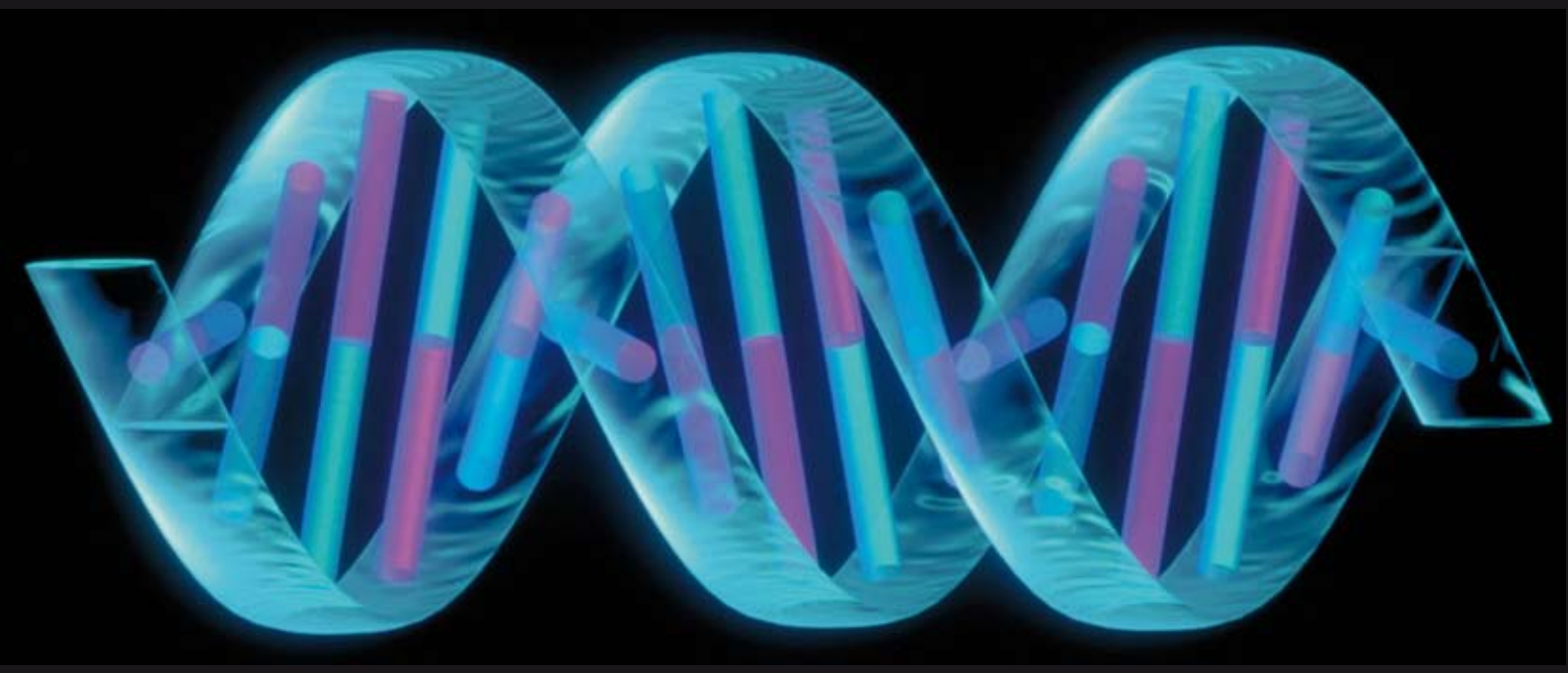
First Report on the Strategy for Science, Technology and Innovation



2006 ~ 2013

Foreword

The Government's Strategy for Science, Technology and Innovation sets a vision for Ireland to become a leading knowledge economy by 2013.

This report reflects the key progress we are making to this end in the inter-dependent areas of:

- Building a world class research system;
- Capturing, protecting and commercialising ideas and know-how;
- Driving growth through research and innovation in enterprise;
- Providing solid sound foundations in education
- Ensuring that the different parts of the research system are working well together

Eighteen months into the strategy, there are many positives to report. We have almost trebled our R&D spend over the past 10 years to get to where we are now.

The increased investment in the higher education sector is having a significant impact in terms of human capital development. Government initiatives such as the Programme for Research in Third Level Institutions, Science Foundation Ireland and the R&D investments in the health, agriculture, marine, energy and environment sectors are contributing to the development of a world-class research base.

This is paralleled by equally dynamic growth in business sector R&D, which is almost double the level recorded in 2000. Enterprise Ireland continues to administer a range of schemes to ensure we have the capacity to capture and transform the ideas and advances coming from higher education research into commercial reality. In January 2008, IDA and Enterprise Ireland launched a new €500m revised and simplified R&D grant scheme for companies to boost their research efforts in order to underpin future competitiveness.

Growth in researcher capacity, coupled with the enhanced R&D tax credit arrangements, continues to be a major attraction for overseas investors, and is resulting in a series of significant industrial and academic research collaborations. It is particularly welcome that as many as 40% of the 114 new projects secured by the IDA in 2007 were R&D investments.

Good progress is also being made in supporting and developing North-South R&D cooperation. An All-Island Innovation Voucher Scheme is now in place, and Science Foundation Ireland has developed a dedicated support mechanism to encourage researchers from Northern Ireland to connect with SFI-funded researchers in the south.

It is clear from a review of our performance that we are making solid progress towards the ambitious goals we have set ourselves. We are already demonstrating a strong capacity to make the new connections between knowledge, innovation, people and enterprise necessary to meet the rapidly evolving demands of world markets. We are fully committed to sustaining this momentum, ensuring we have the right environment for investment, jobs and living standards into the future.

Brian Cowen T.D.

Taoiseach

INTRODUCTION

The Strategy for Science, Technology and Innovation aims to ensure that, by 2013, Ireland will be placed frimly on the global map in terms of the excellence of our research and its application for the benefit of society. The strategy is one of the main programmatic elements of the NDP 2007-2013.

The strategy is an integrated whole-of-government approach to the realisation of an agreed vision - transforming Ireland into a competitive knowledge economy. Over the last 18 months, eight Government Departments, advisory bodies, state agencies and higher education institutions have worked together to sucessfully implement the strategy. This Report represents the outcomes of that work.

As we work our way up the international R&D investment and performance ladder we have many tangible achievements to report. Higher Education R&D spending has almost quadrupled in current terms over 10 years and is now at the EU and OECD average levels. This increased investment is paralleled by equally dynamic growth in business sector R&D which has risen to an estimated €1.56 billion in 2006 - a 17% increase on the previous year - and almost double the level recorded in 2000. Ireland's total expenditure on R&D has almost trebled over 10 years with the result that it reached 1.56% of GNP at end 2006. Our target is to achieve an investment level of 2.5% of GNP by 2013.

The Strategy's objectives of building a sustainable system of world class research teams and double the output of PhDs by 2013 are on target to date. These positive developments, combined with our success in connecting funded research teams with industry and the enhancements to the R&D tax credit arrangements, are transforming what Ireland has to offer to overseas investors. In 2007 IDA concluded negotiations for 114 new investments, 40% of which were in the area of R&D resulting in a series of significant industrial and academic research collaborations. We see the embedding of blue chip international companies in the Irish research sector as a key driver of and catalyser of innovation and a source of high quality, high skill, high added value jobs for our labour force.

Enterprise Ireland is also seeing positive trends emerging with regard to commercialisation of R&D, which I welcome. While appreciating that Ireland is still a relative newcomer to significant investment in R&D, I would expect these trends to continue upwards. There is an appreciable time lag for realisation of the return from investment in R&D but the overall trend in the report is a story of success to date. Overall, the results are very encouraging.

On behalf of the Taoiseach and my Government colleagues, I would like to thank all those who have contributed to this positive outcome. Notwithstanding the downturn in the global economy, I am confident that the commitment and enthusiasm which have taken us this far will ensure our vision for 2013 will be achieved.

Mary Coughlan T.D.

