, academia, Government, etc.)

Progress on Implementation of Action Plan

Total Number of Actions: 21

Number with milestone to end Q1 2014: 14

Number complete or substantial progress recorded: 10

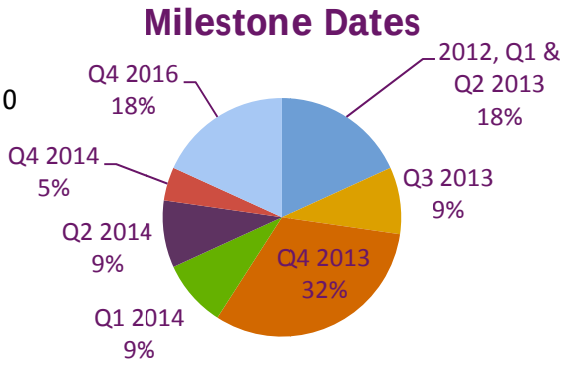
Champion: Dr Keith O'Neill, Enterprise Ireland

Participating Agencies / Government Departments:

EI, IDA Ireland, SFI, DH, DJEI, HRB, NSAI, IMB and HEA

First Milestone Date: Q1 2012

Final Milestone Date: Q4 2016



Progress on implementation of Action Plan for Priority Area D [Connected Health]

Connected health and independent living technologies are technologies that facilitate remote delivery of healthcare and assisted living, moving the emphasis of care to the patient in their own home. This is an emerging area with the potential to transform healthcare and service delivery, thereby reducing burdens on health systems and improving the quality of life and independence of our ageing populations. The RPSG report identified an opportunity to position Ireland as a leading location for developing connected health solutions and recognised that all national stakeholders (the health system, industry, academia etc.) will need to collaborate in the connected health area to solve problems in the delivery of healthcare and also address the wider societal aims including innovation and jobs.

There have been a number of positive developments and trends over the past year in Connected Health. Many of these are driven by legislative and regulatory mandates in key export jurisdictions for Irish-based companies. A key motivator is the ongoing desire to reduce the costs of healthcare whilst, at a minimum preserving current standards and patient outcomes. At home, we can see similar trends in the form of governmental strategy and policy changes.

The Government has published a series of interrelated strategies aimed in part, or wholly, at realising in Ireland the promise of improved patient outcomes at reduced cost for our Healthcare system. Arguably, the *eHealth Strategy* is the most important in this context. Nonetheless, the Department of Health's *eHealth Strategy* has to be understood as an enabler in the context of other Department of Health strategies on universal health insurance, future hospital structures and funding and a Healthy Ireland/wellness strategy. Aside from the direct savings for the healthcare system and the public good of improved health and outcomes, the e-Health Strategy explicitly recognises there are entrepreneurial possibilities and job creation potential that a clear, user-friendly strategy might have. For example, the "Open Innovation" system used in Australia to source novel solutions from private providers in the field of eMental Health was 50 times more cost effective than traditional procurement of solutions.

Expected outcomes of the eHealth strategy during the next 4 years include:

- Patients can access their own health records and maintain a health diary.
- Patients can inform themselves on health information through accredited sources of information and use this information to construct health plans.
- Care Providers, through access to accurate management, process and cost data, have the opportunity to develop innovative services based on new revenue models.
- National healthcare ICT spend re-aligned to the EU average of between 2-3% (from 0.85%).

EI client companies are mindful that there will need to be a deep infrastructural investment to realise the eHealth strategy including a National Health Identifier Infrastructure, ePrescribing Systems, Online Referrals and Scheduling, Tele-healthcare - particularly relating to the management of chronic diseases, Development of Patient Summary Records and Online Access to Health Information.

The actions contained in this plan are focussed on supporting a number of the above objectives and thus enabling the growth in this sector. We are making significant progress across all areas of the action plan, as outlined below, and are working with our partners in the Health System to update existing actions where necessary and to plan for new activities where appropriate.

To address research gaps and build capacity, SFI launched the SFI Research Centres Programme 2013 and the SFI Investigators Programme 2014 as Themed Calls. Theme selection was based on an

analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has an opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and wider stakeholder consultation.

Following a review of the above criteria the NRPE area D; 'Connected Health and Independent Living' was selected as a theme in the SFI Investigators Programme 2014 call. Furthermore, a strategic version of the SFI Research Professorship Programme was launched in Q2 2014 that will seek to build research capacity in the 'Connected Health' and 'Ageing' sectors.

SFI is also continuing to fund into this sector through bottom up calls with funding committed through the SFI TIDA 2013 and US-Ireland R&D Partnership Programmes, as did the HRB through a HRB Research Leaders Award, Health Research Centre in Primary Care and a number of Health Research Awards.

It is important to note that significant components of the SFI Research Centres INSIGHT (primarily aligned with NRPE Area B) and INFANT (primarily aligned with NRPE Area F) are in the 'Connected Health' space, thereby strengthening the research investment in Priority Area D.

The Health Innovation Hub is now in place which will facilitate industry and healthcare system engagement to develop and validate products and services informed by health needs and support adoption and commercialisation of new innovations in the connected health space.

SFI is also supporting the development of the eHealth and Smart Aging initiatives as outlined in the 2014 Action Plan for Jobs which will positively impact on this sector.

E - Medical Devices

Focus: This Priority Area is focused on further strengthening Ireland's position as a hub for medical devices, through integrating existing enterprise and research strengths to drive development and manufacture of next generation medical devices here.

Vision: To further develop Ireland's position as a global hub for Medical Devices, through integrating existing enterprise and research strengths to meet strategic research needs of the sector, drive diversification and ensure development and manufacture of next generation Medical Devices here.

Progress on the Implementation of the Action Plans

Total Number of Actions: 26

Number with milestone to end Q1 2014: 13

Number complete or substantial progress recorded: 12

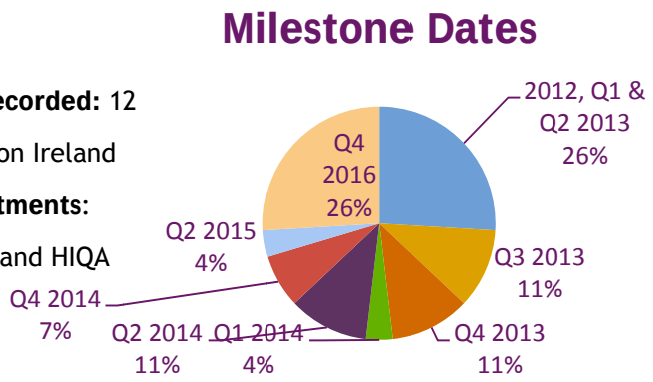
Champion: Dr Manus Ward, Science Foundation Ireland

Participating Agencies / Government Departments:

SFI, IDA Ireland, EI, HRB, DH, HEA, NSAI, IMB and HIQA

First Milestone Date: Q1 2012

Final Milestone Date: Q1 2014



Progress on implementation of Action Plan for Priority Area E [Medical Devices]

Ireland is one of the leading global hubs for the medical devices industry, generating €6.7 billion (2009) in exports and employing more than 22,700 people (90 per cent in foreign multinational companies). Ireland is now the second largest exporter of medical products in Europe, behind Germany. Eight of the world's 10 largest medical device companies are located in Ireland. Of the 120 companies in the sector, 50 are foreign owned (mainly US) MNCs, 40 are Irish companies engaged in sub-supply and contract manufacturing and there are approximately 30 indigenous companies involved in developing and marketing finished products. While the R&D base is small, most foreign MNCs do carry out R&D in Ireland; mainly process, but some product R&D. Of the key FDI companies in the sector, Abbott, Boston Scientific, Medtronic, Stryker, DePuy, Vistakon, Covidien and Nypro are engaged in significant product development.

In the action plan there were 26 separate actions spread across 10 agencies/departments (HRB, EI, IDA Ireland, IRC, DH, HSE, IMDA, NSAI, IMB, HIQA). The initial actions focused on understanding the research capacity within the Medical Device sector and how best to address deficiencies in both capacity and skill sets. The Technology Ireland forum completed a Centre mapping exercise that identified key Centres that directly supported the Medical device sector and continues to look at opportunities for an integrated approach for future investment in this sector. In parallel Forfás has undertaken a mapping exercise to determine the national research capacity within this and the other Priority Areas. Based on input from TI, capacity analysis and a wider consultation with sister agencies/departments and other relevant stakeholders, SFI included themes relevant to this sector in the SFI Research Centres 2013 and the SFI Investigators Programme 2014 Calls. In the SFI Research Centres 2013 call, a pre-proposal application was invited to proceed to the full proposal stage in January 2014 after evaluation by a joint scientific and impact panel.

A number of other initiatives have been launched to address capacity and skill needs in this sector that include:

- The Irish Research Council's Employment-Based Postgraduate programme
- The SFI Industry Fellowship
- Continued funding for the Bioinnovate Ireland Programme by Enterprise Ireland
- The launch of a strategic version of the SFI Research Professorship Programme
- A National Framework for Doctoral Education (including structured PhDs) is currently under development by the HEA and QQI in partnership with the HEIs with a view to completion on schedule by Q3 2014.

Through bottom up calls funding bodies and agencies have continued to build on capacity within the sector. SFI has committed funding to the Irish Centre for Fetal and Neonatal Translational Research (INFANT) for a 6 year period (2013-2019) as part of the SFI Research Centres Programme. Additional funding has been committed through the SFI Investigators Programme, and the SFI Technology Innovation Development Award Programme. The HRB also has significant commitments in active awards relevant to Priority Area E.

It is important to note that the MedTech FDI sector in Ireland continues to be predominately manufacturing so in this context:

- In 2013 IDA Ireland commissioned the Circa Group to undertake an external consultation with enterprise to compare the MNC Life Sciences (including Medical Technologies) research needs with the Priority Areas.

- IDA Ireland is collating a Detailed Description of Needs (DDN) for the FDI MedTech Sector this action item will continue on a rolling basis to include periodic updates to ensure it remains current.
- IDA Ireland supported over 1,700 new jobs in the MedTech FDI Sector in 2013. Investments had strong regional dispersion with many companies investing in process R&D to support manufacturing transformation in this Sector. Particular growth in areas such as orthopaedics (DePuy and Stryker) was observed during this period.
- Several companies have highlighted an interest in engaging in applied research (TRL 5-9) on novel approaches to discrete manufacturing that include technologies such as 3D printing and advanced automation/packaging. At present there is no infrastructural research solution to address this opportunity. IDA Ireland/EI are currently embarking on an exercise to engage with manufacturing firms to assess the business case for further public and/or private investment in applied research infrastructure and core operational funding to support high value manufacturing sectors (e.g. Medical Technologies) (as per Action item 63 in the APJ 2014).

A major focus of the next phase on the implementation of the action plan for the *Medical Devices* area will be on the development of the clinical infrastructure in Ireland and the regulatory framework to ensure an integrated system of effective mechanisms for industry to engage with research and translational infrastructure (both clinical and non-clinical). Key actions include:

- Establish and implement HRB funded Clinical Research Facilities (CRF) activities at Galway, Cork and St. James Hospital and establish a collaborative network between these and other existing CRFs.
  - Relevant to Priority Area E, the HRB has provided funding for business development capacity within its CRF to increase their industry-led trials activity, including engagement with the medical devices sector. In addition, a development lead is currently being appointed by the HRB to develop a business plan for the National Clinical Research Framework, in collaboration with CRF Directors.
- Establish health research networks to increase capacity for collaborative working within and between health specialists.
  - The Expression of Interest phase of a Clinical Research Network call launched in late 2013 is now complete and 15 shortlisted applicants have been invited to submit full proposals by Autumn 2014.
- Develop initiatives to facilitate knowledge transfer and exchange between academia and the health services / Government departments / State agencies / industry.
  - The HRB Knowledge Exchange and Dissemination (KEDS) Awards made to 39 PIs in 2013 are now completing and the best KED ideas will be presented at a HRB conference in 2014.
- If appropriate, fund a Medical Technology Centre that can engage with companies within the medical device field and that includes mechanisms for interdisciplinary research.
  - A decision on a Medical Device Centre will be made in Q4 2014.

The Health Innovation Hub is now in place which will facilitate industry and healthcare system engagement to develop and validate products and services informed by health needs and support adoption and commercialisation of new innovations in the Medical Device Sector. Furthermore, the development of the eHealth and Smart Aging initiatives as outlined in the 2014 Action Plan for Jobs which will positively impact on this sector.

F - Diagnostics

Focus: This Priority Area is focused on ensuring that research strengths developed over the last decade of investment are fully exploited. Ireland has developed significant research capacity in a range of areas that underpin development of diagnostics, including biomedical research, nanotechnology, materials and photonics. There are opportunities for commercialisation in emerging growth areas such as personalised medicine/companion diagnostics, nutrition related diagnostics, veterinary diagnostics and point-of-care devices. Applications in connected health can also be promoted through focused investment and/or coordination.

Vision: Seek to create a mechanism to effectively leverage the research base and identify and exploit commercialisation opportunities with strong market pull in medical, nutritional, veterinary, industrial and in vitro diagnostics. Further investigate potential in imaging and in vivo diagnostics.

Progress on the Implementation of the Action Plans

Total Number of Actions: 29

Number with milestone to end Q1 2014: 20

Number complete or substantial progress recorded: 16

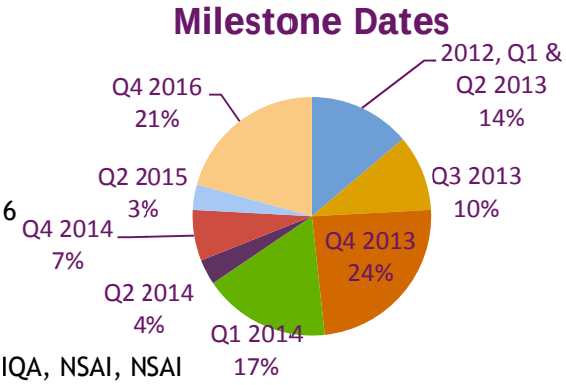
Champion: Dr Barry Heavey, IDA Ireland

Participating Agencies / Government Departments:

SFI, EI, IDA Ireland, HRB, DJEI (via TI), DH, HEA, HSE, HIQA, NSAI, NSAI

First Milestone Date: Q4 2012

Final Milestone Date: Q4 2016



Progress on implementation of Action Plan for Priority Area F [Diagnostics]

The global market for in-vitro diagnostics was valued at $44 billion in 2010 (anticipated CAGR of 5 per cent) and imaging market was valued at $5.7 billion. The diagnostics market is continually expanding, and also dramatically changing. Key foci include: new markers of disease or health status arising from basic biomedical research; new formats of diagnostic products e.g. point of care testing; companion diagnostics; and home diagnostics. Enterprise capacity in Ireland is currently stronger in the in-vitro and molecular diagnostics segment. There are approximately 25 companies in Ireland developing in-vitro and molecular diagnostics. Of these, 9 are based on technologies from Irish HE institutions and 10 are units of MNCs including Abbott and Beckman Coulter.

To address research gaps and build capacity, SFI launched the SFI Research Centres Programme 2013 and the SFI Investigators Programme 2014 as Themed Calls. Theme selection was based on an analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has an opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and wider stakeholder consultation.

Following a review of the above criteria the NRPE area F; 'Diagnostics' was selected as a theme in the SFI Research Centres Programme 2013 call. A pre-proposal submitted to this call was invited to proceed to the full proposal stage in January 2014 following positive evaluation by a joint scientific and impact panel with a funding decision on this application expected in Q4 2014.

The academic groups involved in the development of this proposal are engaging with a broad spectrum of industry players in the diagnostics field (both indigenous and multinational) and seeking their financial commitment to the program and guidance on research themes. IDA Ireland and EI have and will assist in providing introductions to companies where requested. SFI will also engage with diagnostic industry experts to assess the proposal. Hence this process is covering a number of the actions embedded in the action plan, such as identification of immediate and longer term research interests of industry and the exploration of the rationale for the creation of a Diagnostics development centre.

Furthermore, 'Diagnostics and Biomarkers in the area of Food for Health' and 'Personalised Medicine' were selected as themes in the SFI Investigators Programme 2014 call.

The Health Innovation Hub is now in place which will facilitate industry and healthcare system engagement to develop and validate products and services informed by health needs and support adoption and commercialisation of new innovations in the Diagnostics sector.

The Health Research Board has made commitments across a number of HRB schemes in 2013, where many biomedical animal health, and food focused researchers will cite diagnostics as an area where their research links to this research Priority Area. Several EI commercialisation fund and innovation partnership awards and DAFM's Stimulus and FIRM Programmes have also been awarded to fund applied research to take diagnostic technology closer to commercialisation.

On the Agri-food side, the growth and intensification of Irish animal production driven by Food Harvest 2020 targets and increased global demand for food has the potential to pose significant problems for animal health. It is important, therefore, to ensure that adequate investment is targeted towards the continued development of robust diagnostics for animal diseases of economic importance to Ireland (e.g. Johne's, mastitis, TB, parasitic infection, bluetongue, and infertility). Great opportunities exist to harness existing strengths within the field, leading to the future commercialisation of outputs.

From an FDI industry perspective the diagnostics space has been relatively quiet, with no recent investments from new name companies or expansions/R&D investments by existing clients in the last 18 months or in the short term pipeline.

G - Therapeutics - Synthesis, Formulation, Processing and Drug Delivery

Focus: This Priority Area is focused on developing competence and activity in pre-manufacturing research, technology and development areas responding to industry needs in Ireland in therapeutics/pharmaceuticals (for example, the manufacture and formulation of small molecules and bioprocessing research). Drug delivery is also an opportunity for further enterprise development based on innovative drug delivery systems.

Vision: To further embed, diversify and support the international competitiveness of (bio)-pharmaceutical manufacturing and process development (small molecules, biologic based therapeutics and vaccines) in Ireland by developing our public research capacity in drug synthesis, formulation and delivery.

Status on Implementation of Action Plan

Total Number of Actions: 15

Number with milestone to end Q1 2014: 13

Number complete or substantial progress recorded: 13

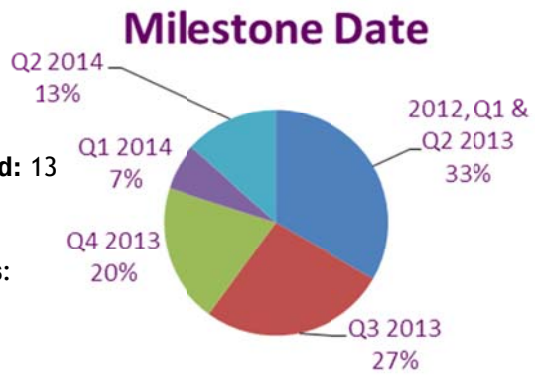
Champion: Dr Chantelle Kiernan, IDA Ireland

Participating Agencies / Government Departments:

IDA Ireland, EI, SFI, DJEI (through TI), IMB, IRC

First Milestone Date: Q4 2012

Final Milestone Date: Q2 2014



Progress on implementation of Action Plan for Priority Area G [Therapeutics - Synthesis, Formulation, Processing and Drug Delivery]

Ireland is a major manufacturer of pharmaceuticals and biologics, with 25,000 employed within 81 foreign companies based in Ireland and exports of €38.2 billion (2008). There are also small but growing indigenous pharma and drug delivery sectors. The main focus for Ireland within the field of therapeutics is to develop competence and activity in research, technology and development areas to support therapeutics manufacturing, for example, the manufacture and formulation of small molecules, biologics and associated process research.

As of Q1 2014 substantial progress has been made in addressing action items for this Priority Area with a 100% completion rate against all 13 actions due for the period 2012-Q1 2014. Implementation to date has predominately focused on the multinational (MNC) innovator therapeutics manufacturers, due to their significant on-shore presence.

The IDA Ireland-led Working Group (WG) which consists of EI, SFI, DJEI (through TI), IMB and IRC have met in different configurations over the implementation period to address the required action items.

Notable developments against actions are outlined below:

1. Understanding Current and Future Industrial Research Needs

- In 2013 IDA Ireland commissioned the Circa Group to undertake an external consultation with enterprise to compare the MNC Life Sciences research needs with the Priority Areas.
- EI has undertaken an external consultation to gauge indigenous companies current and future research interests relating to manufacturing.
- IDA Ireland has completed a Detailed Description of Needs (DDN) for both the Pharma and Bio Sector and has requested that the National Institute for Bioprocessing Research and Training (NIBRT - *Bio*) and the Pharmaceutical Manufacturing Technology Centre (PMTC - *Pharma*) periodically review and update with their associated industry members to ensure it remains current.
- NIBRT and PharmaChemical Ireland (PCI) members have established the Industry Tech Group which is now an official group in PCI that will evaluate industry needs on a rolling basis.
- SIA Group moderated an engagement session involving a broad range of agencies from the State sector to catalogue existing knowledge on enterprise research needs residing in each WG member organisation. The SIA Group findings and survey material are presently being collated into a first draft, once available these findings will contribute to the identification and prioritisation of future sub themes within this PA.
- A National Framework for Doctoral Education (including Structured PhDs) in Ireland is currently under development by HEA and QQI in partnership with HEIs with a view to completion on schedule in Q3 2014.
- The HEA have compiled a 'national database of existing research infrastructure in the HEIs: 'Large Items of Research Infrastructure' (LIRE)[9]. It has also developed a set of accompanying guidelines for access to the equipment.

9 www.hea.ie/content/large-items-research-equipment-database

2. Developing an Ecosystem to Support Therapeutics Manufacturing

- The *Pharmaceutical Manufacturing Technology Centre* (PMTC) was fully established in Q3 2013, hosted in the University of Limerick (EI/IDA Ireland funded). The PMTC Board includes representation from the two other major Bio Pharma research centres of scale i.e. NIBRT and the *Synthesis and Solid State Pharmaceutical Centre* (SSPC), to facilitate bilateral and multilateral research collaborations between enterprise and the 3 research centres.
- SFI has also continued to fund the Synthesis and Solid State Pharmaceutical Centre (SSPC) as part of the SFI Research Centres 2012 Programme. SSPC is centred at UL and is a joint initiative bringing together 90 top-class researchers from 7 further higher education institutes, in addition to 17 industry partners. The primary scientific aim of SSPC is to better understand mechanisms and control processes and to predict outcomes for the efficient and environmentally sustainable production of medicines. The economic objective of the SSPC research is to help the pharmaceutical sector to migrate towards more R&D activities, in addition to providing highly-trained scientists and engineers to the sector. Ultimately, this strategy will position Ireland as a global hub for the pharmaceutical industry.
- A major development in 2013 was the recruitment of Michael Zaworotko (Department of Chemistry, University of South Florida) to the University of Limerick. Professor Zaworotko is an internationally recognised leader in crystal engineering and co-crystallisation and ranks 20th in the world in terms of highest citation impact score in the field of chemistry.
- *'Production of Biological Therapeutics'* was selected as a theme in the SFI Investigators Programme 2014 call.
- The IMB[10] is now actively engaging with IDA Ireland and a presentation on the future manufacturing and research needs of the Therapeutics Sector was given to an IMB team of site reviewers. All are in agreement that this process should continue as a regular occurrence. Similarly NIBRT have developed strong relations with the IMB and the Food and Drug Administration (FDA) and has provided training programs to the regulators.
- The IMB participated as mentors in the Health XK project in 2013 to give guidance on the regulatory pathway for start-up companies.

3. Consolidating the Research Ecosystem- Strengthening the 'Therapeutics' Brand and Improving Collaboration

- An Academic Research Landscape review is in progress as part of a cross agency initiative cataloguing current research capacity underpinning this RP area. This should also facilitate in a gap analysis for future requirements.
- The 3 main centres supporting this Priority Area (PMTC, NIBRT, and SSPC2) have collaborated with the agencies in consultation with DJEI/Technology Ireland to inform the development of a national framework for a coherent approach to branding and marketing research centres. As part of this exercise Ireland's key research competencies in the Therapeutics area have been identified. This exercise has informed the approach to branding and marketing Ireland's research capability across research centres of scale in a coherent manner in this and the other 13 Priority Areas. Work will continue in 2014 to roll out this national framework.
- Two research centres have collaborated in submitting a joint application for the SFI 'Spokes Centres' funding call which if successful would further bolster collaborative activity aligned to this Priority Area.

[10] from 1 July 2014, the Health Products Regulatory Authority, HPRA

Next Steps

Important considerations for the next phase of the implementation of this action plan include:

- Broadening actions to address the research needs of the wider therapeutics manufacturing ecosystem, including sectoral sub-supply, both indigenous and multinational, with a view to developing the research capacity necessary to support the entire value chain.
- Evaluating the future research needs of the indigenous sub-supply firms in this sector.
- Biologics Manufacturing has been identified as a growing and strategically important opportunity for Ireland. A gap analysis of Ireland's research capacity relevant to this sector would bolster Ireland's efforts to exploit this opportunity.
- Forthcoming H2020 calls that could support this Priority Area.

H - Food for Health

Focus: This Priority Area is focused on building the capacity to develop and produce functional foods or ingredients in Ireland. The challenge is to ensure full integration of the research base and enterprise to enable product development and validation of product claims to meet regulatory requirements.

Vision: Invest strategically in Foods for Health research to drive innovation and enable the food sector to achieve its full potential in a sustainable manner thereby contributing to the achievement of the overall Food Harvest 2020 Vision of Acting Smart, Thinking Green, and Achieving Growth, increasing public awareness of the role of nutrition, thereby supporting population health.

Progress on Implementation of Action Plan

Total Number of Actions: 21

Number with milestone to end Q1 2014: 3

Number complete or substantial progress recorded: 3

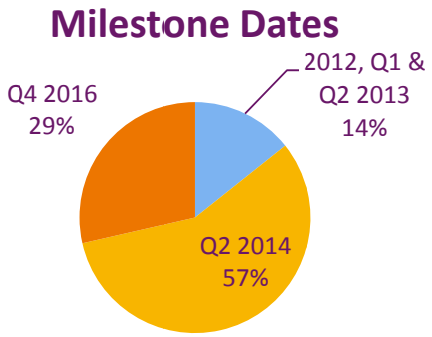
Champion: Richard Howell, Dept. Agriculture, Food & the Marine

Participating Agencies / Government Departments:

DAFM, HEA, EI, Teagasc, SFI, HRB & MI

First Milestone Date: Q4 2012

Final Milestone Date: Q4 2016



I - Sustainable Food Production and Processing

Focus: This Priority Area is focused on sustainable, competitive and efficient:

- Agri-food production;
- Marine fisheries and seafood;
- Food processing including manufacture of safe, value added and innovative foods.

Vision: Invest strategically in Sustainable Food Production & Processing research to drive innovation and enable the sector to achieve its full potential in a sustainable manner thereby contributing to the achievement of the overall Food Harvest 2020 Vision of Acting Smart, Thinking Green, and Achieving Growth.

Progress on Implementation of Action Plan

Total Number of Actions: 15

Number with milestone to end Q1 2014: 4

Number complete or substantial progress recorded: 4

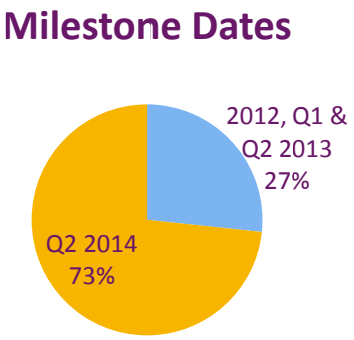
Champion: Richard Howell, Dept. Agriculture, Food & the Marine

Participating Agencies / Government Departments:

DAFM, HEA, EI, MI, EPA, SFI and Teagasc

First Milestone Date: Q4 2012

Final Milestone Date: Q2 2014



Progress on implementation of Action Plans for Priority Areas I, H [Food for Health; Sustainable Food Production and Processing]

There has been significant progress to date in implementing this Action Plan with considerable activity by all concerned across the board. Some of the highlights and details are outlined below:

Objective 1: Develop a Strategic Research Agenda in line with Food Harvest 2020

The DAFM led Working Group (WG) comprising all relevant funders (DAFM, Teagasc, MI, EI, SFI, IDA Ireland, IRC, HEA, & EPA) formed to undertake this work met on 4 occasions over the past year in addition to progressing matters via numerous email exchanges. The Group agreed to conduct (and has since progressed) the work along the following lines:

- Agreed at the outset that the Strategic Research Agenda (SRA) should also include Innovation (SRIA); that it should be a relatively short high level document capable of being regularly reviewed and updated comprising 4 chapters: Introduction/Context; SRIA proper; Implementation modalities; and Methodology. It will also need to be cross-referenced to relevant Joint Programming Initiative (JPI)[11] actions.
- Agreed to draw on existing "intelligence" residing in each WG member organisation resulting from previous surveys and routine day to day contact with their respective client bases including, in particular, those involving industry stakeholders along the food production & processing chain.
- Decided to conduct a web based survey of all relevant stakeholders aimed at updating, supplementing and reality checking existing intelligence. This was undertaken by posting letter and form on the DAFM website, with links to it on a number of other funder websites, and then each WG member plus Bord Bia and Food and Drink Industry Ireland (FDII) of IBEC alerted/encouraged their clients via email to avail of the opportunity to make a submission. The survey ran from 18th February to 2nd April and resulted in 46 submissions many from major players in the food industry.
- SIA Group moderated engagement session involving a broader range of agencies from the State sector held on 2nd October 2013.
- The funder intelligence, SIA Group findings and the survey material is presently being collated into a manageable format and a first draft of the entire document prepared. This will then be considered by both the WG (or subset thereof) and the DAFM hosted, industry led, Expert Advisory Group on publicly funded Agri-food research over summer 2014 with a view to refining and prioritising the content and finalising all 4 parts of the SRIA before submitting to the RPAG.

Meanwhile the various funders have addressed the other elements of this objective by ensuring a well-coordinated approach to new funding of research relating to these 2 Priority Areas. This is being achieved through regular exchange of information; inclusion of complementary topics in planned calls (e.g. EI and DAFM on dairy processing); involvement in each other's coordinating and evaluation processes (e.g. EPA Water and Climate Change Coordination Committees); and joint funding arrangements (e.g. Teagasc with SFI for 'Future Agri-Food'; DAFM and Teagasc with IRC for Employment-based Postgraduate Scheme). A well-coordinated approach to Irish investment in relevant JPI (FACCE[12], HDHL[13] and to a lesser extent Water and Climate) and ERANET (e.g. ICT Agri;

11 http://ec.europa.eu/research/era/joint-programming_en.html

12 https://www.faccejpi.com/

ANIWHA[14)] actions has also been assured through the operation of Steering Committees operated by DAFM and the EPA.

In addition, relevant funders have continued significant investment in research and innovation relevant to these PAs including, for example, SFI phase 3 support for the APC Centre and inclusion of *Sustainable Food* in its 2013 Centres Call; EI renewal of support for the Food for Health Technology Centre (Food for Health Ireland) and progression to near finalisation of the new Dairy Processing Technology Centre; HRB funding for a 2nd term of the Centre for Health and Diet Research and support for a networking initiative under the DEDIPAC[15] pillar of the *Healthy Diet for a Healthy Life* JPI; DAFM continuance of institutional capacity/capability maintenance/building awards under its 2013 & 2014 Calls; EPA scoping study on research needs relating to Water Quality & Agriculture.

Objective 2: Ensure that the skillsets of graduates, postgraduates and researchers are relevant to the needs of stakeholders and ensure that a critical mass of researchers is in place to deliver on the Vision

- A National Framework for Doctoral Education (including Structured PhDs) in Ireland is currently under development by HEA and QQI in partnership with HEIs with a view to completion on schedule in Q3 2014.
- DAFM has included a topic in its 2014 Competitive Call to facilitate continuation/renewal of its successful Agri-Food and Forestry Graduate Development Programme providing transferable skills for students and researchers engaged in publicly funded Agri-food research projects. DAFM also intend discussing possibilities for joint funding with other funders.

Objective 3: Ensure research outputs from State funded research are exploited in accordance with the National IP Policy for the maximum benefit of the State, society and enterprise.

- DAFM is in the process of renewing and combining the 2 industry-led Research Expert Advisory Groups that it has hosted under Food Harvest over the last several years into a single broadly-based stakeholder entity. This group will, *inter alia*, help guide the content of the SRIA and subsequently monitor the translation of resulting research outputs into innovation actions; act as national platform for relevant European Technology Platforms; identify pain points and weaknesses in the national support system; and inform development of all issues in the Action Plan.
- Further round of investment by EI in RPO based TTOs via its *Technology Transfer Strengthening Initiative*.
- Teagasc continues to roll out its new Gateways Technology and Knowledge Transfer Strategy providing technology offers, updates, expertise and services to the food industry through a dedicated team of researchers designated as Customer Relationship Managers each responsible for a portfolio of clients.
- While the primary purpose of the EPA Research Programme is support for policy and to develop solutions for environmental challenges, in so far as is possible without compromising its primary mission, the EPA will seek to lever its investments for economic impact too.

13 http://www.healthydietforhealthylife.eu/

14 https://www.anihwa.eu/

15 https://www.dedipac.eu/

Objective 4: Ensure existing infrastructure is fit for purpose and managed appropriately and that future infrastructure needs are identified

The HEA-compiled database of Large Items of Research Infrastructure (LIRE) in the HEIs will, when extended to include Teagasc, be quite helpful for the cost effective progression of the APs especially if the National Guidelines on Access to Infrastructure is endorsed and routinely embedded in the custom and practice of the RPOs. The recent EPA/Teagasc co-funded National Soils Database and the Soil Information System (due for launch in September 2014) constitute a major e-Infrastructure in relation to Soils and Land use.

Science Foundation Ireland funded the Alimentary Pharmabiotic Centre (APC) as part of the SFI Research Centres Programme 2012. APC is a joint initiative that brings together researchers from UCC, Cork IT and Teagasc, in addition to at least 13 key industry partners. APC will align internationally recognised Irish research capabilities to focus on linking Irish science with industry and society through excellence in research, education and outreach in gastrointestinal health. Specifically, the Centre will perform world-class research into the link between gut microbiota and human health, leading to the development of future foods and medicines. APC will directly support 109 top-class research jobs.

'Sustainable Food Production and Processing' was selected as a theme in the SFI Research Centres Programme 2013 call. A pre-proposal was invited to proceed to the full proposal stage in January 2014 following positive evaluation by a joint scientific and impact panel with a funding decision on this application expected in Q4 2014.

'Sustainable Food Production and Processing' and 'Diagnostics and Biomarkers in the area of Food for Health' were selected as themes in the SFI Investigators Programme 2014 call. Furthermore, a strategic version of the SFI Research Professorship Programme launched in Q2 2014 will seek to build capacity in the ‘Food Security’, ‘Sustainable Food Production’ and ‘Sensory Food Science’ sectors.

J - Marine Renewable Energy

Focus: The focus of this Priority Area is to position Ireland as a research, development and innovation hub for the deployment of marine renewable energy technologies and services. This would facilitate the creation of an early stage industry and research cluster and open up the possibility of becoming a significant exporter of electricity. The development and testing of ICT applications in a marine environment (based on the Smart Ocean concept) could be supported to enable this Priority Area.