Tanaiste and Minister for Enterprise, Trade and Employment

Executive Summary

Chapter 1 – Vision and Challenge

The Strategy for Science, Technology and Innovation (SSTI) 2006-2013 is based on a shared vision of placing Ireland firmly on the global map in terms of the excellence of our research and its application for the benefit of society. Ireland is in a highly competitive global market and we need to increase productivity and innovation and grow quality jobs for our people. The SSTI is Ireland's strategic response to increased competition and the need for improvements in efficiency, quality and productivity and a growing need to innovate. In essence the Strategy aims to deliver world class people and enterprises with the drive and capacity to succeed.

We are building a world class research system and we are capturing, protecting and commercialising ideas and knowhow. The interdependencies of different elements of our national system of innovation require measured and balanced progress to be made simultaneously on a range of fronts linking many Government Departments and Agencies in a whole-of-Government effort.The SSTI is an integrated whole-of-government programme and a key investment element of the NDP 2007-2013 with an allocation of €8.2billion.

This Report outlines the progress that has been made since the Strategy was launched.

Chapter 2 – World Class Research

World class research and world class people are key deliverables under the Strategy.

Compared to ten years ago, overall R&D expenditure has almost trebled from €855million. In 2007 it grew from €2.3billion to €2.5billion. The increase was driven by strong investment growth in both the business and higher education R&D performing sectors. Ireland's R&D expenditure intensity grew to an estimated 1.56% of GNP in 2006. *(1)*

Higher Education R&D (HERD) spending has almost quadrupled in current terms over ten years and has now reached the OECD and EU-25 average HERD intensity ratio. This investment is having a significant impact in terms of human capital development, attraction of FDI and commercialisation. Between 2004 and 2006, the total number of higher education researchers rose from 4,152 to 4,690, an increase of 13%.

The SSTI target to double the output of PhDs by 2013 over the 2005 base is advancing significantly. The most recent data show total outputs rising from 808 in 2005 to 976 in 2006 which is well on track for achieving the overall goal of exceeding annual output of 1,300 by 2013. A key objective of the strategy is not only to increase the output of PhDs, but to maintain quality and see this knowledge intensive capacity spread through all sectors of the economy.

The Higher Education Authority (HEA) is engaged in an open process with key educational and business stakeholders in progressing the development of Structured PhD programmes supported by the Strategic Innovation Fund. PRTLI 5 will also focus on funding the early stage flow into the SET pipeline, postgraduate students and early stage researchers.

(1) R&D Expenditure Intensity is the ratio of total R&D expenditure to overall economy activity as measured by Gross Domestic Product (GDP) or Gross National Product (GNP)

A clear policy on researcher careers is being developed, one which will, ideally, allow researcher flows both ways between academia and enterprise. The Advisory Science Council (ASC) has completed a study on researcher careers and presented this to the Higher Education Research Group. The findings of this deliberative process will then be reported back to the Cabinet Committee on STI by the end of 2008 for appropriate action.

To achieve a world class research system it is necessary to grow the cumulative number of Science, Engineering and Technology Principal Investigator (PI) research teams in Ireland by 350 over the period to 2013 and of Postdoctoral researchers by 1,050. Towards that end the number of PIs funded by Science Foundation Ireland (SFI) has been increased from a baseline of 200 in 2005 to 284 by end of 2007 – somewhat ahead of the target set for SFI.

In December 2007, a total of 31 Stokes Professorships and 37 Lectureships were awarded €57million. This programme is attracting highly skilled research active individuals to Ireland - 49 of the 67 approved candidates are foreign-based. To build our world class research base we are attracting top-level researchers from abroad as well as developing a significant Irish cadre of researchers. Significant progress has been made in removing barriers to entry to Ireland for researchers from third countries. A simplified system based on 'hosting agreements' from accredited research organisations was implemented in October 2007.

SFI is succeeding in connecting its funded research teams with industry. Excellent research is a highly significant pull factor in attracting FDI investment in R&D in Ireland. Nine CSETs (Centres for Science Engineering Technology) are partnered with over 40 multinational companies and SMEs. In addition, in November 2007 SFI made research investment awards of €71 million to support 12 Strategic Research Clusters (SRCs) involving 48 companies, both multinational and SME.

It will be an ongoing focus of the SSTI to ensure a match between places created by the Programme for Research in Third Level Institutions (PRTLI) and the capacity of the higher education system to absorb SFI, PRTLI and other agency supported teams.

The fourth cycle of PRTLI, which was announced in August 2007 with an allocation of €230 million, is set to deliver 819 spaces and circa 600 highly qualified research personnel. A further €30 million will be attracted to the cycle 4 programmes from non-exchequer sources. A number of national initiatives, specifically national collaborations, in areas of strategic interest to Ireland will be formed as a result of Cycle 4. This will further enhance the work done in earlier cycles of PRTLI to develop critical mass in areas of importance for Ireland. Examples include NanotEire (a national nanotechnology initiative), FoodIreland (a national food initiative) and NPBPS (formation of a biopharmaceutics 'corridor' between Belfast, Dublin and Cork). PRTLI 5, which is due to launch in the near future, is expected to include an additional space provision infrastructure focus. On the basis of investment to date and by reference to funding profiled under the NDP, the SSTI target of 3,525 new/additional researcher places should be met by 2013. This results from carefully co-ordinated cross-Government planning.

The HEA is engaged in an open process with key educational and business stakeholders in progressing the development of Structured PhD programmes catalysed by the Strategic Innovation Fund. Eight programmes in areas of strategic interest to the economy and society were funded in Cycle 4 e.g. Structured Programme in Creative Arts and Media. The first structured national programme for clinician scientists was also funded in Cycle 4. PRTLI 5 is also expected to focus on funding the early stage flow into the pipeline, postgraduate students and early stage researchers.

Chapter 3 – Capturing, Protecting and Commercialising Ideas and Knowhow

The absorption of human talent nurtured through the investments in the science base is one of the most effective means of knowledge transfer to enterprise. A further output is IDA Ireland capacity to attract mobile R&D investments. Fifty-four projects were supported by IDA Ireland in 2006 involving a total investment of almost €470million. This has increased from €140million in 2004. Exploitation of the knowledge and technology created in our research system is being realised through (a) strengthening the Intellectual Property (IP)/ Commercialisation function within the Higher Education Institutes (HEIs) and (b) implementation of a range of measures supported by Enterprise Ireland to develop collaborative links between industry and academic researchers.

Significant resources are now devoted through Enterprise Ireland's science and technology funding to assist HEIs to realise the goal of making IP management a central part of their mission. At end 2007, just over €73 million had been provided for such schemes.

The initiative to maintain and strengthen Technology Transfer Offices in Higher Education Institutions is focussed on increasing the transfer of intellectual property to industry from research in the HEIs. To date, 9 institutes have been approved for funding totalling €15.6million (NUIG, UCD, DCU, UCC, NUIM, TCD, RCSI , DIT and WIT). A new function has been established in Enterprise Ireland to provide centralised support to the Technology Transfer Offices in HEIs.

EI's Commercialisation Fund (CF) supports academic researchers to take the outputs of research with commercial potential and bring them to a point where they can be transferred to industry. There were 160 such awards in 2007, up from 140 in 2005.

In terms of commercialisation outputs all of the trends recorded are very positive:

- The Intellectual Property Fund supported 120 patents in 2007 compared to just 33 in 2005;
- Start-ups have grown from 5 in 2005 to 13 in 2007;
- Licences from State funded research have more than tripled from 15 in 2003 to 55 in 2007; and,
- Invention disclosures from researchers have grown from 135 in 2005 to 264 in 2007.

Business incubator units have been supported in Institutes of Technology and are encouraging the engagement of colleges with local firms in the development of new projects. The number of people employed in new enterprises in incubators at the end of 2007 was 584, up from 150 in 2005.

As the ramp up in investment in research in Ireland is very recent by international standards, these positive trends are expected to continue into the future, in the context of the sustained investment planned in the NDP.