Vision: To position Ireland as a research, development and innovation hub that will leverage the Irish enterprise base and maximise the economic benefit to Ireland from the development and future deployment of marine renewable energy resources, and specifically to:

- Drive the earliest feasible deployment at scale of marine renewable energy technologies and services;
- Create an industry and research cluster leading to sustainable marine energy commercialisation, a vibrant industry and job creation in Ireland;
- Develop the competitive technical and systems capacity to meet future renewable electricity needs of Ireland and of European export markets; and
- Develop and test new enabling ICT applications in the marine environment based on the Smart Ocean concept.

Progress on Implementation of Action Plans

Total Number of Actions: 22

Number with milestone to end Q1 2014: 10

Number complete or substantial progress recorded: 6

Champion: Kevin O'Rourke/David McAuley,

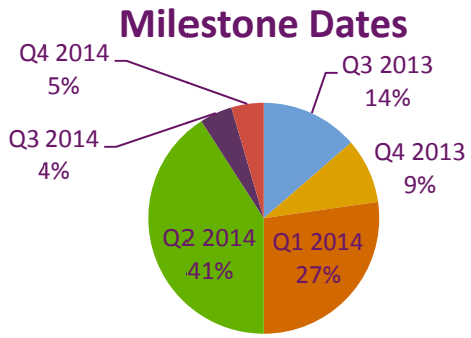
Sustainable Energy Authority of Ireland

Participating Agencies / Government Departments:

DCENR, SEAI, HEA, EI, IDA Ireland, EPA

First Milestone Date: Q3 2013

Final Milestone Date: Q4 2014



Progress on implementation of Action Plan for Priority Area J [Marine Renewable Energy]

Within its renewable energy targets, Ireland has set itself a target of 500MW of ocean energy capacity by 2020. Given the current state of development of the suite of power conversion, transmission and ICT technologies in this environment, this represents a very significant challenge to which industry will be looking to academic researchers for innovative solutions.

The DCENR commitment to the ongoing development of this Priority Area was re-affirmed in February 2014, with the publication of *The Offshore Renewable Energy Development Plan* with a vision of "our offshore renewable energy resource contributing to our economic development and sustainable growth, generating jobs for our citizens, supported by coherent policy, planning and regulation, and managed in an integrated manner" The plan will be implemented by the Offshore Renewable Energy Steering Group (ORESG).

The Energy Research Portal16 has been re-designed to reflect the underlying action plan themes and to support information sharing. Further development is underway to simplify data collection and "layered" research infrastructural maps will become available on the portal in mid-2014.

Research Centres such as UCC's Hydraulics and Maritime Research Centre (HMRC) have attracted significant EU funding from the EU's Seventh Framework Programme for ocean energy projects and pan-European network development over the period 2007-2013. Many of these projects are ongoing. Changes in Horizon 2020, however, will mean that adoption of Technology Readiness Levels (TRL) will be critical as Ocean energy projects will need to compete with other technologies at similar TRLs.

The latest enterprise supports include the SEAI prototype development fund, the development of the Atlantic Marine Energy Test Site (AMETS), and the Galway and Cork test sites. A market support tariff of €260/MWh for the first 30MW of installed wave and tidal devices awaits successful technologies, promoting commercial interest in developing in Ireland.

The first pre-commercial scale wave energy deployment may come from ESB's WestWave Project, with potential EU NER300[17] support of €23.5 million.

Supply chain studies are underway to assess current Industry/SME capacity in meeting the needs (including skills) of the growing renewable and energy efficiency industries. The distinction between wave, tidal and offshore wind capability will become evident from these studies.

Overall, this Priority Area is developing well at a national level, with clear policy interventions, and a growing RDI community.

Science Foundation Ireland (SFI) has funded the Marine Renewable Energy Ireland (MaREI) Research as part of the SFI Research Centres Programme 2012 in Q2 2013. MaREI is located at UCC but is a joint initiative also bringing together researchers at UCD, CIT, UL, NUIG, NUIM, Marine Institute and Teagasc, in addition to approximately 45 industry partners. MaREI will conduct world-leading research in all aspects of marine renewable energy from marine robotics and materials, to ocean conditions, offshore wind, wave and marine energy devices. They will also develop technologies to deliver power to the grid for electricity supply at home and abroad. This investment has the potential to position Ireland at the forefront of the marine renewable energy research sector globally. MaREI will directly support 77 jobs and has the potential to support the creation of significant employment in the long-term through spin-out companies and intellectual property in

16 http://www.seai.ie/research

17 http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

the field of marine renewable technology and marine energy materials, devices and solutions for industry.

To address research gaps and build capacity, SFI launched the SFI Research Centres Programme 2013 and the SFI Investigators Programme 2014 as Themed Calls. Theme selection was based on an analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has an opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and wider stakeholder consultation.

Following a review of the above criteria, 'Energy and Environmental Sustainability' was selected as a theme in the SFI Investigators Programme 2014 call. Furthermore, a strategic version of the SFI Research Professorship Programme launched in Q2 2014 will seek to build capacity in the 'Marine' sector.

SFI is also continuing to fund into this sector through bottom up calls with funding committed through the SFI Investigators Programme 2013.

K - Smart Grids and Smart Cities

Focus: This Priority Area is focused on the development of Smart Grids and Smart Cities using a layer of technologies (including software, sensor hardware and control and interface systems) and design solutions to more effectively and efficiently manage complex infrastructure systems, enable greater resource efficiency and help move to a low carbon society.

Vision: To invest strategically in positioning Ireland as a research, development and innovation hub in Smart Grid and Smart Cities, capitalising on Ireland's unique resources and attributes, leveraging the enterprise base and maximising the economic benefit to Ireland from developing these technologies, and specifically to:

- Position Ireland as an innovation test bed and location of excellence in the development, testing and scale deployment of technology products and services enabling smart grid and smart cities implementation;
- Develop and apply intelligent flexible systems and components for real time end-to-end supply and demand management of electricity and other key municipal services;
- Enable achievement of renewable energy, energy efficiency and CO2 abatement targets to 2020 and beyond, and enabling renewable energy export;
- Support an industry and research cluster leading to product and services commercialisation, a vibrant export industry and job creation.
- Position Ireland as an exemplar of sustainable, efficient and secure electricity services and of smart cities and communities.

Progress on Implementation of Action Plans

Total Number of Actions: 20

Number with milestone to end Q1 2014: 10

Number complete or substantial progress recorded: 7

Champion: Kevin O'Rourke/David McAuley,

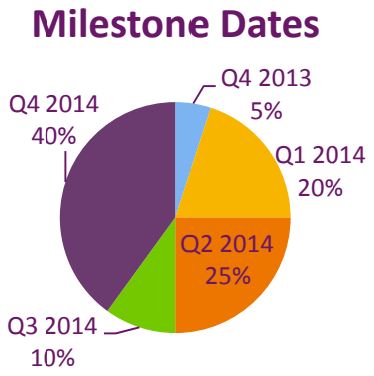
Sustainable Energy Authority of Ireland

Participating Agencies / Government Departments:

DCENR, SEAI, HEA, EI, IDA Ireland, EPA

First Milestone Date: Q4 2013

Final Milestone Date: Q4 2014



Progress on implementation of Action Plan for Priority Area K [Smart Grids and Smart Cities]

Smart Grids and Smart Cities involve the application of advanced electrical engineering and service technologies, facilitated by ICT and accompanying solutions to more effectively and efficiently manage complex infrastructure systems. They open up new markets for existing and new technologies, with the level of system benefits justifying their use within major infrastructural investments. They typically use a layer of technology, including software, sensor hardware and control and interface systems, which can be embedded in the design of new infrastructure or applied to existing infrastructure, harnessing and applying real time data to create more intelligent, interconnected and integrated systems which provide higher quality and higher efficiency services to the citizen. Ireland has particularly strong research and operational experience in active implementation of ambitious energy and community policies, a recognised industrial research base in software, data management and wider ICT, and an advanced electricity system. Together these can provide a potential competitive advantage with respect to developing world leading solutions in these fields, attracting future FDI and stimulating indigenous enterprise in this sector.

The Smart Grids and Smart Cities action plan, launched in July 2013, has helped to focus co-ordination activities across multiple agencies already pursuing development in this emerging sector. Many stakeholders, including industry, have helped to identify the challenges and highlight opportunities in this research priority.

The Energy Research Portal[18] has been re-designed to reflect the underlying action plan themes and to support information sharing. Further development is underway to simplify data collection and "layered" research infrastructural maps will become available on the portal in mid-2014.

The 2014/2015 EU Horizon 2020 Energy programme offers significant opportunities in its "Smart Cities and Communities" and "Competitive Low-Carbon Energy" calls. The Joint Agency Project Team, JAPT (SFI, SEAI, EI and IDA Ireland) are working with key research centres (Beaufort Research, IERC, and ERC) and industry to develop targeted applications for high value projects.

The Smart Grid Implementation Advisory Steering Group, comprising DCENR, EirGrid, ESB Networks, Enterprise Ireland, IDA Ireland, SEAI, SFI and Smart Grid Ireland provide strategic planning for smart grids and smart cities support, including, for example, the development of a distributed National Test Bed in this Priority Area.

A recent survey of more than 100 commercial organisations gathered their opinions on the smart grid and smart cities sector, identifying the main drivers, technology enablers and future opportunities. This has revealed many useful insights. It is evident that most of the necessary infrastructure is already available and it provides a range of useful facilities and test beds. Other insights, such as disparities between the needs of electricity system operators and the focus of technology developers highlight the need for the adoption of recognised Technology Readiness Levels, for instance.

In skills, the Irish Research Council and SEAI have signed a memorandum of understanding in relation to co-funding of PhD students in energy technologies. Upcoming legislative changes in how energy qualifications and training are provided (EU Energy Efficiency Directive) may help in developing a national framework for energy skills.

State-supported initiatives like Tyndall's International Energy Research Centre (IERC) combine industrial and academic researchers to develop and test some of the protocols, products and services essential for smart energy technologies to mature in Ireland.

18 http://www.seai.ie/research

To address research gaps and build capacity, SFI launched the SFI Research Centres Programme 2013 and the SFI Investigators Programme 2014 as Themed Calls. Theme selection was based on an analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has an opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and wider stakeholder consultation.

Following a review of the above criteria, the NRPE area K; 'Smart Grids and Smart Cities' was selected as a theme in the SFI Research Centres Programme 2013 call. Furthermore, a strategic version of the SFI Research Professorship Programme launched in Q2 2014 will seek to build capacity in the 'Smart Cities' sector.

SFI is also continuing to fund into this sector through bottom up calls with funding committed to proposals as part of the Investigators, TIDA 2013 and Industry Fellowship 2013 Programmes.

L - Manufacturing Competitiveness

Focus: This Priority Area is focused on the development and application of technology and knowledge management systems to reduce costs, eliminate waste, drive resource efficiency and improve product quality for increased competitiveness.

Vision: To further enhance the innovative capacity of the manufacturing base (for increased competitiveness and productivity) by harnessing new knowledge to underpin this industry with the core competencies required to be energy and resource efficient, ICT enabled, and a leader in quality. By 2020 Ireland will be:

- Creating more resource efficient and effective manufacturing systems;
- Securing manufacturing technologies against scarcity of energy and other resources;
- Creating innovative products and processes by embracing leading edge technologies;
- Developing new agile, more cost effective manufacturing processes and technologies; and
- An internationally recognised hub for "quality" in manufacturing.

Progress on Implementation of Action Plan

Total Number of Actions: 16

Number with milestone to end Q1 2014: 14

Number complete or substantial progress recorded: 13

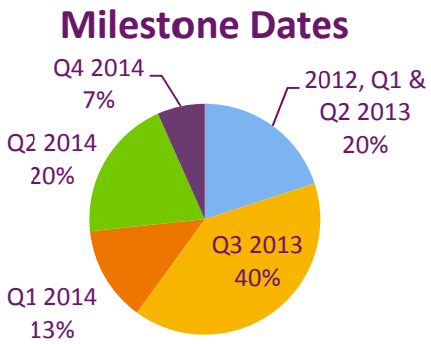
Champion: Deirdre Glenn, Enterprise Ireland

Participating Agencies / Government Departments:

EI, SFI, EPA, IDA Ireland, DAFM and DJEI (through TI)

First Milestone Date: Q4 2012

Final Milestone Date: Q4 2014



M - Processing Technologies and Novel Materials

Focus: This Priority Area is focused on enabling the Irish manufacturing base to transition into one with enhanced capabilities in processing technologies and materials science and engineering.
Vision: To further enhance the innovative capacity of the manufacturing base (for increased competitiveness and productivity) by harnessing new knowledge to underpin this industry with the core competencies required to be energy and resource efficient, ICT enabled, and a leader in quality. By 2020 Ireland will be:

- Creating more resource efficient and effective manufacturing systems;
- Securing manufacturing technologies against scarcity of energy and other resources;
- Creating innovative products and processes by embracing leading edge technologies;
- Developing new agile, more cost effective manufacturing processes and technologies; and
- An internationally recognised hub for "quality" in manufacturing.

Progress on Implementation of Action Plans

Total Number of Actions: 16

Number with milestone to end Q1 2014: 14

Number complete or substantial progress recorded: 13

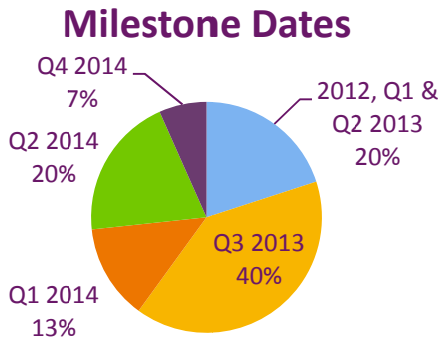
Champion: Deirdre Glenn, Enterprise Ireland

Participating Agencies / Government Departments:

EI, SFI, EPA, IDA Ireland, DAFM and DJEI (through TI)

First Milestone Date: Q4 2012

Final Milestone Date: Q4 2014



Progress on implementation of Action Plans for Priority Areas L, M [Manufacturing Competitiveness; Processing Technologies and Novel Materials]

A key driver of the manufacturing industry is competitiveness. Competitive manufacturing employs a systematic approach to produce high quality products, components and materials at the least cost and with the least waste. Competitive manufactures use highly talented innovative people to design and develop products and processes that utilise inputs such as materials, components, energy and scientific knowledge. These inputs are then transformed into innovative products that both define and meet customer needs. Ireland needs to be internationally known as a hub of excellence for manufacturing competitiveness in order to sustain and grow this industry nationally. Irrespective of size or ownership, the adaption and utilisation of new knowledge is critical for manufacturing competitiveness.

In order to grow and sustain the Irish based manufacturing industry, Ireland must have the technological capacity and capabilities required for next generation manufacturing. The next generation of manufacturing industries will require continual and radical innovation focused on processing technologies and the utilisation of new materials. Successful implementation of this research Priority Area will result in the technological upgrade of the Irish based manufacturing companies; assist in attracting and retaining foreign owned companies; and, contribute to the creation of a workforce with the capabilities required for next generation manufacturing.

Significant progress has been made to date to deliver on two of the manufacturing-linked Research Priority Area action plans; Manufacturing Competitiveness; and Processing Technologies and Novel Materials. Some of the highlights of this work are outlined below.

1. Understanding Industry's Research Needs

A significant amount of work has taken place, led by EI and IDA Ireland, to determine the research needs of the manufacturing industry (both large and small companies across sectors). Working in consultation with DJEI and other funding agencies these industries needs have been mapped against the current public research activity to assess any gaps in research and capacity. Two specific gaps have been identified to date:

- Manufacturing Competitiveness research
- Additive Manufacturing research and infrastructure

EI and IDA Ireland are continuing to engage with manufacturing firms to determine their research needs. In particular, the enterprise agencies are currently embarking on an exercise with industry to assess the business case for further public and/or private investment in applied research infrastructure and core operational funding to support high value manufacturing sectors (e.g. Medical Technologies).

2. Funding Research and infrastructure to meet the needs of Industry

Significant progress has been made to date;

EI and IDA Ireland are in the process of merging two existing Technology Centres (I2E2 and ICMR) to form the Irish Centre for Manufacturing Research Technology Centre. This centre will focus on market-driven research to address the strategic manufacturing challenges of competitiveness, sustainability and efficiency.

SFI funded the AMBER Research Centre as part of the SFI Research Centres 2012 Programme in Q2 2013. AMBER is a joint initiative bringing together 99 researchers from TCD, UCC and RCSI, in addition to 18 industrial partners. The primary aim of AMBER is to deliver internationally leading materials research that will be industrially and clinically informed, with outputs including new discoveries and devices in ICT, medical device and industrial technology sectors.

SFI launched the SFI Research Centres 2013 and the SFI Investigator Programme 2014 as Themed Calls. Theme selection was based on analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and a wider stakeholder consultation.

Following a review of the above criteria the NRPE area L; 'Manufacturing Competitiveness' was selected as a theme in the SFI Research Centres 2013 call. In January 2014, research groups were invited to submit a full proposal with a funding decision on this application expected in Q4 2014. Furthermore, 'Manufacturing Competitiveness' and 'Processing Technologies and Advanced Materials' were selected as themes in the SFI Investigators Programme 2014 call.

The HEA has developed institutional profiles for all higher education institutions which include details of their research activity levels. It has also entered into a process of Strategic Dialogue with each of the institutions through which their individual research activities and strengths are being monitored and strategically highlighted. The HEA have compiled a 'national database of existing research infrastructure in the HEIs: 'Large Items of Research Infrastructure' (LIRE)19. It has also developed a set of accompanying guidelines for access to the equipment.