Chapter 4 – Research and Development for Enterprise, Innovation and Growth

The key elements of the new approach to strengthen research and innovation in the enterprise sector outlined in the Strategy include:

(i) raising awareness and increasing the number of firms doing R&D,

(ii) improving soft supports to develop technology strategies in firms,

(iii) achieving step increases in quality and quantity of R&D activity,

(iv) building in-company technology capability,

(v) increasing inter-company and industry-HEI collaboration, and

(vi) simplifying the administrative and operational procedures of programmes.

A key measure of progress is that R&D performed in the business sector (BERD) rose by 17.3% to an estimated €1.56 billion in 2006, almost double the level recorded in 2000. Enterprise Ireland and IDA continue to work closely with companies to strengthen the research and technological base of the enterprise sector to underpin future competitiveness and quality employment and thereby drive forward the target of growing BERD to €2.5 billion by 2013 (€3.4 billion in 2008 terms).

IDA acts internationally to promote the exciting new research capabilities now available in Ireland. In 2007 IDA concluded negotiations for 114 new investments, 40% of which were in the area of R&D resulting in a series of significant industrial and academic research collaborations, notably in the SFI CSETs. DePuy Ltd, Thermoking, Vistakon and Zimmer Holdings, Genzyme, Lanacaster laboratories, Teva Pharmaceutical, Citco Funds Services, Unum, Eyewonder, ServiceSource and Beckman Coulter are just some of the IDA supported companies who have invested in R&D activities in Ireland since 2007.

In January 2008, IDA and Enterprise Ireland launched a new €500million revised and simplified R&D grant scheme for companies. Notably, there is a clear progression in the types of companies supported, from R&D novices right up to those with considerable R&D experience. Enterprise Ireland has begun an aggressive R&D promotion campaign targeted at indigenous enterprise, highlighting incentives and supports as follows:

- The R&D Capability Scheme provides support for companies to invest in major R&D programmes, and is targeted at a range of indigenous enterprises including high potential start ups, established clients and large R&D performers.
- The Innovation Management Initiative aims to increase the innovation per formance (both technical & non-technical) of Irish based companies by providing training and consultancy in innovation and R&D management.·
- In March 2008 Enterprise Ireland launched its Enterprise Innovation Networks initiative. This will grant funding of up to €200,000 per annum, over 3 years, to four successful industry representative groups to establish an Enterprise Innovation Network amongst their member companies. Each network must identify a research theme or technology of direct relevance to their mem bers
- The Tech Search service was relaunched in September 2006 and is designed to provide companies, in particular SMEs, with tools and information to investigate licensing. TechSearch achieved 35 licensing agreements in 2006 with a further 40 agreements in 2007
- The Innovation Partnership Initiative is designed to generate collaboration between companies and researchers in the third level sector to develop new innovations. There has been a doubling of the average project size over the past 3 years.

Engagement by Enterprise Ireland with self-forming industry groups resulted in Industry led Research Programmes (ILRPs), Competence Centres or a combination of both. These programmes aim to solve technical challenges faced by industry in Ireland to an agenda set by the industry sector

groups. A call to the research community on defined industry cluster needs should lead to establishment of Competence Centres by end-2008.

The Innovation Voucher initiative was introduced in April 2007. Innovation Vouchers worth €5,000 are allocated to small businesses to work with public knowledge providers on specific innovation questions. 428 companies had received Innovation Vouchers by end 2007.

Enterprise Ireland administers the Knowledge Acquisition Grants Scheme, which is specially designed for the particular needs of manufacturing and internationally traded service companies. This will allow grants of up to €50,000 to be paid on a once-off basis for projects up to 1 year.

As Government investment in public sector research increases, we must retain a two to one ratio of private to public sector investment.

The R&D tax credit scheme is specifically designed to reward increased expenditure on R&D by allowing companies a tax credit of 25% of the increase in qualifying R&D spend as compared with such expenditure in a base year. The scheme was enhanced in 2007 and again in two Finance Bills in 2008. The R&D tax credit scheme now assists in making Ireland a more attractive location for companies to carry out additional R&D and also helps Ireland retain existing activities in an increasingly competitive international environment. It can have a key role to play in developing and attracting high value-added projects, which are essential to the development of a knowledge-based economy. When coupled with our strong research base the tax credit is a very significant pull factor utilised by the IDA in attracting FDI investment in R&D in Ireland.

Chapter 5 – Science Education and Society

The SSTI outlines how we must build strong science foundations in primary and second level education. The SSTI calls for a strengthening of the link between primary and secondary cycles.

The Strategy proposes to increase participation rates in the science subjects at second level by: (i) reforming the science curricula for leaving certificate, (ii) investment in continuous professional development and networks for teachers, (iii) awareness promotion and the provision of guidance materials, (iv) rebalancing the content of the science curriculum in the direction of problem solving and (v) revisiting the issue of technical assistance for schools to facilitate practical coursework. This will be complemented through the work of Discover Science and Engineering in increasing awareness and training teachers.

One area that the Strategy emphasized was the case for course development in the Colleges of Education where more emphasis needs to be placed on science teaching methodologies and on awareness of scientific issues. The Teaching Council is reviewing all pre-service training and the findings of this review will inform the development of science teaching. The inspectorate has undertaken a detailed evaluation to report on the quality of teaching and learning in science in primary schools. The evaluation was conducted in 40 schools throughout 2007 and aimed to answer two key questions: (1) Is the science curriculum being implemented effectively? and (2) What actions would improve the quality of teaching and learning in science. The data is being analysed by the Evaluation Support and Research Unit of the inspectorate and the report of the evaluation is due for publication in early 2009.

Transition Year is an important nodal point in the study of science at second level. It literally marks a transition from nearly universal study of science subjects to a figure of 60% of the Leaving Cert cohort taking a science subject or subjects. Transition Year can be used in part to introduce school

students to sampler modules with a scientific orientation and to engage in informed discussion on potential careers in the sciences.

The SSTI set out the case for reform of the science curricula in Leaving Certificate, particularly physics and chemistry subjects, to ensure a continuum from Junior cycle with the emphasis on project-based hands-on investigative approaches and the completion of practical coursework. The current position is that the NCAA is reviewing the revised syllabi for Leaving Cert Physics, Chemistry and Biology introduced since 2000. Revised draft syllabi in these subjects will be circulated for consideration later this year.

The Maths curriculum is being revised following approval by the Minister of proposals to strengthen the emphasis on real life application. A pilot was introduced in 2008.

Survey data suggests some disconnect between the junior cycle and primary cycle at one end and the junior cycle and senior cycle at the other. A composite report covering alignment of curricula at all three levels is anticipated shortly.

A key goal in the strategy is to increase the percentage taking Chemistry and Physics subjects at Leaving Certificate generally to 20% of the overall cohort by the conclusion of this Strategy. At present the respective figures are 14.3% and 14.0%. *(2)*

The overall objectives of Discover Science and Engineering (DSE) are to increase the numbers of students studying the physical sciences, to promote a positive attitude to careers in science, engineering and technology and to foster a greater understanding of science and its value to Irish society. In developing and rolling out its science education programmes, Discover Primary Science and Discover Sensors, DSE works closely with the Primary Curriculum Support Programme, the Second Level Support Service and Teachers' Professional Networks in maths and science.

An evaluation of DSE is in train for completion shortly. Its findings will be applied to inform the future orientation of DSE in a way that maximises its contribution to the goals of the SSTI.

Chapter 6 - Research in the Public Sector

This Chapter outlines the role of SSTI in advancing the important sectoral areas of Agriculture and Food, Health, Environment, Marine and Energy and embedding these in our national innovation system. In developing and implementing programmes there is a strong emphasis on cross-sectoral projects with a view to achieving synergies from our overall investment in R&D.

Agriculture and Food

The priority under the Strategy is to build a knowledge economy in agri-food so as to provide a scientific foundation and support for a sustainable, competitive, market-oriented and innovative agriculture, food and forestry sector.

A Research Group representative of industry, State agencies and research institutes advises the Department on research matters and also acts as the Irish Platform to interact with the EU Technology Platform 'Food for Life' under the Seventh EU Framework Programme for Research and Technological Development (FP7) 2007-2013.

(2) Cohort studying in academic year 2007/2008

Significant progress is being made by DAFF and its agencies in building a knowledge economy in agri-food mainly via investment under its public good competitive research programmes – FIRM, Stimulus and COFORD. This is given additional value by cross-sectoral cooperation, for example the Diet & Health Research Centre being developed in association with the HRB.

In 2006, 58 collaborative research projects, to the value of €31 million, were funded under FIRM in all areas of food research including food safety, food quality & manufacturing, food and health and the food supply chain.

In the agricultural production area, 79 research projects have commenced since 2006 arising from approx. €42million grant aid provided under DAFF's Stimulus Programme. Much of this research is aimed at underpinning sustainable agricultural production practices and policies and is focused mainly on the themes of Agri-Energy, Agri-Environment, Plant Biosciences; and Agri-Economics.

Since the beginning of 2007 COFORD has put in place research programmes in climate change and forests, biodiversity, forests and water, forest planning and management, forest policy and economics, totalling 27 projects at an estimated cost of €13 million to 2012.

Arising from the re-structuring of Teagasc Research activities, plans are well advanced for Centres of Excellence in the areas of Animal Science, Plant/Crop Science and Environment, and Rural Research Centres, as well as Functional Foods laboratories, and a large animal facility.

Health

The SSTI calls for Ireland to build the R&D potential within the health service and link this to investment in basic sciences.

A Health Research Group has been established under the auspices of the Interdepartmental Committee on Science, Technology and Innovation. Its task is to formulate and oversee implementation of a national health research policy and strategy with clearly defined objectives and priorities.

The pharmaceutical and medical devices industries' presence in Ireland has grown at a faster rate with a higher level of foreign direct investment than in other countries. These healthcare industries are increasingly dependent on high quality clinical research provided by specialists in well-equipped centres. Efficiency and effectiveness in the governance and operation of ethical committees and of clinical trials is a potential strength which should be developed.

The HSE is the largest supplier of health services but does not at present have an identifiable research budget within its €12.3 billion allocation, although it clearly supports research; in the main via hospital budgets. A hospitals survey is in train with a view to quantifying this substantial area of health research as regards scale and nature of investment. When read together with BERD and HERD surveys this should enable, for the first time, a mapping of virtually the full extent of R&D in the health sector.

In 2007 the HSE published a strategy document on its research priorities and on medical education and training. The HSE anticipates appointing a clinician Director of Health Research who will function, inter alia, as a central contact point for all issues related to the conduct of health research in the HSE.

It is understood that the Common Contract for consultants, which is being finalised with the HSE and medical bodies, will include provisions on clinician research time.

The HRB has an audit of population health research in Ireland in train, the objective being to strengthen research capacity in this area.

Three clinical research facilities (CRFs) are being developed, one each at St James's Hospital, Dublin; University College Hospital Galway; and, Cork University Hospital. The aim of the Health Research Board (HRB)/ Health Service Executive (HSE) Clinical Research Facilities is to provide the infrastructure – the physical space, facilities and the experts - needed to support patient-focused research studies.

Environment

The SSTI states that the future strategic direction of environmental research will be to anticipate and respond to changing circumstances and to engage in research to generate new knowledge of the environment and environmental technologies. In accordance with this objective, an environmental research centre is being developed as a centre of excellence within the Environmental Protection Agency (EPA) in close cooperation with the HEIs to build capacity in environmental data handling, modelling, assessment and guidance. This centre has the potential to become a key environmental component of the knowledge economy and will be the cornerstone of future environmental research.

A key development in 2007 was the establishment of a new Climate Change Research Programme with thirteen projects and four fellowships to be awarded immediate funding from the overall budget of €8.7 million.

In 2008, research and funding under STRIVE has been stepped up, both to facilitate new projects and to ensure that the projects already commenced can be satisfactorily completed.

Marine

Investments under the NDP 2000-2006 have seen positive developments in the infrastructure for Marine Research. The SSTI aims to build upon this investment by raising the profile and standing of key Irish facilities and to develop Ireland as a global monitoring centre for climate change assessments through the medium of marine and freshwater ecosystems.

In 2008 a centralised system is being set up to administer research funding and track marine research activity funded across the full range of initiatives.

The Beaufort Marine Research Awards in Biodiscovery are now in place. These seven-year awards, to two institutions, total €7.23million. In addition, the Beaufort Marine Research Award in Marine Sensors and Communications will result in a €2.5million investment over a 7-year period.

Key elements of the National Ocean Energy Strategy are being implemented:

- Irish researchers have been successful in attracting research funding from the Seventh EU Framework Programme for Research and Technological Development (FP7) 2007-2013 of €1.5million for renewable ocean energy;
- A quarter-scale Test Site for prototype wave energy devices has been estab lished in Galway Bay;

- Planning is at an advanced stage for the development of an offshore grid-connected test site to accommodate full-scale wave energy devices, to be developed following their trials in Galway Bay;
- An industry forum for this emerging sector has been created and is meeting on a regular basis.

Galway Bay has been identified as the location for SmartBay *(3).* Research partnerships are already in place and will be extended to other groups. Agency partnerships have been put in place with Environmental Protection Agency, Enterprise Ireland and IDA and industry collaboration agreements have been created with IBM, Intel and Transas.

The Marine Functional Foods Initiative is a seven-year research initiative valued at €5.32 million and comprehends a cross-institute research consortium led by Teagasc.

Nine marine projects with Irish participation were approved for funding in the first round of the FP7 Cooperation Programme. Total grant-aid to Irish partners is estimated to be in excess of €4.9 million and two major projects are led by Irish research institutions.

Energy

The Government, in March 2007, published the Energy Policy White Paper and set out a number of recommendations on energy research. The Energy Research Council's Strategy was published in May 2008. The Strategy addresses the key thematic research areas in relation to security of supply, rational use of energy, renewable energy technologies and national energy infrastructure. The issue of developing cross–sectoral research initiatives, including in areas such as climate change, enterprise, agriculture and transport, are also addressed. A public consultation process is being undertaken to inform the development of an overall energy research strategy framework, with any necessary Government deliberations to follow.

On 6 March 2008 at the Energy Innovation Forum, the Minister for Enterprise, Trade and Employment announced details of the agreement with the Minister for Communications, Energy and Natural Resources to combine resources and to target a world-class research capacity investment through SFI of €90 million in the areas of sustainable energy and energy efficient technologies, over the period to 2013. The Renewable Energy Development Group has been reconstituted to provide focus and coordination of research and other support mechanisms and better linkages between government and industry. A National Ocean Energy Unit has also been set up, based at Sustainable Energy Ireland.

Sustainable Energy Ireland (SEI) has published an all-island inventory of energy research and researchers for 2006. Significant levels of participation in FP7 and other international energy research programmes are being targeted. The Hydraulics and Maritime Research Centre (HMRC) in University College Cork is coordinating the CORES project (Components for Ocean Renewable Energy Systems), which will run from 2008 to 2011. The total cost is €4.49 million, with an EU contribution of €3.45 million. The aims of this project are to research and test the components for a floating wave energy device.

(3) SmartBay is a test and demonstration research infrastructure comprising a networked deployment of a suite of emerging new technologies. It aims to strategically position Ireland as a major player in the emerging global market for environmental technologies

All-Island initiatives and collaborative proposals are being developed under FP7. Following a competition in which applicants were evaluated by an international peer review, seven projects were recommended for funding in 2007 under the Charles Parsons Energy Scheme, two of which were from Higher Education institutions in Northern Ireland.

Enterprise Ireland has reviewed opportunities to progressively enhance the active engagement of Irish energy industries with R & D programmes (2006-2013) across the value chain for the Irish energy sector, as required by the Energy Policy White Paper.