In terms of research infrastructure, Forfás have initiated an exercise to investigate if an RTO (Research and Technology Organisation) is an appropriate model for research infrastructure for manufacturing in the Irish context.

3. Ensuring the Availability of appropriately skilled researchers to meet the needs of Industry

A number of initiatives have been launched to address capacity and skill needs in this sector including;

The HEA is currently developing a strategy for improving the interface with employers, following the National Strategy for Higher Education objectives and Roadmap for Employment – Academic Partnerships (REAP) 2011 guidelines for enhancing industry-academic engagement in the provision of skills. A National Framework for Doctoral Education is also being developed by the Authority with QQI and in partnership with the HEIs – with a view to completion on schedule by Q3 2014.

The Irish Research Council launched the Employment-Based Postgraduate Programme ('industrial Masters and PhDs') funding talented researchers to work in industry on site with their enterprise mentor on innovative research ideas, and the Programme is a partnership across all funders. The Programme, which is a co-educational experience, is demand led by enterprise but applications from the 14 Priority Areas are specifically encouraged. Enterprise Ireland is acting as a strategic promotion partner promoting the EBP Programme to employers across the economy. The Programme builds on the Enterprise Partnership Scheme whereby students and postdocs are jointly funded by enterprise and the IRC to conduct research whilst based at a HEI.

A strategic version of the SFI Research Professorship Programme was launched to build capacity in the 'Manufacturing (Advanced Manufacturing / Manufacturing Competitiveness)' and

19 www.hea.ie/content/large-items-research-equipment-database

‘Biomanufacturing’ sectors. 'Manufacturing Competitiveness' and 'Processing Technologies and Advanced Materials' were also selected as themes in the SFI Investigator Programme 2014 call.

Next Steps

A major focus of the next phase on the implementation of the actions for the Manufacturing Competitiveness; and Processing Technologies and Novel Materials Research Priority Areas will be to ensure the most appropriate funding mechanisms are put in place to address the research gaps identified and to build capacity as required.

In addition, the availability of appropriately skilled researchers continues to be of critical importance to the manufacturing industry. The HEA, in consultation with the Expert Skills Group on Future Skills Needs, and other funding agencies are undertaking a number of actions to address the ongoing skills gap and to ensure the availability of appropriately skilled researchers to meet the needs of this industry.

N - Innovation in Services and Business Processes

Focus: This Priority Area is focused on enabling both the manufacturing and service sectors to innovate their service offering, service delivery and business processes. Examples include: servitisation of manufacturing, smarter commerce, business model innovation and risk governance.

Vision: To capture customer centric innovation that combines non-technological and technological know-how in order to conceive and develop new globally successful operating models, products and business processes. Inherent to this is:

- Understanding consumer behaviour in order to extract real time information for the production and design of products and services;
- Understanding human interaction with IT for concept development and design;
- Monetising mechanisms for new service opportunities;
- Utilisation of technology for management of business processes; and
- Legal affairs such as regulatory and competition analysis.

Progress on Implementation of Action Plan

Total Number of Actions: 10

Number with milestone to end Q1 2014: 9

Number complete or substantial progress recorded: 9

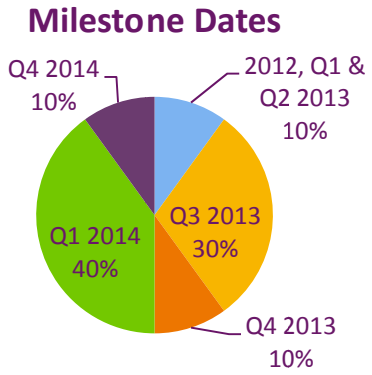
Champion: Emmanuel Dowdall, IDA Ireland

Participating Agencies / Government Departments:

SFI, EI, IDA Ireland, Teagasc, IRC, HEA and Forfás

First Milestone Date: Q4 2012

Final Milestone Date: Q4 2014



Progress on implementation of Action Plan for Priority Area N [Innovation in Services and Business Processes]

This Priority Area is unique in that firstly, it is cross-cutting, i.e. spanning multiple, if not, all enterprise sectors. Secondly, it is also a nascent area as it has not been considered as a theme in its own right prior to the NRPE. In order to address this uniqueness and to "kick-start" activity in the area, Forfás undertook a study, under the auspices of the Research Prioritisation Action Group (RPAG), to identify how Ireland might best support RD&I in Innovation in Services and Business Processes (ISBP).

The research found a growing awareness among businesses of the need to innovate in services and business processes for success in markets, and that correspondingly, public support measures and publicly-funded research programmes need to adjust to better support ISBP.

The final report, 'Assessment of Publicly Funded RD&I Supports for Innovation in Services and Business Processes', sets out a detailed roadmap and associated actions to ensure that public supports for ISBP in Ireland are aligned with international best practice.

The report was adopted by RPAG at its meeting in March and implementation of the recommendations is to be progressed through the RPAG. An advisory group comprising representatives from Forfás, IDA Ireland, EI, SFI and IRC has been established to facilitate implementation. The advisory group is chaired by IDA Ireland with EI as deputy chair.

The Advisory Group is specifically addressing the following recommendations from the report:

1. **Reviewing existing RD&I instruments**

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

2. **Building interdisciplinary skills capacity**

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

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

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

4. **Initiating a major public services initiative in ISBP**

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

The Advisory Group will report to RPAG on progress made regarding the implementation of these recommendations.

SFI have a number of initiatives underway to support this Priority Area. To address research gaps and build capacity, SFI launched the SFI Research Centres Programme 2013 and the SFI Investigators Programme 2014 as Themed Calls. Theme selection was based on an analysis of gaps in SFI's portfolio of awards, sectors of importance to the Irish economy, a review of Priority Areas, emerging areas where Ireland has an opportunity to lead, gaps identified from Research Centres mapping (Technology Ireland), enterprise needs, areas of focus from the Action Plan for Jobs, potential areas of focus in Horizon 2020, SFI's Agenda 2020, relevant needs of sister agency/dept. strategy and wider stakeholder consultation.

Following a review of the above criteria, *'Innovation in Services and Business Processes'* was selected as a theme in the SFI Investigators Programme 2014 call. In addition, a strategic version of the SFI Research Professorship Programme launched in Q2 2014 will seek to build capacity in the ISBP sector.

Furthermore, in view of the multidisciplinary nature of this Priority Area and the fact that conventional funding mechanisms may not be appropriate for the funding of research in this area, SFI is to promote the principles of *'Innovation in Services and Business Processes'*, as outlined in the Forfás-commissioned CMI report, in all of the SFI Research Centres.

5. Research for Policy and Practice; and Research for Knowledge

In addition to the 14 Priority Areas outlined in the Report of the Research Prioritisation Steering Group, the report acknowledges the importance of continued research funding to support:

a) Research for Policy and Practice (research that Government departments and their agencies undertake or commission in pursuit of specific policy objectives and mandates) and

b) Research for Knowledge (support for excellent research in new and unanticipated research areas)

Together, these areas address important societal challenge, including ensuring the well-being of Irish citizens and protecting our environment.

Research for Policy and Practice is important in helping the Irish Government to achieve its policy objectives. Research programmes designed to inform the policy process play a vital role in agenda setting and increase the likelihood of translating important findings in relation to health, education, the terrestrial and ocean environments, social and societal development and other research domains into feasible and implementable services and systems. This research also helps us in meeting our policy responsibilities at minimum cost; encourages innovation; and supports productivity and fiscal integrity by actively seeking new and better ways of doing things. Research for Policy and Practice not only informs national policy but also national positions and responses at international level. In many areas, policy is negotiated within the EU context, out of which emerge obligations, regulations and income transfers. The quality of our negotiating effort is directly shaped by the quality of the evidence-based research that we bring to the negotiating table. Key examples of achievements in Research for Policy and Practice during the reporting period include:

- Provision of support, under the auspices of the European Joint Programme 'A Healthy Diet for Healthy Life', for Irish researchers to participate in a Knowledge Hub to develop a research agenda on **Determinants of Dietary and Physical Activity (DEDIPAC).** The Hub will boost transnational cooperation, multi-and inter-disciplinary collaboration among research communities and shape a joint policy research agenda.
- Publication of a report, **Environmental Protection through Research** in 2013 that outlines the vital role that EPA-funded research evidence has played in helping to: identify and tackle environmental challenges in the areas of climate change, water and sustainability; in developing novel solutions to protect Ireland's environment; and in ensuring that EU and national environmental policies are implemented in the most cost-effective manner.
- Completion of a **Department of Agriculture, Food and the Marine** supported study, under the CoFoRD forest research programme, to identify the factors that influence farmers' decision-making processes with respect to afforestation, which identified a number of key issues and generated a suite of recommendations for policy-makers which could help increase afforestation levels.
- Policy simulation models developed by **Teagasc** have been used extensively to provide evidence to inform negotiating positions by the Irish Government in international policy negotiations. These include the Common Agricultural Policy, International trade agreements, Rural Development policy, Climate Change agreements and EU Environmental Directives.
- The Government's Integrated Marine Plan for Ireland (Harnessing Our Ocean Wealth), published in July 2012, sets out three over-arching goals for, and implementation of, a new **Strategic Marine Research and Innovation Strategy for Ireland (2014-2020),** currently in

preparation, which seeks to identify, initiate and support the research priorities needed to achieve the Integrated Marine Plans objectives.

- The publication of an independent study of recommendations **from Inquiries into events in families and their interactions with State services**, and their impact on policy and practice (Department of Children and Youth Affairs and Irish Research Council, Government Publications 2013).
- SFI's **Policy PhD Fellowship** programme provides postgraduates with a research experience that focuses on various aspects of RD&I investment and its impact in small advanced nations such as Ireland. The outputs will prove invaluable to the Foundation and the Irish Government in assessing the impact of their investment to date and the delivery of future investments. Currently, there are three projects funded as part of this programme. Two of these fellowships are co-funded by SFI and the HEA, whereas the remaining fellowship is funded solely by SFI. This Call was run in partnership with the IRC.
- SFI's **PhD Fellowship programme in Science Technology Engineering and Maths Education** (STEM) is designed to support the requirement for fourth level professionals in STEM education to educate and prepare teachers at all levels but especially in primary and post-primary schools. This will include the effective implementation of STEM education and evidence-based research into teaching and learning in the STEM disciplines. SFI expects to fund a number of PhD fellowships in 2014 that encompass the theme of STEM. This Call is being run in partnership with the IRC.
- SFI is participating in the **Small Advanced Nations Initiative** involving New Zealand, Singapore, Israel, Finland, Denmark and Ireland. This initiative was established in 2012 to explore possibilities for collaboration in an increasingly inter-connected and competitive global economy. Specifically, it aims to establish what insights small advanced countries can gain from looking at each other and what tools and metrics can and should be used to monitor small nation science, innovation and enterprise systems.

Research for Knowledge is driven by a knowledge creation motive rather than a sectoral opportunity or a specific, identified enterprise need. That said, Research for Knowledge underpins these areas by developing the human capital necessary to maintain a pipeline of well-educated graduates and post-doctoral researchers capable of addressing our societal and economic needs. Research for Knowledge also plays a key role in the recruitment and retention of world class senior researchers capable of undertaking the research needed to underpin Ireland's knowledge economy, and engage with and deliver benefit for enterprise and other national stakeholders. Key examples of achievements in this area during the period of this report include:

- A commitment by the HRB to invest €6m up to 2016 in the **HRB Scholars Programme in Health Services and Population Health** (SPHeRE), to train researchers who can bridge the gap between generation of new knowledge in health and social care and the effective translation of that knowledge into benefits for health policy and practice.
- The release of **ten new research reports** by the EPA in 2013 related to climate change. The research evidence in these reports has continued to strengthen national research capacity and human capital, especially in the area of climate adaptation, a rapidly evolving area both from a research and policy perspective.
- Continued funding by DAFM during the period (and possible continuation under its 2014 Call) of its **Graduate Development Programme** allowing Masters and PhD students and early stage researchers engaged in publicly funded Agri-food, marine or forestry research projects

enhance their industry relevant knowledge and transferable skills and provide an interface between industry and academia.

- The publication of the report **ÉMIGRÉ: Current Irish Emigration and Return** (Irish Research Council 2013) which looked at why people are emigrating from Ireland today and the impact recent emigration is having on the Irish abroad and on the families and communities they have left behind.
- In line with its mandate to cultivate the 'seedcorn' i.e. knowledge creators and skilled researchers of the future the Irish Research Council funds excellent early stage career researchers and their excellent ideas through **the Government of Ireland Postgraduate Scholarship Scheme and the Government of Ireland Postdoctoral Fellowship Scheme**. Any discipline may be supported so that capacity exists to address the human capital and knowledge needs across the economy and society.

6. Systemic Recommendations

Introduction

The Report of the Research Prioritisation Steering Group set out 13 systemic recommendations to improve the efficiency and effectiveness of the STI system in order to support the implementation of Research Prioritisation. This section summarises progress on implementation by the relevant agencies and departments.

Many of these recommendations are being progressed through the implementation of the 14 Action Plans for the Priority Areas. Additionally, the Framework of Metrics and Targets for STI Investment will monitor the implementation of Research Prioritisation in the 14 Priority Areas and the impact of public STI investment in broad terms. Progress on these recommended actions is set out below.

1. *Government should re-state its objectives for science, technology and innovation policy with clear goals and metrics for each element of this policy. In the first instance there is a need to set a new over-riding national objective to accelerate the delivery of specific economic outcomes from our investment in research.*

The RPAG has drafted an overarching Goal and three underpinning policy Objectives, for national STI Policy. While the economic imperative is paramount, the Goal and Objectives also acknowledge the importance of societal impacts of publicly funded research. These statements will be considered by Government in an appropriate policy context. The second part of this recommendation has been addressed in the Framework for Monitoring Public Investment in STI, developed by the RPAG and agreed by Government in June 2013.

2. *The policy goals and objectives that are set should be underpinned by a set of national indicators that reflect the goals and objectives (e.g. R&D intensity of enterprise; number of research personnel per 1000 employees) and this should include indicators of economic impact. These indicators should help to clarify programme level objectives and targets and the allocation of resources. There should also be clarity in the allocation of roles and responsibilities to achieve the high level targets.*

A comprehensive Framework of Metrics and Targets for STI Investment has been developed by the RPAG and was agreed by Government in June 2013 and published in July 2013. The Framework[20] will firstly monitor the impact of public STI investment in broad terms, and secondly, monitor the impact of the implementation of research prioritisation in the 14 Priority Areas. The purpose of setting these targets is twofold; to stretch the public enterprise support system in order to maximize the impact of public investment in R&D; and to assess the success over time of the implementation of research prioritisation. The Framework comprises three levels of targets – Overarching National targets; Departmental/ Agency-level Targets; and Priority Area Targets. The targets are underpinned by a wide range of monitoring metrics covering the enterprise support environment, including inputs, outputs and outcomes. The metrics are to be monitored annually and the RPAG will oversee their monitoring.

3. *The Department of Jobs, Enterprise and Innovation (DJEI) should annually monitor performance, with independent oversight, on behalf of the Government. These regular reviews should report timely and consistent data that will determine the allocation of resources at a system level and inform and underpin future priority setting exercises.*

20 www.Forfás.ie/publications/2013/Title,11020,en.php

Difficulties in monitoring performance at the system level can be addressed by introducing standard measurement and reporting systems across funding programmes.

The Action Plan for Jobs 2014 contains a commitment to initiate an independent assessment of progress in implementation of Research Prioritisation in Q3 2014.

As part of ongoing monitoring of progress, detailed Action Plans have been developed for each of the 14 areas. The Action Plans, endorsed by Government in July 2013, set out the detailed blueprint for the funding Departments and agencies in order that the potential opportunity in each Priority Area is realised. Each Action Plan includes a vision, key objectives and specific actions along with timelines and those responsible for leading and supporting delivery of the action. Reporting on progress to RPAG takes place on a quarterly basis.

In parallel, the RPAG developed a framework of metrics and targets for monitoring the impact of public investment in STI which contains overarching national targets as well as targets for the individual research funding agencies and for Priority Areas.

Science Foundation Ireland has completed an internal review of its implementation of Research Prioritisation in 2013 and has established that over 94% of projects funded in 2013 were aligned to the 14 Priority Areas or the 6 underpinning Platform Science and Technologies. SFI has also developed a data management system (SESAME) to accurately monitor and evaluate its suite of programmes on a regular basis. This enables the Foundation to monitor its investment across the 14 Priority Areas and PSTs and address gaps in its portfolio if deemed appropriate. This is in addition to regular external reviews of its major programmes, with the CSET, SRC, Principal Investigator and SIRG programmes recently evaluated.

In the case of Teagasc, 93% of its funded projects in 2013 were aligned to two of the Priority Areas, namely, Sustainable Food Production and Processing; and Food for Health.

4. *The funding mechanisms that will be used to give effect to the Priority Areas should be assessed to ensure that they are fit-for-purpose in terms of delivering economic impact. Programmes that focus on commercialisation and innovation leading to economic outputs should integrate the core principles of programmes that identify needs, invent solutions and commercialise products or services.*

This Recommendation is being addressed through the implementation of the individual Action Plans for the 14 Priority Areas. The Action Plans[21] set out the detailed blueprint for funding Departments and Agencies to re-align the majority of competitive, public research funding for economic objectives, around the Priority Areas over the next five years. Each Action Plan includes a vision, key objectives and specific actions along with timelines and those responsible for leading and supporting delivery of the action.

In addition, wider ecosystem or framework conditions that need to be addressed are identified to allow investment in the Priority Area yield the optimum return. Action Plans will remain live and evolve over time to ensure that they can respond to real-time market developments and opportunities. The RPAG will oversee their monitoring. These Action Plans have been approved by Government in June 2013 and published in July 2013.

In relation to the second part of this Recommendation, Programme evaluations such as the Forfás 'Evaluation of Enterprise Supports for Research, Development and Innovation', have assessed the fit-for-purpose nature of the various funding mechanisms, in particular for Science Foundation Ireland, Enterprise Ireland and IDA Ireland, in this regard.

21 www.Forfás.ie/publications/2013/Title,11020,en.php

In the case of the Marine Institute, as part of the development of the 'Integrated Marine Research & Innovation Plan 2014 – 2020' the range of funding mechanisms to be employed under it will be assessed and it will also set out how funding should be mobilised, co-ordinated and focused to maximise delivery and avoid duplication in supporting the Priority Areas.

All SFI programmes have been reviewed internally and deemed fit for purpose while all SFI industry facing programmes have a core focus on commercialisation and innovation leading to economic impacts. Moreover, industry partnerships ensure the relevance of the research.

All Enterprise Ireland programmes are designed to support the commercialisation of research or market driven industry research and innovation. They are rigorously monitored according to Enterprise Ireland metrics and regularly evaluated by independent external experts to ensure they are fit for purpose and that they lead to economic outputs. All of Enterprise Ireland's industry research programmes fund projects that are specifically requested and directed by industry and, as such, each individual project's relevance is ensured.

Prior to each annual call, the Department of Agriculture, Food and the Marine assess the suitability of the FIRM, Stimulus and CoFoRD programmes to meet the needs of the sector in light of changing circumstances and it introduces changes to ensure their on-going relevance and complementarity with other research funding offerings.

The Environmental Protection Agency Research Programme has as its primary purpose to fund research in order to support effective and efficient policy development and implementation and to develop solutions to address environmental challenges, thereby delivering a positive economic impact. Where relevant, the EPA seeks to lever its investments to identify potential commercial opportunities arising from its research projects through correspondence with other funders who are also part of the EPA research co-ordination groups.

The Health Research Board undertakes an ongoing review of its funding mechanisms which ensures alignment between the HRB strategic priorities and the objectives of individual funding schemes. This review process is informed by data from an end of grant evaluation on healthcare innovations and societal and economic outcomes and impacts.

5. *Applications for funding under the Priority Areas will require at least a two-stage process. The applications should be screened based on demonstrated relevance to the Priority Areas, clarity of deliverables and, where appropriate, end-user engagement. Applications that pass the test of relevance to the Priority Area should be reviewed against the criteria of excellence and originality based on established peer review processes.*

The Research Prioritisation Action Group (RPAG) has discussed how application procedures for research funding can be tailored to assess relevance to, and impact on, Priority Areas as well as assessing excellence, and have set out the principles of stage gate approach to evaluation. The process will require researchers to demonstrate the economic relevance of their work as well as the scientific excellence, if they are to receive funding under the 14 Priority Areas.

SFI has defined 'impact' as the demonstrable contribution that excellent research makes to economy and society. SFI also recognises that some research projects may have immediate impact whereas other projects may take much longer to achieve impact. Applications for research funding within the scope of Research Prioritisation, i.e. competitively-awarded funding for publicly-performed research (HEIs and PROs) will be assessed in a formal, two-stage process. Applicants will be required to submit a written Impact Statement setting out the intended or potential impact of the proposed research, while Stage Two will assess the scientific excellence of the proposal, with scientific excellence a prerequisite for all research funding.

In the case of the Environmental Protection Agency (EPA), projects are also subject to a two stage review prior to receiving funding, including a National Overview Committee who review shortlisted priorities for relevance and avoidance of duplication in an Irish context.

As the Marine Institute's calls for proposals are targeted towards applied or developmental research in the marine sector, the two stage process can be combined into one application stage. The evaluation criteria applied to proposals for funding include (i) Strategic Context and Rationale and (ii) Benefits and Impacts of the Research.

All new Teagasc funded research project proposals and Walsh Fellowship applications are subject to a two-stage evaluation process, i.e. an impact assessment followed by a scientific assessment. The Walsh fellowships are also reviewed externally.

The HRB operates a two-stage assessment process tailored to its individual statutory mandate and health sector needs. Applications are checked for alignment with (i) HRB strategic priorities and (ii) the scope, objectives, relevance and other non-technical elements of individual schemes (differs by nature of scheme). Applications that pass this eligibility check are then subjected to an international peer review.

6. *There should be an ongoing review of all funding programmes to ensure continued relevance and clarity of purpose, that programmes have sufficient scale and that unnecessary duplication is avoided. The review should ensure that the costs of the programme are commensurate with the benefits achieved. New programmes should be avoided if the objectives can be achieved through the adaptation of existing programmes.*

In relation to this Recommendation, the Forfás 'Evaluation of Enterprise Supports for Research, Development and Innovation, have assessed the fit-for-purpose nature of the various funding mechanisms, in particular in relation to Science Foundation Ireland, Enterprise Ireland and IDA Ireland.

Avoidance of new programmes if objectives can be achieved through adaptation of existing programmes, will be addressed through the implementation of the 14 Action Plans for the Priority Areas, as new funding programmes are considered. SFI has reviewed all its programmes in line with this recommendation and has taken steps to reduce the number of programmes where appropriate.

Enterprise Ireland's programmes and activities are regularly evaluated by external experts in order to ensure their relevance and their ability to achieve economic impacts. In 2013, three major Enterprise Ireland programmes were evaluated, namely the Technology Centres Programme, the Technology Transfer Strengthening Initiative and the Innovation Partnerships. In 2014, the Campus Incubation Programme, the Applied Research Enhancement Centres Programme (precursor to Technology Gateways) and the Commercialisation Fund, as well as Ireland's participation in the European Space Agency, will all be evaluated.

In relation to the Department of Agriculture, Food and the Marine, it operates three Expert Advisory Group on research which, *inter alia*, advise on the purpose and sustainability of its three research related programmes, namely FIRM, Stimulus and CoFoRD.

The EPA Research Programme was independently reviewed in 2012 and the overarching finding of the review was that the STRIVE Programme was both effective and efficient in achieving the objectives set for it. The programme was found to be well managed, providing value for money investments in environmental research across universities, Institutes of Technologies, public sector agencies and the private sector.

The Health Research Board developed a clear organisational strategy for investment in health research, the *HRB Strategic Business Plan 2010-14*, which is agenda-led and governs how the HRB develops, evaluates and reviews its funding calls. Since 2010, all HRB schemes have been reviewed

to ensure their continuing relevance and those not aligned with the goals of the organisation have been discontinued or restructured. In addition, the HRB has developed a suite of new schemes that underpin its business priorities and which also address the HRB-led actions as identified in the five Health-related Priority Area Action Plans.

The Marine Institute continues to work with other national research funding agencies where there is an overlap of its research activities to ensure that research effort is not duplicated and that co-funding opportunities are maximised to fulfil the strategic programme requirements of the Institute.

Both Teagasc programmes, the Walsh Fellowship Programme and the Teagasc Internal Call, are reviewed continuously.

The Irish Research Council has developed a strong partnership approach across a range of Government department and Agencies in line with its mandate to fund and support research across all areas required by the economy and society. This strategic approach also facilitates the streamlining of programmes and initiatives and eliminates duplication. The two most notable examples are the Employment based Postgraduate Programme ('industrial Masters and PhDs' initiative) led by the IRC and in partnership with DAFM, Teagasc, Marine Institute, SEAI, SFI and Teagasc, and the Research Project Grants Scheme where the Council acts as an agent and partners with a range of Government departments and agencies, including Dept. of Children and Youth Affairs, Dept. of Social Protection, Dept. of Environment, Community and Local Government, Dept. of Foreign Affairs and Trade, Health Services Executive and Family Support Agency.

SFI's new data management system, SESAME, enables the Foundation to accurately monitor and evaluate its suite of programmes on a regular basis thus ensuring their continued relevance and purpose. In addition SFI commissions regular external reviews of its major programmes, with the CSET, SRC, Principal Investigator and Starting Investigator Research Grant programmes recently evaluated.

7. *Given the number of funding bodies and programmes, department and agencies should agree to a coherent and consistent approach to the administration of funding programmes. Differences of approach in areas such as auditing add to the administration costs for agencies and research organisations.*

This is being addressed through the implementation of the 14 Action Plans for the Priority Areas, in particular through joint calls and similar initiatives. In addition, the Framework of Metrics and Targets for STI sets targets around the proportion of competitive funding dispersed via joint instrument with other agencies. For example, Science Foundation Ireland and Teagasc have co-funded a themed research call, namely 'Future of Agri-Food'.

In the case of the Health Research Board, it has national co-funding arrangements with the Health Service Executive (HSE), Science Foundation Ireland (SFI), the Department of Agriculture, Food and the Marine and the Medical Research Charities Group (MRCG). It has always had a strong ethos of collaboration which allows it to leverage the best value from its investment in health research. The HRB also works closely with partners in Northern Ireland and Britain, Europe and the United States to promote health research on the island of Ireland.

SFI continues to engage with other national agencies through partnerships and it adopts the 'lead agency principle' thereby reducing costs and the administration burden. In implementation of the NRPE through the RPAG, SFI has built strategic partnerships with other national agencies for collaborative funding initiatives. These include the 2013 SFI Investigators Programme that will fund key projects in the Future Agri-Food space, jointly with Teagasc. SFI and the IRC are collaborating on 2 separate initiatives that will fund projects in the Employment Based Programme and in STEM education. SFI and the Higher Education Authority have funded a number of Science Policy projects

that will investigate topics such as the impact of R&D spend on innovation and economic return to the state. SFI and its sister agency Enterprise Ireland continue to work closely on the commercialisation focused SFI Technology Innovation Development Award (TIDA) programme.

Enterprise Ireland leads market-led research and innovation programmes, also on behalf of IDA Ireland, and both the Technology Centres programme and the Innovation Partnerships programme are managed by Enterprise Ireland and are open to client companies of both agencies.

The Marine Institute continues to maintain close contact with other funders to try to ensure consistency of approach in funding processes and procedures. It also shares information on research funding awarded to gain an overview of marine research which is funded in Ireland.

Under its previous research programme (2007 – 2013), the EPA established research coordination groups of key stakeholders for the three pillar areas (namely Climate, Water and Sustainability). These groups improve the co-ordination of environmental research, where priorities for inclusion in calls and longer term objectives are presented and discussed, with the aim of enhancing synergies and collaboration with key policy-makers and decision-makers and other funding agencies.

Teagasc has partnered with SFI for the Future Agri-Food theme of the 2013 Investigators Programme and it also funded three positions in the IRC employment-based postgraduate programme in 2013.

8. *Funding programmes for physical infrastructure should adapt to recognise the current priority to maintain and support the operation of existing infrastructure while also incentivising the sharing of resources, thereby utilising their full capacity. A key requirement to achieve this will be a national inventory of all significant publicly funded infrastructure and equipment.*

The Higher Education Authority has completed a national inventory of all significant publicly-funded research infrastructure and equipment. A database of *Large Items of Research Equipment* (LIRE) has been developed and is accessible through a searchable, online portal[22]. This database will be developed in the future with a view to expanding the range of research infrastructure available through it, in tandem with increasing its accessibility.

In parallel with compiling this national inventory, the HEA has developed guidelines for the Higher Education Institutions on providing access to users from the institutions and enterprise. The key principle embodied in the guidelines is that by default, all public funded equipment should be available to users from other HEIs and from enterprise.

SFI has set out an *access charge plan* that allows researchers to included access charges to major infrastructure as line item in the budgets of their grant applications.

Separately, the Marine Institute continues to operate a National Research Vessel Access Programme, which is an infrastructure access support programme that provides researchers with access to the national research vessels. The programme maximises the use of this significant state investment in world-class research infrastructure and provides researchers with opportunities to partner with European colleagues, building future research collaborations.

EPA infrastructure investments have been limited and typically linked to existing infrastructures, thereby enhancing the use of shared resources and locations.

The Health Research Board is investing in the infrastructures, networks and ancillary supports that are fundamental enablers of health research. Current HRB infrastructure investments include support for the three Clinical Research Facilities at Cork University Hospital, University College Hospital Galway and St James Hospital Dublin, as well as the Centre for Advanced Medical Imaging

22 www.hea.ie/content/large-items-research-equipment-database

(CAMI) there. Furthermore, the HRB is making progress towards establishing a national bio-banking system and support infrastructure in conjunction with others. It is also developing a national clinical research framework to link clinical research facilities and centres across the country and ensure common standards, high quality data management and policy development, and act as a one-stop-shop for enterprise engagement with this infrastructure.

9. *Policies and procedures for the commercialisation of intellectual property arising from publicly funded research should be fast, predictable and consistent.*

In June 2012, the Government published the national Intellectual Property Protocol. The IP Protocol sets out the Government's policies to encourage industry – from start-ups and small and medium enterprises to multinational corporations - to benefit from the research and development done in Ireland's public research institutions.

A key recommendation of the IP Protocol report was the development of a central Technology Transfer Office to act as a '*one-stop-shop*' for businesses seeking to use IP originating from publicly funded research. This new office was established in Enterprise Ireland in 2013 and formally launched in June 2014 as '*Knowledge Transfer Ireland*' (KTI). KTI will drive a world class technology transfer system in Ireland, ensuring it is responsive to the needs of both industry and academia.

The aim of KTI is to make it easier for companies to access and use ideas developed through publicly-funded research to develop new products and services and ultimately create jobs and exports. KTI will ensure that the IP Protocol is delivering to the needs of business and stakeholders.

SFI has adapted its procedures to ensure IP Management is carried out in accordance with the IP Protocol. Likewise, the Marine Institute has adapted its Calls for Proposals documentation and Grant-Aid Agreements to ensure IP management is carried out in accordance with the IP Protocol.

The HRB is also committed to ensuring the protection and appropriate commercialisation of any IP that emerges from its funded programmes and projects and is actively engaging with KTI to develop appropriate processes for health research supported outside of the major hospitals and universities.

So also the Irish Research Council which has worked very closely with Knowledge Transfer Ireland in the context of the implementation of the IP Protocol for the Employment-Based Postgraduate Programme.

Teagasc TTO recently joined a consortium, led by UCC TTO, funded through Enterprise Ireland via the Technology Transfer Strengthening Initiative, to increase efficiencies in how such Public Research Organisations TTOs manage and commercialise IP from state funded and supported research. While Teagasc already has policies and procedures in place for management of IP, in accordance with the National IP Protocol, a key role of this consortium is to review and update all such policies and procedures, with a view to streamlining such processes and template agreements used in order to further increasing transparency, consistency and universal approaches across Irish PRO. This process is currently underway, as well as a new case manager having being assigned to facilitate commercialisation of Teagasc IP, which should speed up and improve the processes involved.

10. *Research centres with a mandate to engage with industry, including CSETs (Centres for Science, Engineering and Technology), SRCs (Strategic Research Clusters) and public research organisations must develop a distinctive industry-focused culture. They should have the breadth of multidisciplinary research activity and the range of expertise (including business development skills) to partner with industry. A key performance indicator for such centres will be the proportion of funding leveraged from enterprise. Developing such centres will require alignment around the Priority Areas and, for HEI based centres, sufficient autonomy to prioritise an industry-oriented mission.*

In February 2013, the largest ever state/ industry co-funded research investment was announced. This amounted to €300 million in total, in the form of €200 million of exchequer funding and €100 million co-investment by over 150 industry partners. 7 world class Science Foundation Ireland large-scale Research Centres will be funded over 6 years supporting key growth areas and research will be undertaken into major societal challenges, including health, communications and energy.

These Research Centres will be structured on a hub and spoke model consisting of a number of targeted projects undertaken in partnership with industry that connect into the central hub, which contains the platform research and core operations. They incorporate an interdisciplinary approach and a significantly increased industry focus with more partners from that sector and a requirement for at least 30% of industry co-funding.

The new SFI Spokes Programme, which begun in 2013, is a vehicle to enable the addition of new industrial and academic partners and projects to a SFI Research Centre, so allowing the Centre to expand and develop in line with new priorities and opportunities. This will ensure that the Research Centre retains its ability to do cutting edge research and its industrial relevance, and so enhance its sustainability.

The Spokes programme also provides a vehicle to link together, in a meaningful and relevant way, different Research Centres. The Programme has been designed to deliver excellent basic, oriented research results and discoveries in targeted projects associated with SFI Research Centres and hence will deliver significant economic and societal impact during the lifetime of the programme.

Elsewhere, programmes funded by the Department of Agriculture, Food and the Marine have always encouraged both inter-institutional and inter-disciplinary collaboration. Whilst not funding industry participation, the Department of Agriculture, Food and the Marine has always welcomed industry involvement and this usually occurs via in-kind contributions, particularly in food processing projects supported under the FIRM programme.

Teagasc continues to implement its Food Technology and Knowledge Transfer Strategy and has recently published a special edition of the Teagasc Technology Portfolio describing the current technologies, capabilities, services and expertise relating to the meats sector.

One of the core objectives of the Health Research Board Clinical Research Facilities (CRFs) will be the development of commercial links and to this end the HRB expects that a proportion of the core grant of the CRFs, National Clinical Research Framework (NCRF) and Clinical Research Networks will be used in developing a business model that facilitates industry-led clinical trials activity.

11. Innovation activity should be recognised by the system for career progression for academic staff within HEIs and public research organisations.

In 2013, the HEA commenced annual publication of profile/ performance templates for each HEI, giving visibility to research and knowledge transfer with performance metrics which are and will remain aligned to those used by the enterprise agencies. This emphasis on performance in research and innovation at institution level is intended to, and expected to, impact on performance appraisal at individual level. In June 2014, the HEA published the 2011/12 profiles and these are available on the HEA web site.