As a result of this review, Enterprise Ireland supports appropriate investment opportunities in energy enterprises and research that have the potential to deliver new innovative products and services.

Chapter 7 - All Island and International R&D

The Strategy outlines the need for continued engagement with the EU institutions and appropriate international organisations to ensure the optimum return for our research sector. Collaboration on an all-island basis is a central tenet of the Strategy ensuring that all potential synergies are harvested to the benefit of the population of the whole of the Island.

A new FP7 National Support Network, which aims to ensure that a coordinated and coherent approach towards FP7 is adopted and that Ireland achieves the maximum benefit from the EU FP7 Programme, has been put in place. Preliminary statistics on success rates for the first year of the Seventh EU Framework Programme for Research and Technological Development (FP7) 2007-2013 show that Irish researchers have leveraged €57 million associated with successful proposals within the first 54 calls for proposals.

Based on the work undertaken by the Network in 2007, the Cabinet Committee on Science, Technology and Innovation approved a proposal to increase the total share of Community funding to be targeted by Ireland over the lifetime of FP7 from €400 million to €600 million. This revised target is considered realistic yet sufficiently challenging.

Since 2006, the Department of Enterprise, Trade and Employment, with assistance from Forfás, has continued to monitor and evaluate Irish engagement with international programmes. In 2007, there were 700 attendees at seven general FP7 training events and more than 2,200 attendees at 43 theme-specific information events.

Irish research teams, with support from funding agencies, continue to contribute to the development of a number of new research infrastructures at European level. During 2007, the European Commission provided funding to seven groups in Ireland for the preparatory actions in these areas which include clinical trials and biobank facilities, ocean exploration infrastructures, social science databases and infrastructures associated with research in the humanities.

In the area of high performance computing, recent investments in Ireland have been designed in such a way that Irish facilities will connect to other global facilities giving benefits to the research community in Ireland and ensuring the maximum synergy from national investments.

The Advisory Science Council (ASC) commenced a study in order to help develop a strategy for Ireland's international engagement in science, technology and innovation. The outcome of this study, which is expected to be completed this year, will help to guide decision making on the internatio-

nal research organisations in which Ireland should seek closer involvement.

The Department of Enterprise, Trade and Employment and the Advisory Science Council have established and continue to develop links with the NI Inter Departmental Working Group on Innovation (chaired by DETI) and with MATRIX (NI Science Industry Panel).

Good progress is being made in supporting and developing North/South cooperation in R&D. The intention to set up a North / South Innovation Fund was announced in March 2007 consequent to the agreement on restoration of institutions and devolved government in Northern Ireland. Following discussions between the Department of Enterprise, Trade and Employment and the Northern Ireland Departments, agreement has been reached on the amount of funding to be made available over a three year period. The contribution from the Republic of Ireland side has been set at €60million, to be sourced from within the overall envelope of NDP committed investment in R& D. On the Northern Ireland side there is a global provision of £Stg 90million, comprehending innovation both within Northern Ireland and on a collaborative all-Ireland basis.

Officials from both sides continue to meet to identify potential collaborative projects and cooperative mechanisms. As a result of these discussions, an All Island Innovation Voucher Scheme, which is being administered by Enterprise Ireland and Invest NI, was launched on 27 May 2008.

Science Foundation Ireland (SFI) has invited applications from existing SFI award holders for supplementary funding for collaborative projects with scientists in Higher Education Institutions in Northern Ireland. SFI has also indicated that it will carry out a future Centre for Science Engineering and Technology (CSET) Call on an all island basis.

Collaborative approaches are also being developed institutionally, through FP7 and through the Ireland / US R & D Partnership.

1 Vision and Challenge

The success of the Irish economy over the past decade has been unprecedented. GDP growth since 2000 averaged more than 5% per annum which, while less than in the preceding period, compares very favourably to growth rates elsewhere in the EU. The legacy of the last decade has been very positive in many respects, notably in a highly productive manufacturing sector, which includes many of the world's leading high tech companies, and a dynamic and developing internationally traded services sector. Ireland continues to win international investments from global corporations because we are seen as a business location continuing to offer a low corporation tax regime, a young skilled and well-educated workforce with relevant technological and business skills, a strong and growing R&D environment complemented by a strong Intellectual Property regime with a fast improving industrial infrastructure. These are the strong foundations on which the next stage of our economic and social development will be based.

The Strategy for Science, Technology and Innovation (SSTI) was formulated on the premise that factors which contributed to our economic success in the past would not be sufficient to sustain our success in the future. Its implementation is a vital response to increased competition and the need for improvements in efficiency, quality and productivity and a growing need to innovate. The Strategy is based on a shared vision of placing Ireland firmly on the global map in terms of the excellence of our research and its application for the benefit of society. Its vision remains a compelling one:

"Ireland by 2013 will be internationally renowned for the excellence of its research, and will be to the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture."

High quality innovative research can result in economic and social benefits for the country as a whole. These benefits can be considered along the lines of benefits traditionally seen as economic, such as creating employment in the production of ICT products, the creation of spin-off companies in the pharmaceuticals sector, or they can be more complex benefits related to a healthier workforce, an improvement in the environment, or further enhancment of Ireland's reputation, leading to increased foreign investment.

The recent Report of the High Level Group on Manufacturing (March 2008) further reiterates the need for investment in leading edge technology to drive productivity. It highlights the need for innovation, including non-technological innovation, across all elements of business functions to gain a competitive edge through differentiation. It recognizes that continuous investment in people is vital in today's business environment - in continuous learning, re-skilling and in developing management capability for the innovative organization.

Growing research capability is a core component of the European Union's drive to become the most competitive and dynamic, knowledge-driven economy in the world. The Lisbon European Council of March 2000 aimed to make Europe more competitive and innovative on the world stage. As part of that process, the Barcelona European Council concluded that Europe as a whole should aim to reach a target of spending 3% of GDP on R&D by 2010, with two thirds of that spend to come from industry. Ireland has fully embraced that challenge. The Strategy for Science, Technology and Innovation (SSTI) 2006-2013 represents our comprehensive plan to guide us towards that goal.

The SSTI outlines the areas in which demonstrable achievements are required if Ireland is to achieve its goal. These include:

· Increased participation in the sciences by young people;
· Significant increase in the numbers of people with advanced qualifications in science and engineering;
· Enhanced contribution of research to economic and social development across all relevant areas of public policy including agriculture, health, environment and the marine and natural resources;
· Transformational change in the quality and quantity of research undertaken by enterprise - both directly and in cooperation with third level institutions;
· Increased output of economically relevant knowledge, know how and patents from those institutions;
· Increased participation in international S&T cooperation and transnational research activity;
· An established international profile for Ireland as a premier location for carrying out world class research and development;
· Greater coherence and exploitation of synergies to mutual advantage in the development of STI policy on the island of Ireland.

In summary, the Strategy aims to deliver world class people and enterprises with the drive to succeed and the resources to do so.

In January 2007, the Government backed the vision with the resources required for its implementation and committed a total budget of €8.2 billion under the National Development Plan 2007-2013. This funding will be apportioned among the following programme areas:

Science, Technology and Innovation Sub Programme €6.1billion

• World Class Research STI	€3.46 billion
• Enterprise STI	€1.29 billion
• Agri-Food Research	€ 641 million
• Energy Research	€ 149 million

• Marine Research	€ 141 million
• Geo-science	€ 33 million
• Health research	€ 301 million
• Environment Research	€ 93 million

The investment in human capital, physical infrastructure and commercialisation of research outlined above is complemented by investment in initiatives set out in the NDP allocations for Higher Education and the Foreign Direct Investment activities of the IDA. Taking account of these amounts, the global NDP investment in STI over the period 2007-2013 will amount to €8.2 billion.

The interdependencies of the national system of innovation cannot be overstated and consequently cross-Government connectedness around a common and shared strategy has been an important enabler in progressing its implementation. The symbiotic interdependencies also mean that we must progress on all aspects of the strategy in a balanced manner. Thus, for example, growth in the strength of the higher education science base must be more than matched by enhancement in private R&D activity and sectoral research strength; doubling the output of PhDs requires a strengthened pipeline of students and a strong labour market demand and career opportunities for the resulting talent pool that will be created; strength in institutional research capacity will be suboptimal without the capacity for commercialisation of ideas and technologies that it will inevitably produce; strengthening science, engineering, technology must be balanced with strengthening humanities and social sciences will enhance our research base and, at the same time, provide a greater understanding of the changes taking place in the Irish economy and society that will enable policymakers to reflect the appropriate balance required for optimal social and economic gain. Consequently, in assessing the progress being made in implementing individual aspects of the Strategy, the focus on balance and connectedness that give real synergies must also be to the fore.

This report outlines the progress that has been made in realizing the vision outlined above since the SSTI was launched in mid 2006, having regard notably to the first full year of its operation, 2007, as a key element of the National Development Plan.

2 World Class Research

The SSTI builds on the progress made under the NDP 2000 - 2006 in developing a world class research system in Ireland. PRTLI and SFI investments continue to fundamentally change the scale and quality of research carried out in Ireland. As the SSTI notes, a world class system requires dedication, persistence and sustained commitment and the phase of development currently underway must result in (i) significant increases in research capacity, quality and output, (ii) significant increases in investment in 4th level and the public research system, (iii) reform in the universities, and (iv) better management of the research and innovation environments.

The SSTI has set two overarching and interlinked goals for developing the research system - to build a sustainable system of world class research teams across all disciplines and to double our output of PhDs. While building critical mass in our research teams we must maintain the world class standards that we have fostered by competitive process under the NDP 2000-2006, notably through means of the rigorous peer review process.

Achievement of these goals will facilitate flows of researchers into the country and from academia to enterprise. Over time the aim is to encourage researchers in the course of their careers to move back and forward between academia and enterprise in order to optimally realize their abilities.

To complement the growth in researcher intellectual capital it is also necessary to address the historically arising shortfall in infrastructure by upgrading existing facilities and providing new ones. In the context of NDP 2007-2013 this is being done in a strategic way to ensure alignment between research investments and infrastructure provision. Given the scale of investments and interdependence between PRTLI and SFI, particular attention is being given to ensuring coherence between infrastructure provision and lead in times and the spatial demands of research personnel.

The SSTI has targeted a more structured approach to postgraduate formation to ensure effective development of our researchers, shorter PhD duration, increased completion rates and greater command of generic skills. Notable in this regard is the national framework programme on postgraduate skills expected to be progressed as part of the PRTLI 5 call. The development of career paths with potential to give Ireland a competitive advantage in the international market for top researchers is an essential criterion for success of our major investment in 4th level research.

It is important to note that building the number of researchers will not be achieved by organic growth alone and that a range of initiatives will be required to remove obstacles to mobility of researchers. The intent is to make Ireland keenly competitive in the international talent stakes.

Progress to Date

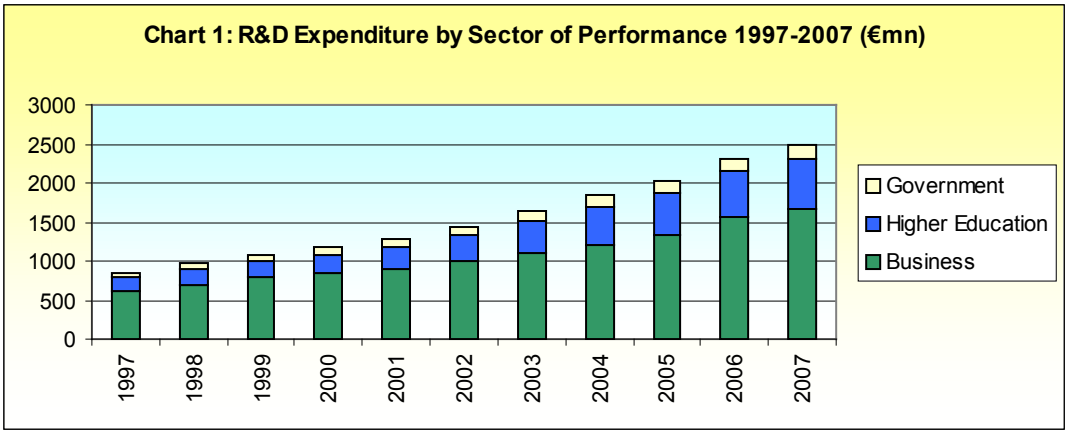
In the light of the challenges outlined above, the following outlines progress made in implementing the Key Actions listed in Chapter 2 of the Strategy.

Key Action: Build on recent NDP investments to deliver a sustainable, world-class research system across the spectrum of humanities, physical and social sciences

It is important, as we track the performance of Ireland over the lifetime of the SSTI, that we should benchmark ourselves against the leading R&D investing countries using internationally comparable science and technology indicators which have been developed by the OECD.

Overall Research & Development (R&D) performance continued to improve in 2007, maintaining the positive growth trends seen over recent years. Total expenditure on R&D across all sectors of the economy (GERD) posted further strong gains during the latest year. Total spending climbed to an estimated €2.5 billion during 2007 from the confirmed €2.3 billion spent on R&D activities in the previous year. Critically, overall increases in R&D spending are been driven by strong spending growth in both the business and higher education R&D performing sectors.

Chart 1: R&D Expenditure by Sector of Performance 1997-2007 (€mn)

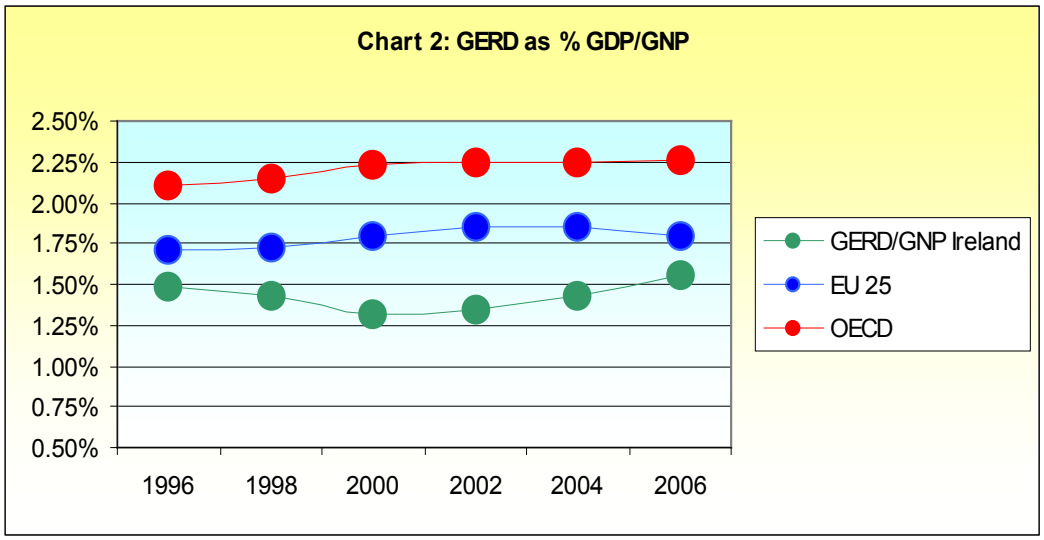


Compared to ten years ago, overall R&D expenditure has almost trebled from the €855million in total recorded in 1997 (chart 1). The average annual growth rate was 11.3%. This strong growth rate placed Ireland among the top R&D growth performing countries in the OECD, which clearly indicates that Ireland is in catching up mode. Maintaining these growth rates over the remainder of the NDP will significantly progress the goal of developing a strong knowledge economy in Ireland.

R&D Intensity

One of the accepted key indicators in measuring a country's progress toward building a stronger knowledge economy is R&D expenditure intensity. This is the ratio of total R&D expenditure to overall economy activity as measured by Gross Domestic Product (GDP) or Gross National Product (GNP). As can be seen in chart 2, Ireland's total R&D intensity ratio was estimated to be 1.56% of GNP in 2006.