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

12. A consistent quality framework should be developed for postgraduate education and training incorporating the Structured PhD model. Responsibility for monitoring of the output and quality of Masters and PhD training and education should rest with the Department of Education and Skills (DES). Indicators of the quality of postgraduate education and training should be developed by DES and integrated into the Government's overall framework for monitoring science, technology and innovation.

As per this Recommendation, the Higher Education Authority (HEA), in cooperation with QQI (Quality and Qualifications Ireland, an agency of the Department of Education and Skills established in November 2012), and in partnership with the HEIs, is currently developing a National Framework for the development of Doctoral Education, with a view to completion on schedule in Q3 2014. This will incorporate the structured PhD model. The Irish Research Council is aligned with the proposed approach and framework, and in the context of its awards not only are four year awards being facilitated but the specifics of the PhD experience and training is assessed. The Deans of Graduate Studies sign off on all student applications and subsequent reports. Implementation of the National Framework is a key area of focus for the IRC.

The National Employers Survey, to be conducted by the HEA, in conjunction with IBEC and ISME, during the academic year 2014-15 will also provide qualitative feedback on enterprise take-up of skills. Other relevant developments in higher education include the implementation of the Irish Survey of Student Engagement (ISSE), the objective of which is to increase transparency in relation to the student experience in higher education institutions and to enable direct student input on levels of engagement and satisfaction with their higher education institution.

In the case of SFI, it supports PhD students for four years, thus enabling participation in structured PhD programmes.

A key deliverable of the Health Research Board across a number of the Priority Areas is the development of capacity in Ireland to undertake high-quality population health sciences and Health Services Research (HSR). The Structured Population and Health Services Research Education [SPHeRE] Programme, launched in 2013, expands the 2007 PhD Scholars Programme in Health Services Research. The skillsets of graduates of these programmes will be vital to enabling future testing and validation of products and services in a healthcare setting.

13. Initiatives to improve further and keep under continuous review the alignment between the supply of trained researchers from academia and the demand for such skills from the enterprise sector are imperative:

- *A proportion of PhD funding should be earmarked to support the development and rollout of the industrial PhD model in Ireland.*
- *A proportion of PhD funding should be redirected towards the development of industry driven Masters programmes.*
- *Technology Transfer Offices within the HEIs should develop a coherent and integrated programme of support for PhD students and early stage post-doctoral researchers that enables them to identify and exploit commercial opportunities arising from their research.*

In response to recommendations to align supply and demand of trained researchers, the Irish Research Council has rolled out an Employment-Based PhD and Masters programme where awardees will be employees with the majority of time spent in-company. The emphasis of the funding programmes is on exploratory research aimed at producing new concepts, findings and innovations

within Ireland. The Council operates a number of specific programmes designed to support collaboration between enterprise and academia, through individual researchers.

The Employment-Based Postgraduate Programme is a new and exciting initiative offering an employment focused postgraduate experience. The programme offers researchers the opportunity to complete a Masters or PhD degree while employed by a private company or public organisation based in the Republic of Ireland.

The aim of the Employment-Based Postgraduate Programme is to:

- Educate researchers at Masters and PhD level with an insight into business aspects of research and innovation.
- Facilitate research collaboration, knowledge transfer and networking between Irish based enterprise and researchers at Irish Higher Education Institutions.

For employers, the programme offers the opportunity to employ a talented postgraduate researcher to work (as part of his/her postgraduate degree) on an agreed project which must have direct relevance to the company. The researcher will spend 50-70% of his/her time based onsite at the company's facilities.

The programme also enables the development of strong relationships with the academic team supporting the researcher. This programme builds on the Enterprise Partnership Scheme and the Department of Agriculture, Food and the Marine partnered with the Irish Research Council on the pilot programme, with a number of other agencies also now partnering in the successful programme.

Looking ahead, there will be an increased emphasis on Masters students and the programme is now embedded as a component of the Action Plan for Jobs 2014. Awards are being funded in national Priority Areas, in alignment with the missions of the respective Departments and agencies, and Enterprise Ireland has become a strategic promotion partner for the programme.

Early feedback from the HEIs indicate that supports are in place for students and postdocs, and that the education of these cohorts on technology transfer is a key component of Masters and PhD programmes and of postdoc career development in general.

Teagasc has partnered with the IRC in the employment-based postgraduate programme, funding three positions in 2013, and it is currently developing a training and development programme for post-doctoral fellows. It will include modules on entrepreneurship and Commercial Awareness for Researchers and will be available in 2015. SFI has also partnered with the IRC in the employment-based postgraduate programme, funding four positions in 2014.

7. Education and Skills

National Strategy for Higher Education 2030

The commencement of the NRPE was preceded by the 2011 publication of the National Strategy for Higher Education to 2030 in which the commitment to prioritisation and consolidation was reinforced alongside commitments to sustain the vitality and enhance the performance of Irish research across a broad range of disciplines. It also emphasised the responsibilities and the potential of higher education to address social and economic challenges in partnership with the community and with the enterprise base. Higher education institutions' role in ensuring that an increasing diversity of students acquire the skills to enable them to participate fully in the 'knowledge society' focuses attention on their quality, relevance, and responsiveness.

The comprehensive reform and structural reconfiguration of the Irish higher education sector, envisaged in the National Strategy for Higher Education to 2030 and now underway, will ensure that, through the consolidation of programme provision, the generation of critical mass in research, and the sharing of resources and pooling of expertise across all areas of the higher education mission, Ireland emerges as a strong player in the global higher education landscape of the future.

In the Higher Education System Performance Framework 2014–2016 published in 2013, the Department of Education and Skills has distilled from the National Strategy and from liaison with other Departments and agencies a set of key performance indicators for the higher education system which will underpin the HEA's work in this area. Together with the key system-level objectives and research priorities presented in this document, the Higher Education System Performance Framework clarifies the policy-context within which the HEA will monitor institutional performance.

The implementation of the national strategy is resulting in greater clarity for higher education institutions regarding national priorities and in the achievement of greatly increased transparency regarding the profiles and the performance of the higher education system. Through the initial profile templates published by the HEA in 2013, clear information is now available at institution-level, at sectoral level and at national level on the performance of higher education across a range of core areas including research and knowledge exchange. Henceforth, these performance profiles will be published annually.

Work is ongoing to maximise the alignment of the variety of national expectations of higher education and to this end, the DES and HEA are working closely with the Central Technology Transfer Office/Knowledge Transfer Ireland and with all relevant Departments and Agencies to achieve consistency across Government on the use and further development of performance metrics for research and knowledge transfer. A key objective of this work is to support performance enhancement at institution level and at national level in a way that minimises bureaucratic burden and that maximises the strategic value for the higher education system.

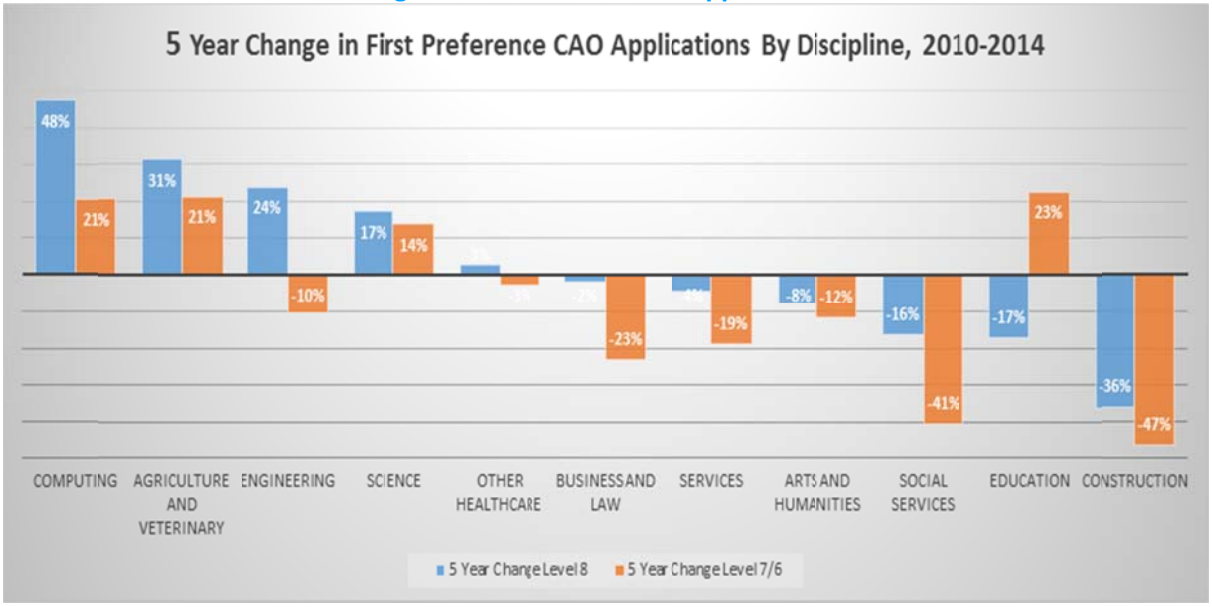
Trends in the supply of skills

The focus on prioritisation under the NRPE and under the broader *Strategy for Science, Technology and Innovation* has been accompanied by very positive improvements in the take-up of Science, Technology, Engineering and Computing courses in Irish higher education over recent years. This has resulted in a steady increase in the supply of mainstream science and technology graduates over recent years. For example, the higher education system is on course to achieve a doubling in the numbers of ICT level 8 graduates two years ahead of the schedule set out in the first ICT Action Plan.

The steady increase in demand for STEM programmes is resulting in a situation where entry points are rising and the number of places expanding, simultaneously. This will result in larger numbers of better qualified entrants into higher education. Between 2010 and 2014, the number of first preference applications to level 8 computing courses increased from 2,920 to 4,311. Over the same period first preference applications to Engineering (excluding Civil) rose from 2,594 to 3,215 and in Science from 4,194 to 4,916.[23] CAO trends provide a good preview of future graduate trends and these trends are encouraging and very supportive of the skills base that Ireland requires to underpin the Priority Areas and economic sectors identified through the NRPE (see Fig. 7.1).

In addition to the significant increases of skilled graduates coming through mainstream undergraduate and postgraduate provision, since 2011 the Springboard and ICT Skills Conversion initiatives have provided over 18,000 higher education upskilling opportunities across NFQ level 6 to 9 in areas of identified immediate skills needs. A further 6,000 places have been sanctioned for the immediate year ahead (2014-15). These programmes represent a new level of industry-academic partnership in terms of programme design and delivery of upskilling programmes – developments which will provide a basis for the ongoing refreshment of mainstream undergraduate provision.

Figure 7.1: Trends in CAO Applications



Data source: Higher Education Authority analysis of CAO first preference applications data 2010-2014.

23 V. Patterson (2014). An Analysis of CAO First Preference Applications 2014, Dublin: Higher Education Authority.

Appendix A: Membership of the Research Prioritisation Action Group

	Seán Sherlock T.D. (Chair)	Minister for Research and Innovation Dept. of Jobs, Enterprise and Innovation; and Department of Education and Skills
	Richard Howell	Dept. of Agriculture, Food and Marine
	Dale Crammond	Dept. of Agriculture, Food and Marine
	Bob Hanna	Dept. of Communications, Energy and Natural Resources
	Brendan Whelan	Dept. of Communications, Energy and Natural Resources
	Mary Doyle	Dept. of Education and Skills
	Christy Mannion	Dept. of Education and Skills
Dr	Nuala Bannon	Dept. of Environment, Community and Local Government
	Siobhán Nic Thighearnáin	Dept. of Environment, Community and Local Government
	Joe Hutchinson	Dept. of Foreign Affairs and Trade
	Bairbre Nic Aongusa	Dept. of Health
	Audrey Hagerty	Dept. of Health
	Dermot Curran	Dept. of Jobs, Enterprise and Innovation
	Pauline Mulligan	Dept. of Jobs, Enterprise and Innovation
	Anne Keeley	Dept. of Public Expenditure and Reform
	Helen Blake	Dept. of the Taoiseach
	Gearóid Mooney	Enterprise Ireland
	Deirdre Glenn	Enterprise Ireland
Dr	Keith O'Neill	Enterprise Ireland
Dr	Brian Donlon	Environmental Protection Authority
	Declan Hughes	Forfás
Dr	Graham Love	Health Research Board
Dr	Maura Hiney	Health Research Board
	Tom Boland	Higher Education Authority
	Muiris O'Connor	Higher Education Authority
Dr	Barry Heavey	IDA Ireland

	Leo Clancy	IDA Ireland
Dr	Chantelle Kiernan	IDA Ireland
Dr	Eucharia Meehan	Irish Research Council
Dr	Peter Heffernan	Marine Institute
	Jenny O'Leary	Marine Institute
Prof	Mark Ferguson	Science Foundation Ireland
Dr	Manus Ward	Science Foundation Ireland
	Kevin O'Rourke	Sustainable Energy Authority of Ireland
	David McAuley	Sustainable Energy Authority of Ireland
Dr	Frank O'Mara	Teagasc
	Declan Troy	Teagasc

Secretariat

John Dooley, Forfás

Dr Eamonn Cahill, Forfás

Fionna Hallinan, DJEI

Andrew Gavin, DJEI

Appendix B: Update on the Framework for Monitoring Public Investment in STI

This Appendix contains updates on the metrics and targets set out in the Research Prioritisation: Framework for Monitoring Public Investment in Science, Technology and Innovation, published in July, 2013. As the metrics are derived from a number of surveys many of which are only repeated on a biennial, or less frequent, basis updates are not available for all.

Table B1: National Targets

	Metric	Baseline	Update *if available*	Target for 2017
NT1	Gross domestic Expenditure on R&D (GERD) Intensity	2.01% GNP (2011)[24]	2.05 % GNP (2012)	2.5% GNP by 2020
NT2	GERD private : public ratio[25] (% performed by enterprise)	71% (2011)	72% (2012)	66.6%
NT3	Business Expenditure on R&D	€1.96bn (2012e)		€2.2bn (+€240m)
NT4	Total Researchers in enterprise sector	10,618 (2011)		11,718 (+1,100)
NT5	Productivity (value-added / employee) in Irish-owned, manufacturing firms with total R&D ≥ €100k	€66k (2011)	€63k (2012)[26]	€75k
NT6	Number of firms with R&D investment *p.a.* that is			
	i. Significant (€100k– €2m)	916		1,016 (+100)
	ii. Large (€2m)	154 (2011)		169 (+15)
NT7	Proportion of FDI R&D Investments involving MNC-MNC or MNC-SME collaborations[27]	*New metric*	One MNC-MNC-SME collaboration in 2013	10%
NT8	Proportion of turnover attributed to new-to-firm or new-to-market product innovations	9.3% (2010)		10.3%
NT9	Number of enterprises engaged in collaborative research with HEIs/PROs	351 (2011)		386 (+35)
NT10	Number HEI/PRO spinouts > 3 years old + number mergers & acquisitions of spinouts	44 (2013)		69 (+25) by 2017
NT11	Number of HEI/PRO licensing agreements	87 (2012)	119 (2013)	105(+18)
NT12	National drawdown from Horizon 2020	FP7 €600m over 2007-13		€1.25bn over 2014-20
NT13	National citation ranking[28]	20th		20th
NT14	Innovation Union Scoreboard ranking	10th (2012)	9th (2014)	8th
NT15	Share publicly-performed R&D financed by enterprise	€31.2m (2010)		€180m over 2013-7

[24] This baseline has been revised downwards, based on latest data, from the value cited in the Framework document.

[25] Maintaining a 2:1 ratio is important in ensuring an appropriate balance between activity in the public and private sectors i.e. to ensure that public investment does not "crowd-out" private investment.

[26] The decline in recorded productivity between 2011 and 2012 can be attributed to the strong growth in employment over the period, which exceeded the growth in value-added - with employment growing 10%, value-added by 8% and resulting in value-added per employee decreasing by 2%; this is as expected in an upturn with a lag of one-two years from hiring new staff and achieving the potential in terms of growth in value added per employee.

[27] This is a new metric intended to engender a new level of intra- and inter-agency cooperation.

[28] Maintaining Ireland's current ranking to will be extremely challenging in view of the reduced research budget, the greater emphasis on applied research which tends to generate fewer academic publications, and increasing competition from Asian nations.