Chart 2 shows that Ireland has resumed an upward trend in R&D intensity from 2000 following a period when R&D growth did not keep pace with a rapidly growing economy. As some less sustainable drivers of recent economic growth wane and pressures intensify to return to export driven growth underpinned by sustainable competitiveness, there is both an opportunity and necessity to rapidly improve Ireland's R&D intensity closer to or above the OECD average R&D intensity of 2.2%.



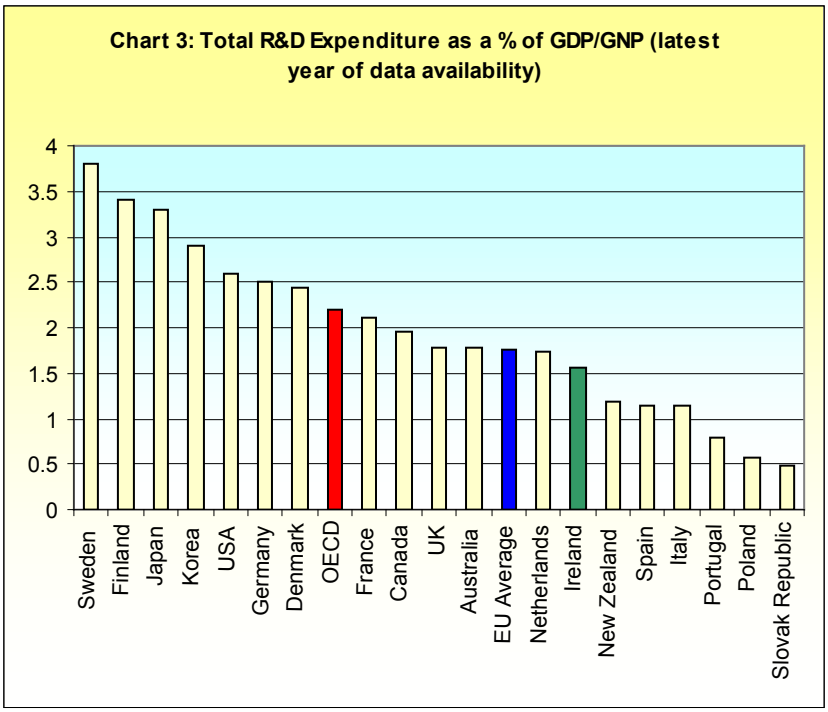
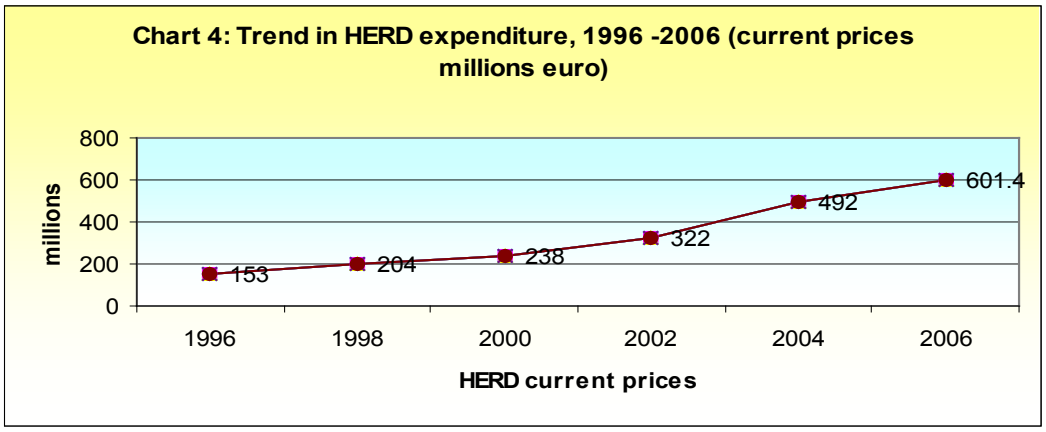


Chart 3 compares Ireland's R&D expenditure intensity with the leading countries in the OECD. This group comprises Sweden (3.8% of GDP), Finland (3.4% of GDP), Japan (3.3%), Korea (2.9%), United States (2.6%) and Germany (2.5%). Ireland has set a target to reach 2.5% of GNP by 2013. The EU Commission in June 2007 commenting on R&D targets of member states stated that *"Only a small number of Member States (Austria, Denmark, Ireland, Germany and Finland) have over recent years experienced rates of growth which, if they are maintained, would be sufficient to advance these countries significantly towards their targets."*

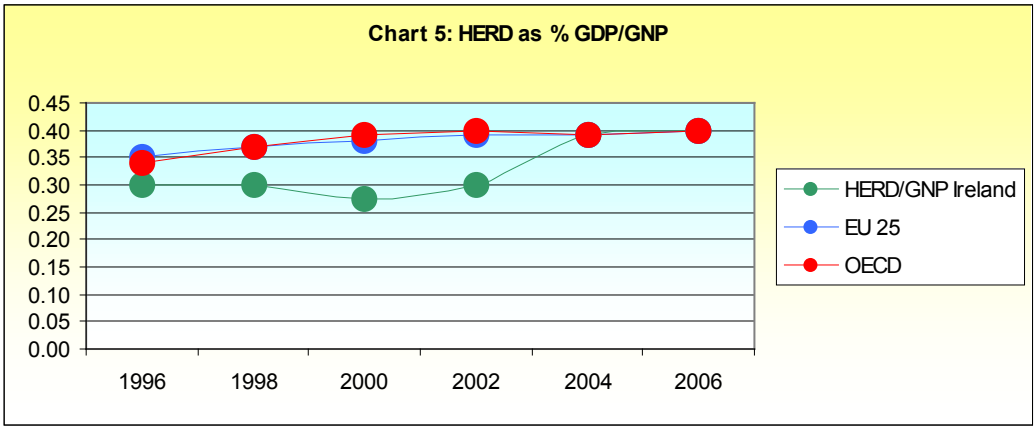
Key Action: Deliver quality by increasing the number of research teams led by internationally competitive principal investigators

Key Action: Upgrade existing infrastructure and develop new facilities to support research

Chart 4 shows how Higher Education R&D expenditure has been moving steadily upwards over the past ten years, with overall R&D spending almost quadrupling in current spending terms. From 1998 to 2000 the increase was 16.8%, but from 2000 onwards the growth trend began to accelerate. From 2000 to 2002 there was a 35% increase, and between 2002 and 2004 there was a substantial rise in HERD of 52.5%, underpinned by new funding investments from the public side via Science Foundation Ireland, the Program for Research for Third Level Institutes and other R&D funding agencies. Since 2005 the growth trend has begun to ease, with a still strong 22% upturn in HERD.