Table B2: Update on Deliverables and Targets for Enterprise Ireland

	Action	Deliverable	Progress toward Objective
EI1	Proportion of competitive funding dispersed via joint instruments with other agencies	10% by 2017	34% in 2013
EI2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review etc.)	Q2 2013	Complete; Stage gating in place for appropriate schemes like the Commercialisation Fund.
EI3	Commence identification of indigenous enterprise research needs and gaps for the 14 research Priority Areas, in conjunction with IDA Ireland, SFI & other agencies.	Q4 2013	This exercise has commenced as part of wider RPAG activities.
EI4	Establish *Central Technology Transfer Office*	Q4 2013	Complete. Director appointed 2013 and *Knowledge Transfer Ireland* launched May 2014.
EI5	Establish *Connected Health* Technology Centre	Q4 2013	To be launched in 2014
EI6	Establish *Data Analytics* Technology Centre	Q4 2013	Launched
EI7	Establish *Pharmaceutical Manufacturing* Technology Centre	Q4 2013	Launched
EI8	Explore options in order to respond to industry needs for Technology Centres in Medical Devices and Dairy Technology	Q4 2013	Dairy Technology Centre established. Medical Devices solution still being explored.
EI9	Support Technology Ireland to undertake a pilot project in therapeutics Priority Area to maximise synergies between research centres and develop a consolidated branding and marketing message around Ireland's research strengths in the therapeutics area	Q3 2013	This has commenced in conjunction with IDA Ireland
EI10	Number of companies actively involved with Technology Centres	220 in 2017 (158 in 2012)	326 in 2013
EI11	Income from enterprise secured by Technology Centres and Technology Gateways	€3.5m in 2017 (€2.5m in 2012)	€3.5m in 2013
EI12	Undertake joint agency (EI-IDA) interim evaluation of the Technology Centre Programme	Q3 2013	Completed in 2013
EI13	Finalise additional metrics for assessment of Technology Centres (arising from Technology Centre interim evaluation)	Q4 2013	New metric framework established

EI14	Bring together researchers, innovative companies and technology transfer professionals as part of the "Big Ideas" Showcase, the primary technology commercialisation event in Ireland	Q3 2013	Complete
EI15	Pilot assignment of business mentors to Enterprise Ireland Commercialisation Fund projects and other relevant projects	Q4 2013	10 mentors assigned
EI16	Increase BERD in client firms	€850k in 2017 (€735k in 2012)	This data is sourced from the CSO's biennial BERD survey and as such 2013 data will not be available until 2015.
EI17	Increase the total number of people employed (FTE) on in-house RD&I within the Republic of Ireland	9,368 in 2017 (8,516 in 2012)	8,910 in 2013
EI18	Increase number of clients firms with R&D investment *per annum* that is		
	(i) Significant (€100k – €2m)	878 in 2017 (798 in 2012);	858 in 2013
	(ii) Large (> €2m)	60 in 2017 (55 in 2012)	58 in 2013
EI19	Percentage of total turnover attributed to new-to-firm and new-to-market product innovation activities by Irish-owned firms	7.3% by 2017 (6.6% 2010)	6.4% in 2013
EI20	Increase number of client firms supported to engage in collaborative research (including Innovation Vouchers) with HEIs/PROs	830 in 2017 (752 in 2012)	839 in 2013
EI21	Increase number of HEI/PRO HPSU spinouts > 3 years old + number of M&A of spinouts	69 in 2017 (44 in 2013)	44 in 2013
EI22	Increase number of HEI/PRO licensing agreements	105 in 2017 (87 in 2012)	119 in 2013
EI23	Increase drawdown from Horizon 2020 by client firms		Agency-level targets for drawdown are currently being considered by the Horizon 2020 High-Level Group

Table B3: Update on Deliverables and Targets for IDA Ireland

	Action	Deliverable	Progress toward Objective
IDA1	Identify enterprise research needs and gaps for the 14 Priority Areas, in conjunction with EI, SFI and other agencies	Q4 2013	Completed.
IDA2	Establish Connected Health Technology Centre	Q4 2013	Completed.
IDA3	Establish Data Analytics Technology Centre	Q4 2013	Completed.
IDA4	Establish Pharmaceutical Manufacturing Technology Centre	Q4 2013	Completed.
IDA5	Support Technology Ireland to undertake a pilot project in therapeutics Priority Area to maximise synergies between research centres and develop a consolidated branding and marketing message around Ireland's research strengths in the therapeutics area	Q3 2013	A pilot project to develop a consolidated branding and marketing approach for research centres operating in this Priority Area was undertaken during 2013. As a result of this pilot, the research centres involved in this project have enhanced collaboration and co-ordination across a range of areas beyond the original remit of the project.
IDA6	Explore options in order to respond to industry needs for Technology Centres in Medical Devices and Dairy Technology	Q4 2013	Dairy Technology Centre established. Following consultation with the Medical Device industry, feedback suggests preference for an entity with a broader scope and vision. To this end the business need for an entity supporting Discrete Manufacturing is being evaluated. It is anticipated the entity if successful will have an initial but not exclusive focus on Medical Devices. IDA Ireland and EI are jointly currently evaluating this concept with the business case expected by Q1 2015.
IDA7	Investigate supporting Irish collaboration with EU centres in the therapeutics area to avoid duplication	Q4 2013	Ongoing: Key Therapeutics research centres NIBRT, SSPC, PMTC, in association with Pharmachemical Ireland held a "town hall" meeting at NIBRT in May 2014 to publicise and discuss opportunities in the upcoming BIOTEC and SPIRE funding calls within Horizon with all relevant Academic and Industry stakeholders.
IDA8	Increase BERD in client firms	+10% by 2017	IDA approved 27 new Research, Development & Innovation (RD&I)

			projects in 2013. 22 IDA clients participated in the Enterprise Ireland Innovation Partnership Programme in 2013. This data is sourced from the CSO's biennial BERD survey and as such 2013 data will not be available until 2015.
IDA9	Increase number of researchers / technicians employed (FTE) on R&D within the Republic of Ireland	+10% by 2017	IDA approved 27 new Research, Development & Innovation (RD&I) projects in 2013. This data is sourced from the CSO's biennial BERD survey and as such 2013 data will not be available until 2015.
IDA10[29]	Increase number of clients firms with R&D investment *per annum* that is i. Significant (€100k – €2m) ii. Large (> €2m)	+10% by 2017 (173 in 2011) (150 in 2011)	 182 in 2012 158 in 2012 IDA approved 27 new Research, Development & Innovation (RD&I) projects in 2013. 22 IDA clients participated in the Enterprise Ireland Innovation Partnership Programme in 2013.
IDA11	Proportion of FDI R&D Investments involving MNC-MNC or MNC-SME collaborations	10% by 2017	One MNC-MNC-SME collaboration was approved in 2013 as part of the Enterprise Ireland Innovation Partnership Programme.
IDA12	Percentage of total turnover attributed to new-to-firm and new-to-market product innovation activities by foreign-owned firms	11.8% by 2017 (10.7% 2010)	Updated information will come from CSO's Community Innovation Survey 2012 – due Q3 2014.
IDA13	Increase number of client firms engaged in collaborative research with HEIs/PROs	+10% by 2017	IDA actively promoting company engagement in HEI/RPO collaboration through the innovation partnership program and various SFI funding programs. 22 IDA clients participated in the Enterprise Ireland Innovation Partnership Programme in 2013.
IDA14	Increase drawdown from Horizon 2020 by client firms		Agency-level targets for drawdown are currently being considered by the Horizon 2020 High-Level Group

[29] Source: Annual Business Survey of Economic Impact 2013.

Table B4: Update on Deliverables and Targets for Science Foundation Ireland

	Action	Deliverable	Progress toward Objective
SFI1	Competitive funding dispersed via joint instruments with other state research funding agencies	Double to €3.8m by 2017	First comparative data available in May 2015
SFI2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review etc.)	Q3 2013	Complete
SFI3	Increase the investment by companies in SFI research	+20% by 2017	First comparative data available in May 2015
SFI4	Proportion SFI-trainees moving to industry as a first destination	35% by 2017	First comparative data available in May 2015
SFI5	Increase proportion of invention disclosures, patents, licences and spinouts recorded by Enterprise Ireland that are linked to SFI research	+65% by 2017	First comparative data available in May 2015
SFI6	Proportion of research centres' overall funding secured from non-exchequer investment (corporate R&D, EU etc.)	35% by 2017	54% in 2013[30]
SFI7	Proportion of SFI researchers that rely on SFI for the majority of their funding	45% by 2017	35%
SFI8	Research income secured by SFI researchers from international sources such as the EU	€75m by 2017	€54 million in 2013
SFI9	Support Technology Ireland to undertake a pilot project in therapeutics Priority Area to maximise synergies between research centres and develop a consolidated branding and marketing message around Ireland's research strengths in the therapeutics area	Q3 2013	Complete
SFI10	National citation ranking	Top 20	20th in 2012[31]

[30] Data collected for the 7 new Research Centres funded in 2013.
[31] 2013 data not yet available.

Table B5: Update on Deliverables and Targets for Forfás

	Action	Deliverable	Progress toward Objective
F1	Finalise action plans for the 14 Priority Areas	Q1 2013	Completed and published July 2013
F2	Monitor implementation of Action Plans	On-going	On-going. Progress is being monitored through the RPAG on a quarterly basis.
F3	In conjunction with RPAG and DJEI, finalise a statement of Ireland's goal for national STI policy and underpinning objectives	Q4 2013	Completed. Statement drafted and will be incorporated into the new Strategy for STI
F4	Develop a framework for monitoring the impact of state investment in R&D	Q2 2013	Completed and published July 2013
F5	In conjunction with RPAG and DJEI, progress implementation of the systemic recommendations in the Report of the Research Prioritisation Steering Group to improve the efficiency and effectiveness of the STI system	On-going	On-going. Progress is being monitored through the RPAG.
F6	Establish with DJEI a joint Industry-Government Big Data Task Force to progress the Disruptive Reform	Q2 2013	Task Force established. Terms of Reference have been developed for a study on "harnessing Big Data for innovation-led growth: an assessment of Ireland's progress and further policy requirements"
F7	Undertake an assessment of existing and planned initiatives across Government and the private sector that can contribute to Ireland's reputation as a leader in the areas of data analytics and Big Data	Q3 2013	Completed
F8	In conjunction with DJEI, bring a proposal to Government on two pilot data analytics initiatives to seek necessary commitment and resources	Q3 2013	Proposals for two pilot projects have been developed and are being progressed
F9	Identify the research Priority Areas in which the three ICT areas will have a role to play	Q3 2013	Completed
F10	Undertake an international review to establish what R&D structures are in place to support Innovation in Services and Business Processes	Q4 2013	Review completed and road-map developed for Ireland. An inter-agency advisory group has been established to progress initiatives.

Table B6: Update on Deliverables and Targets for Dept. Jobs, Enterprise & Innovation / Technology Ireland

	Action	Deliverable	Progress toward Objective
DJEI1	Implement recommendations of Copyright Review Committee	Q3 2013	The 60+ recommendations in the Report are currently being examined from (a) a legal perspective and (b) policy implications, assuming (a) is possible.
DJEI2	Undertake pilot project in therapeutics Priority Area to maximise synergies between research centres and develop a consolidated branding and marketing message around Ireland's research strengths in the therapeutics area	Q3 2013	A pilot project to develop a consolidated branding and marketing approach for research centres operating in this Priority Area was undertaken during 2013. As a result of this pilot, the research centres involved in this project have enhanced collaboration and co-ordination across a range of areas beyond the original remit of the project.
DJEI3	Develop a framework for how research centres in other PAs should interact and collaborate to ensure they meet industry needs in a sustainable way	Q4 2013	Technology Ireland, which includes representatives of all the enterprise agencies, has agreed an approach to marketing and branding research centres of scale* funded across the 14 Priority Areas by DJEI. A Production Team including DJEI, the enterprise agencies & Knowledge Transfer Ireland (KTI) was established to agree content of marketing material to include primary centres of excellence along with key research themes, underpinning centres and contact details for each centre. More granular detail of Principal Investigators aligned to research themes will be included in web version. The Production Team, which may be expanded to include other national research funders as appropriate, will work towards the launch of a hard copy brochure and web version (to be hosted by KTI) at EI's industry collaboration event scheduled for Q4 2014. *centres of scale to include those which carry out research, have a national remit and have won competitive funding of at least €5m over at least a 5 year period.
DJEI4	Establish National Support Structure for H2020	Q2 2013	Established and led by Enterprise Ireland.
DJEI5	Set targets for Ireland's participation in H2020	Q3 2013	Drawdown target set at €1.25bn

Table B7: Update on Deliverables and Targets for Higher Education Authority & Irish Research Council

	Action	Deliverable	Progress toward Objective
IRC1	Proportion of funding income dispersed through competitive instruments on which collaborating with other state research funding agencies	12% by 2017	In addition to pre-2013 initiatives, the main focus for new collaborations is the Employment-Based Postgraduate Programme which involves a partnership with DAFM, Teagasc, Marine Institute, SEAI & SFI. EI is a strategic promotion partner for this national initiative. Through the Research Starter and Advanced grants a number of new collaborations have been instigated in 2014.
IRC2	Apply mission appropriate standardised principles for assessing research proposals (international peer-review *etc*.)	Q2 2013	Complete.
HEA1	Working with the appropriate agencies, through targeted funding instruments and through strategic dialogue with the HEIs, enable the provision of postgraduate programmes to deliver industry-ready graduates for ICT, Medical Devices, Diagnostics, Food and Energy	Q2 2013- Q2 2014	Under the Higher Education System Performance Framework 2014-16, Key System Objective 1 specifically focuses on the role of the HEIs in skills development and, using the Strategic Dialogue process, highlights the outflow of postgraduates in each discipline. With respect to targeted instruments, the Springboard and ICT Conversion 2014 initiatives are in train. These include significant postgraduate opportunities in areas of identified skills needs.
HEA2	Develop a national database and a policy for maintenance and support of existing research and innovation infrastructure etc. The national policy to be adopted by RPAG.	Q2 2013- Q4 2013	A national inventory of research equipment (> €100k) and associated guidelines have been completed and are available at: www.hea.ie/content/large-items-research-equipment-database
IRC3	Through the employment-based postgraduate programme target applications in Medical Devices, Therapeutics, Manufacturing, Materials and Services.	Q3 2013	Complete for the pilot programme in 2013. This is being carried through to the full programme launch in 2014.
IRC4	Implement a new IRC/DAFM/Industry collaborative programme to	Q2 2013	Complete – a Masters strand has been embedded in the Employment-Based

	have a cohort of Masters research students employed for a 18 – 24 month period in Agri-food companies		Postgraduate Programme.
HEA3	Working with the relevant stakeholders, identify key senior researcher posts in the fields of Food and Energy and develop a mechanism to fill these positions.	Q4 2013	Through the Strategic Dialogue process, the HEA is working with the higher education institutions to align their activities with national economic and social objectives. The development of Ireland's public research system is a key priority within this process and the HEA is engaging with the institutions, as well as with other research funding agencies, to ensure that researcher capabilities address identified industry requirements.
HEA4	Introduce a quality framework for PhD education	Q3 2014	A National Framework for the development of Doctoral Education in Ireland is currently under development by HEA and QQI in partnership with HEIs with a view to completion on schedule in Q3 2014. Other relevant developments in higher education include the implementation of the Irish Survey of Student Engagement (ISSE) and the development of a national Employers' Survey.
HEA5	Bring forward proposals on formal recognition of innovation activity for career progression of academic staff	Q4 2013	Beginning in 2013, the HEA will publish annual profile/performance templates for each HEI, giving visibility to research and knowledge transfer with performance metrics which are and will remain aligned to those used by enterprise agencies & KTI. This emphasis on performance in research and innovation at institution level is intended to and expected to impact on performance appraisal at individual level.
HEA6/ IRC5	Increase proportion of post-graduate researchers on enterprise placements (min. 6 weeks / year)	+20% by 2017	The Employment-Based Postgraduate Programme is currently the key initiative in this regard. The students under this programme are employed by the company for the duration of their course and must spend a minimum of 50% (and ideally 70%) on the employer premises in a structured programme. In 2014, this co-educational research initiative is moving from a pilot to full programme phase.
HEA7	Through performance monitoring and strategic dialogue incentivise an increase in the proportion of STEM academic staff with formal research and	+20% by 2017	The positive trends in student take-up of STEM and the growing emphasis on enterprise and community engagement within the Higher Education System Performance Framework will support delivery of this objective, as will the co-design and co-delivery with industry of

	graduate education collaborations[32] with enterprise		programmes under the Springboard Initiative.
HEA8	Through performance monitoring incentivise an increase in the proportion of research funding (cash) secured by HEIs from enterprise.	+20% by 2017	Under the Higher Education System Performance Framework 2014-16 and associated Strategic Dialogue process, the level of enterprise investment in HEI research activity is monitored and strategically highlighted.
HEA9	Through performance monitoring incentivise the increase drawdown from Horizon 2020 by HEIs		Agency-level targets for drawdown are currently being considered by the Horizon 2020 High-Level Group. Under the Higher Education System Performance Framework 2014-16 and associated Strategic Dialogue process, the level of HEI Horizon2020 drawdown is monitored and strategically highlighted.

[32] Contractual with cash or *in-kind* contribution from enterprise.

Table B8: Update on Deliverables and Targets for Health Research Board

	Action	Deliverable	Progress toward Objective
HRB1	Proportion of competitive funding dispersed via joint instruments with other agencies[33]	10% by 2017	HRB continues to engage with other funding partners both nationally and internationally to sustain existing and develop new co-funding initiatives.
HRB2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review *etc*.)	Q2 2013	The HRB routinely uses both strategic review and international peer-review for evaluation of proposals
HRB3	Increase number of HRB-funded clinicians and health professionals in the health system	100 (+20%) by 2017	The HRB continues to support clinicians and other health professionals through its funding schemes and is on target to reach its 2017 objective
HRB4	Number and value of HRB research awards focused on health policy and practice priorities	51 and €14.8M (+20%) by 2017	The continuing strategic ambition of HRB to allocate a significant proportion of its funding to research focused on health policy and practice has driven a significant shift in overall investment in this direction and puts the HRB on track to reach its target by 2017
HRB5	Number and value of industry- and investigator-led clinical trials performed in HRB-funded CRF and facilitated through HRB-supported Networks (e.g. ICORG)	120 and €6.9M (+20%) by 2017	The CRFs and ICORG continue to develop their clinical trial activities and given their current trajectories, the HRB is on target to reach its objectives by 2017
HRB6	Establish (*T1*) and implement (*T2*) CRF activities at Galway, Cork and St. James Hospital	T1 Q4 2014, *T2* Q4 2016	CRFs have now been established at all sites - in 2013 building commenced at the Galway CRF and the Dublin CRF was officially opened
HRB7	Take steps to establish a national bio-banking system and support infrastructure, in conjunction with Funding Agencies and the D/Health	2016	HRB continues to engage with relevant funding agencies and Government departments to achieve this objective and has been in active discussion with EI, SFI and DAFM about collaborative arrangements to facilitate a national bio-banking platform
HRB8	Increase drawdown from *Horizon 2020* for health research		Agency-level targets for drawdown are currently being considered by the Horizon 2020 High-Level Group. Health researchers performed well in the first stage of the first H2020 call, exceeding European success rates for both

[33] This metric does not capture collaborations and synergistic working between agencies that is not based on a co-funding arrangement. Nor does it capture support provided by the HRB to Irish health researchers to participate in EU programmes such as FP7/Horizon 2020 and the EAHC Public Health Programme and international networks such as the International Council for Laboratory Animal Science.

			coordinators and partners by a number of percentage points. The National Delegate for Health and a National Contact Point for Health, both based in the HRB are working with other Irish and European colleagues to maximise the engagement of health researchers across a number of H2020 themes.
HRB9	Establish a mechanism to enhance opportunities for commercialisation of health research through appropriate liaison with enterprise agencies	Q4 2013	HRB is actively engaging with enterprise agencies on appropriate initiatives' Examples include: - Integration of Clinical Trials Liaison Office (EI-funded) and ICRIN (HRB-funded) - HRB is working on a co-funding arrangement for the NCRF with EI, and on collaborative arrangements on bio-banking (e.g. specific questions on bio-banking in enterprise agency application forms and allocation of a budget line as a direct cost) - HRB is establishing links with Knowledge Transfer Ireland to enhance technology transfer opportunities for HRB-supported clinicians and health professionals.
HRB10	Fund large-scale clinical research-enabling initiatives (CRFs, NCRF, Clinical Research Networks etc.), one of whose core objectives will be the development of commercial links	Q4 2016	The HRB expectation is that a proportion of the core grant of the CRFs, NCRF and Clinical Research Networks will be used for business development.

Table B9: Update on Deliverables and Targets for Dept. Health

	Action	Deliverable	Progress toward Objective
DH1	Publish Health Information Bill	Q4 2013	Health Identifiers Bill 2013 currently before the Oireachtas and is expected to be enacted in Q3 2014. Health Information Bill to be published Q4 2014.
DH2	Ensure development of an appropriate national eHealth strategy	Q4 2013	eHealth Strategy was published Dec. 2013. A Government decision has been made to establish *eHealth Ireland*, under the leadership of a Chief Information Officer (CIO). The recruitment for this position, through open competition, was initiated in May 2014.
DH3	Explore the potential for establishment of a Connected Health Ecosystem	Q4 2013	Assessment is on-going. Includes engagement with N. Ireland CH ecosystem.

Table B10: Update on Deliverables and Targets for Dept. Agriculture, Food & the Marine

	Action	Deliverable	Progress toward Objective
DAFM1	Proportion of competitive funding dispersed via joint instruments with other state research funding agencies	12% by 2017	Following discussions with others the focus for now is on complementary funding rather than joint instruments.
DAFM2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review etc.)	Q3 2013	Believe existing system used by DAFM, although not strictly stage-gate, contains a mix of all the requisite elements such that it achieves the same objective as that which the Experts recommended.
DAFM3	Funding Department and agencies to work together to define and implement a strategic research agenda aligned to the NRPE Priority Areas "Food for Health" and "Sustainable Food Production & Processing", taking account of relevant ERA-NET and JPI SRAs through coordinated suite of funding instruments	Q4 2013	Draft SRIA now taking shape following 5 meetings of the Working Group, numerous bi/tri-laterals & email exchanges, and an online consultation with end-user type industry and other stakeholders. Format agreed; agenda content now being collated, finessed and prioritised; implementation modalities (primarily for funders to agree) yet to be discussed in detail.
DAFM4	Establish a single stakeholder Group to inform and monitor the outputs of initiatives funded in line with the "Food for Health" and Sustainable Food Production & Processing" SRAs.	Q4 2013	Group recently established and met for first time in May 2014. Membership, Terms of Reference and Chair likely to be finalised at next meeting in June 2014.
DAFM5	Implement relevant actions from Food Harvest 2020	Various	On-going
DAFM6	Implement a new IRC/DAFM/Industry collaborative programme to have a cohort of Masters research students employed for a 18 – 24 month period in Agri-food companies	Q2 2013	DAFM partnered with IRC in 2 of its recent employment-based programme Calls resulting in DAFM part/fully funding 3 Masters & 2 PhDs research students in successful projects.

Table B11: Update on Deliverables and Targets for Teagasc

	Action	Deliverable	Progress toward Objective
Tgc1	Proportion of competitive funding dispersed via joint instruments with other state research funding agencies[34]	12% by 2017	2.5% of new Walsh Fellowships awarded in 2013 were awarded via the Employment-Based postgraduate programme with IRC.
Tgc2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review etc.)	Q3 2013	All new Teagasc funded research project proposals and Walsh Fellowship applications are subjected to a two-stage evaluation process. In the first stage of the evaluation all proposals are assessed for potential impact by a panel consisting of two industry experts and Teagasc senior managers. Projects that pass the impact assessment are then submitted to the Scientific Assessment panel, which consists of 5 external experts and Teagasc senior managers. This stage also includes an external review by an expert in the particular area of the project. The Walsh Fellowship applications are also reviewed externally.
Tgc3	Investigate possibility of Teagasc becoming involved in spin-outs resulting from its research activities	Q4 2013	Plans for this are currently underway.
Tgc4	Increase number and value of research collaborations with enterprise	+20% by 2017	As part of the new TTSI initiative, Teagasc has adopted new metric definitions for research collaborations with industry. 2013 will now be taken as the reference year, against which progress will be measured. There were 13 research collaborations with enterprise in 2013.
Tgc5	Increase drawdown from Horizon 2020 by Teagasc researchers		Agency-level targets for drawdown are currently being considered by the Horizon 2020 High-Level Group. Teagasc is focused on increasing the drawdown from Horizon 2020. Targets are currently being examined.

[34] Teagasc runs an annual call for post graduate student fellowships (the Walsh Fellowships) and does not run other competitive funding calls.

Table B12: Update on Deliverables and Targets for Marine Institute

	Action	Deliverable	Progress toward Objective
MI1	Proportion of competitive funding dispersed via joint instruments with other state research funding agencies	12% by 2017	3% in 2013 with co-funding partners EPA and BIM
MI2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review etc.)	Q3 2013	Evaluations of competitive calls for research proposals are carried out by international scientific experts in the relevant field, in accordance with published evaluation criteria that are included in the call for proposals
MI3	Determine, in conjunction with SEAI, the research facilities required for MRE (heavy mechanical engineering, electrical power systems, marine operations and ICT systems)	Q4 2013	Collaborations with SEAI are ongoing through the SLA and work on the Ocean Energy Test Site
MI4	Establish access programme for HEI & enterprise researchers to research infrastructure	Q2 2014	Access to National Research Vessels (*Celtic Explorer* and *Celtic Voyager*) via annual calls to apply for ship-time days to undertake research at sea is open to HEI, Public Research Institutes and Industry
MI5	Progress the SmartBay marine technology test and demonstration facilities in Galway Bay by preparing for the installation of a fibre optic cable	Q4 2013	The fibre optic cable project is progressing well, with all procurement completed and installation scheduled for Q1 2015
MI6	Complete Integrated Marine Research & Innovation Plan (2014-2020)	Q4 2013	The Marine Research & Innovation Agenda for Ireland (2014-2020) is currently being drafted, with Stakeholder and Public consultations planned for completion by Q3 2014

Table B13: Update on Deliverables and Targets for Sustainable Energy Authority of Ireland

	Action	Deliverable	Progress toward Objective
SEAI1	Number of research awards, in areas of key strategic importance ,via joint instruments with other agencies	Min of 4 projects by 2017	
SEAI2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review etc.)	Q3 2013	The SEAI RD&D and Ocean Energy Prototype fund are mostly enterprise-focused. Stage-gate procedures are in place to ensure successful delivery of projects. External evaluation is standard for applications > €100,000.
SEAI3	Identify enterprise research needs and gaps for relevant Priority Areas, in conjunction with EI, IDA Ireland, SFI + other agencies	Q2 2013	Complete. For Priority Areas J and K, the industry partners have been surveyed to identify the needs.
SEAI4	Publish Offshore Renewable Energy Development Plan	Q2 2013	Complete
SEAI5	Promote Irish participation in the European Energy Research Alliance	Q1 2013	UCCs HMRC participate in the Ocean Energy EERA. UCD's ERC are looking to participate in the Smart Grids EERA in 2014. The Smart Cities EERA may also be an option.
SEAI6	Determine, in conjunction with MI, the research facilities required for MRE (heavy mechanical engineering, electrical power systems, marine operations and ICT systems)	Q4 2013	Building on the 2011 SEAI Assessment of the Irish Shipping and Ports Requirements for the Marine Renewable Energy Industry, the Marine Renewables Industry Association (MRIA) are conducting a review of policy development requirements and 'advanced' investment required in maritime infrastructure to meet marine energy developments in the next 10 years.
SEAI7	Establish, in association with other agencies, access programme for HEI and enterprise researchers to research infrastructure.	Q2 2014	A national inventory of research equipment (> €100k) and associated guidelines have been completed and are available at: www.hea.ie/content/large-items-research-equipment-database
SEAI8	Establish SGSC test-bed facilities	Q4 2014	
SEAI9	Establish research centres & networks with participation of all relevant players: enterprise, semi-states, local authorities, planners, funders etc.	Q4 2014	

Table B14: Update on Deliverables and Targets for Environmental Protection Agency

	Action	Deliverable	Progress toward Objective
EPA1	Number of research awards, in areas of key strategic importance ,via joint instruments with other agencies	Min of 4 projects by 2017	The EPA liaises with a variety of funding agencies in relation to identifying research priorities and will, in the coming years, co-fund with others on areas of key strategic importance.
EPA2	Apply where appropriate, standardised principles for assessing research proposals (stage-gate, international peer-review *etc*.)	Q3 2013	Projects are subject to a two stage review including a National Overview Committee who review shortlisted priorities for priorities/relevance and avoidance of duplication in an Irish context.
EPA3	Develop a suite of funding instruments (new, existing or modifications of existing) across all relevant departments and agencies which will include a programme of research to understanding the toxicological properties and environmental fate of new materials through their life cycle	Q3 2013	The EPA has received feedback from key research stakeholders and all agencies with responsibilities for novel materials from research, environment, health and safety aspects in relation to a short consultation undertaken in 2013. The EPA will prioritise the research ideas received and include some topics in the 2014 EPA research call for proposals depending on budget availability.
EPA4	Coordinate and support industry co-funded programmes to enhance resources efficiency across all business sectors.	Q2 2013	The EPA's Green Business Initiative promotes resource efficiency across business sectors in Ireland. Activities include on-site assessments; on-line tools; and training programmes. This ongoing programme works in partnership with SEAI, Bord Bia, Enterprise Ireland, IBEC and others to deliver targeted and relevant supports. The overarching National Waste Prevention Programme (NWPP), is currently being revised for the period 2014-2020 and, following a public consultation, will be published in Summer 2014.
EPA5	Ensure, in association with other agencies, mechanisms are in place to facilitate access by HEI / industry researchers to research infrastructure	Q2 2014	A national inventory of research equipment (> €100k) and associated guidelines have been completed and are available at: www.hea.ie/content/large-items-research-equipment-database

Table B15: Baseline Data for Metrics for the 14 Priority Areas

Identifier	Metric	Source	Rationale
PA-M1	Component of GBAORD aligned with PA	Forfás	Input - *public investment in each PA*
PA-M2	Productivity (value-added/employee)	Forfás ABSEI	Robustness of PA - *prospects for the future*
PA-M3	Total Employment	Forfás ABSEI	Impact – *desired outcome*
PA-M4	Value-added	Forfás ABSEI	Impact - *desired outcome*
PA-M5	Sales	Forfás ABSEI	Impact - *desired outcome*

Results from *Annual Business Survey of Economic Impact* 2012 (*Forfás*)

Table B16: Firms who indicated that *"[Priority Area] directly relevant to business"* or are *"actively engaged in research in the [priority] area"*

		PA-M2	PA-M3	PA-M4	PA-M5
		Productivity (VA/empl k€)	Employment	Value-added (k€)	Sales (k€)
A	Future Networks & Communications	161	161,731	26,011,982	78,579,335
B	Data Analytics, Management, Security & Privacy	191	150,618	28,796,608	79,172,584
C	Digital Platforms, Content & Applications	170	139,694	23,740,604	72,217,260
D	Connected Health and Independent Living	87	64,249	5,584,894	22,486,156
E	Medical Devices	150	58,113	8,690,678	18,738,843
F	Diagnostics	214	49,961	10,692,295	22,911,119
G	Therapeutics: Synthesis, Formulation, Processing and Drug Delivery	302	43,491	13,128,458	29,565,700
H	Food for Health	91	56,524	5,143,514	21,034,396
I	Sustainable Food Production and Processing	91	57,712	5,257,542	19,468,007
J	Marine Renewable Energy	88	33,663	2,962,031	12,480,887
K	Smart Grids & Smart Cities	158	69,687	11,017,488	37,269,913
L	Manufacturing Competitiveness	161	165,506	26,620,843	74,144,455
M	Processing Technologies and Novel Materials	180	153,778	27,717,974	77,513,820
N	Innovation in Services and Business Processes	178	197,376	35,201,688	95,427,162

Note: Priority Areas are not mutually exclusive. Many firms will be included in figures for several areas.

Table B17: Firms who indicated they are "*actively engaged in research in the [priority] area*" (a subset of cohort in Table B16)

		PA-M2	PA-M3	PA-M4	PA-M5
		Productivity (VA/empl k€)	Employment	Value-added (k€)	Sales (k€)
A	Future Networks & Communications	181	43,256	7,843,203	30,633,686
B	Data Analytics, Management, Security & Privacy	273	51,883	14,152,251	37,176,587
C	Digital Platforms, Content & Applications	271	49,276	13,371,804	36,039,073
D	Connected Health and Independent Living	110	18,086	1,982,966	9,687,721
E	Medical Devices	138	29,044	4,010,334	9,146,403
F	Diagnostics	116	12,832	1,482,350	3,189,895
G	Therapeutics: Synthesis, Formulation, Processing and Drug Delivery	482	18,591	8,968,916	21,002,444
H	Food for Health	85	20,710	1,752,357	7,832,883
I	Sustainable Food Production and Processing	92	24,838	2,288,243	7,474,736
J	Marine Renewable Energy	127	9,432	1,201,149	6,983,080
K	Smart Grids & Smart Cities	316	20,803	6,576,086	23,723,591
L	Manufacturing Competitiveness	196	73,274	14,381,760	30,611,293
M	Processing Technologies and Novel Materials	196	58,413	11,423,085	25,456,367
N	Innovation in Services and Business Processes	142	71,622	10,147,789	20,480,273

Note: Priority Areas are not mutually exclusive. Many firms will be included in figures for several areas.

Appendix C: Glossary of Acronyms

ABSEI	Annual Business Survey of Economic Impact
BERD	Business Expenditure on R&D
BIM	Bord Iascaigh Mhara
CAGR	Compound Annual Growth Rate
CRF	Clinical Research Facilities
CSET	Centre for Science, Engineering and Technology
CSO	Central Statistics Office
DAFM	Dept. Agriculture, Food and the Marine
DCENR	Dept. Communications, Energy & Natural Resources
DECLG	Dept. Environment, Community & Local Government
DES	Dept. Education & Skills
DELNI	Dept. Education and Learning Northern Ireland
DJEI	Dept. Jobs, Enterprise & Innovation
DH	Dept. Health
DPER	Dept. Public Expenditure & Reform
DSE	Discover Science & Engineering
EGFSN	Expert Group on Future Skills Needs
EI	Enterprise Ireland
EPA	Environmental Protection Agency
FDI	Foreign Direct Investment
GBAORD	Government Budget Appropriations or Outlays on R&D
GERD	Gross Expenditure on R&D
HEA	Higher Education Authority
HEI	Higher Education Institution
HERD	Higher Education Expenditure on R&D
HIQA	Health Information & Quality Authority
HPRA	Health Products Regulatory Authority

HRB	Health Research Board
HSE	Health Services Executive
ICT	Information & Communication Technologies
IDA	IDA Ireland
IMB	Irish Medicines Board (from 1 July 2014, the Health Products Regulatory Authority, HPRA)
IoT	Institute of Technology
IP	Intellectual Property
IRC	Irish Research Council
KTI	Knowledge Transfer Ireland
MI	Marine Institute
MNC	Multi-National Corporation
NIBRT	National Institute for Bioprocessing Research and Training
NRPE	National Research Prioritisation Exercise
NSAI	National Standards Authority of Ireland
PA	Priority Area
PI	Principal Investigator
PRS	Public Research System
PRO	Public Research Organisation
PST	Platform Science & Technology
Q1/2/3/4	Quarter 1/2/3/4
QQI	Quality and Qualifications Ireland
RDI, RD&I	Research, Development & Innovation
RPSG	Research Prioritisation Steering Group
RPAG	Research Prioritisation Action Group
RPO	Research Performing Organisation
RTO	Research Technology Organisation
SRC	Strategic Research Cluster
SEAI	Sustainable Energy Authority of Ireland
SFI	Science Foundation Ireland
SME	Small or Medium-sized Enterprise

STI	Science, Technology and Innovation
TI	Technology Ireland
TIDA	Technology Innovation Development Award Programme
TRL	Technology Readiness Level
TTO	Technology Transfer Office

Forfás

An Roinn Post, Fiontar agus Nuálaíochta
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