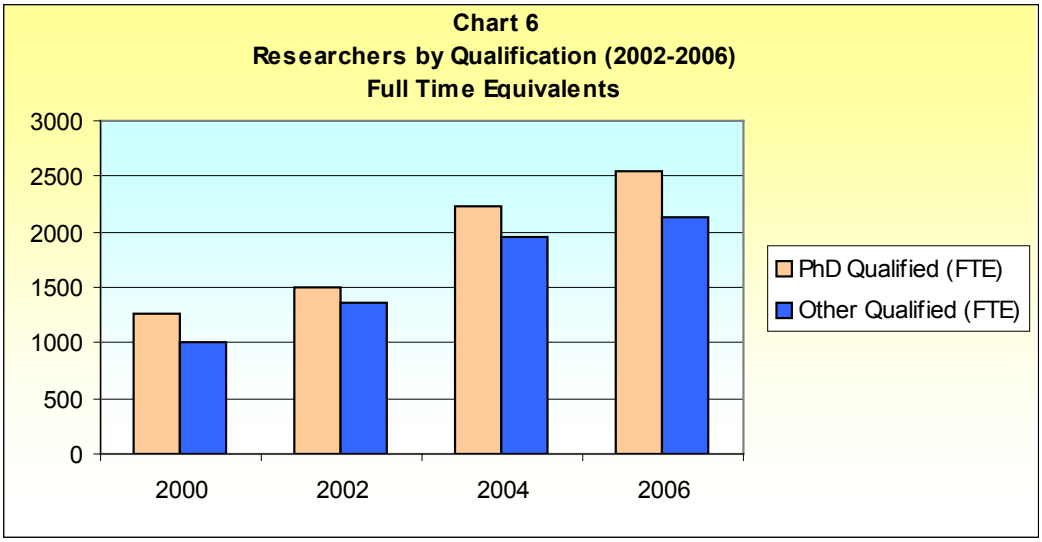
There has been a rapid catch up in the relative performance of HERD spending between 1996 and 2006. Chart 5 shows that from 1996 to 1998, Ireland's spending intensity ratio stood at 0.30% of GNP and was below the EU average intensity ratio of 0.36% of GDP. This intensity gap widening in 2000, when Ireland's HERD intensity ratio fell to 0.27% of GNP, below the rising 0.37% of GDP intensity recorded across the EU. Following some catch up between 2000 and 2002, the previous intensity gap between Ireland and the EU-25 closed rapidly as a result of the significant increases in R&D spending in the Irish higher education sector. Between 2004 and 2006, the HERD spending intensity ratio for Ireland stood at 0.40% of GNP and had matched the overall EU-25 average HERD intensity ratio.



As well as focussing on expenditure indicators of R&D spending performance, it is also important to examine the progress being made in building the human capital and knowledge stock of researchers in the higher education sector. Chart 6 shows the rising trend in researcher numbers working in Universities, Institutes of Technology and other R&D active academic department in the State between 2000 and 2006. Data is examined in full-time equivalents.

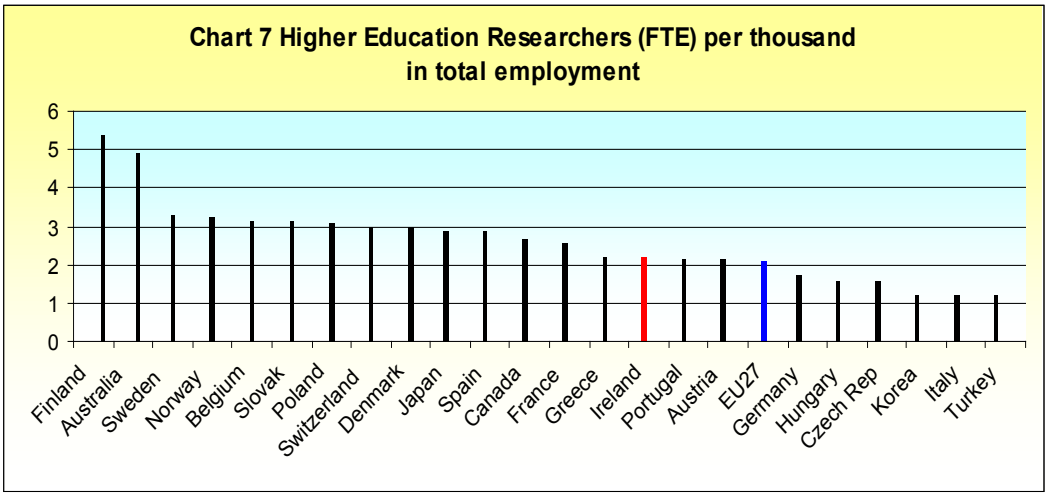
The total number of FTE researchers has more than doubled from the 2,300 recorded in 2000 to stand at 4,690 in 2006. The overall increase has been driven by rising numbers of both PhD qualified researchers and other qualified researchers.

Between 2004 and 2006, the total number of HERD FTE researchers rose from 4,152 to 4,690, an increase of 13%. In 2006, 54.6% of the total number of FTE researchers had PhD qualifications. At 1,398, the majority of higher education sector researchers are employed in the field of natural science, with engineering and technology coming in second at 1,108, then Medical and Health Sciences. FTE researchers in the Humanities and Social sciences accounted for 26.7% of the total in 2007.



Ireland records a ratio of 2.2 FTE researchers per thousand in total employment in 2006. The ratio increased rapidly from 2000 to 2004 but remained static between 2004 and 2006 as FTE researcher growth was matched by the overall robust employment gains in the overall economy.

Chart 7 shows that, despite being above the EU 27 average, Ireland remains below the global leaders of Finland and Australia and a second tier of countries where researcher intensity is between 2.5 and 3.0. In 2000 Ireland was ranked 24th out of 29 benchmarked OECD states. By 2006 Ireland has jumped to 13th place.



A key goal in growing our world class research base is to growthe cumulative number of Principal Investigators (PIs) in Ireland by 350 over the period to 2013 and of Postdoctoral researchers by 1,050. The Strategy has a particular focus on concretizing PI growth in the Science, Engineering and Technology sectors. With the assistance of the key stakeholders, in particular, SFI and the HEA a methodology has been devised to track the cumulative increase in SET PIs and their teams.

Role of Science Foundation Ireland (SFI) in developing a world class research system

SFI is the agency established by Government to make strategic investments in the people, ideas and partnerships essential to deliver outstanding research in strategic areas. The focus is on investment in the components most likely to generate new knowledge, leading edge technologies and competitive enterprises in Ireland in the fields underpinning the two broad areas of Biotechnology and Information and Communications Technology. On foot of the Programme for Government 2007-2012 the remit of SFI was amended in May 2008 to include the broad thematic area of sustainable energy and energy efficient technologies.

SFI is a key player in the overall implementation of the SSTI and has been allocated €1.4billion over the period of the Strategy. In the context of the SSTI objectives, SFI has a target to fund 30 net new PIs and their teams per annum (out of the global total of 350 PIs over the duration of the SSTI) for the period 2006 – 2013.

SFI operates a range of funding programmes aimed at delivering on its objectives, in particular the core Principal Investigator programme, CSET (Centres for Science Engineering Technology programmes, and more recently the Strategic Research Cluster programmes which account for the majority of its funding. These programmes not only increase the number of world class research teams in areas of strategic importance to Ireland, they also make vital connections with industry partners.

Increase in Principal Investigators

Significant progress has been made by SFI in reaching its target to fund 30 net new PIs and their teams per annum over the duration of the SSTI for the period 2006 – 2013. The number of PIs funded by SFI has been increased from a baseline of 200 in 2005 to 284 by end of 2007, 24 PIs ahead of target at a point in time of end 2007 but on target to deliver 30 net PIs each year from 2006 to 2013.

Each of the additional 84 PIs, in turn, leads a team composed, on average, of 8 members. This implies a cohort of over 650 researchers and is testament to the significant contribution SFI is making to the development of a world class research system in Ireland.

Numbers of Researchers Supported by SFI Grants

The SFI Annual Survey, which commenced in 2007, reported that SFI supports 500 grant holders across its key programmes. Just under 2,000 team member researchers are supported on these SFI grants. Approximately 50% are PhD students and approximately 30% are Post Doctoral researchers. This ratio is broadly in line with the best practice team ratio aspired to in the SSTI.

Industry Facing SFI Programmes

SFI currently supports 9 CSETs – 6 in the ICT sector and 3 in the Biotechnology sector involving research partnerships between Irish Universities and multi-national and indigenous companies such as GlaxoSmithKline, Hewlett Packard, Bell Labs, Lucent Technologies, Intel, Medtronic, Alimentary Health, Becton Dickinson, Analog Devices, Hospira, Inverness Medical Innovations, Enfer Technologies, Amic AB, Deerac Fluidics, Commergy, Magnetic Solutions, Eblana Technologies, Storm

Technologies, Ashling Microsystems, Beaumont Hospital, Robert Bosch, Brightwork, IBM Ireland, Intel Ireland, Iona Technologies, KUGLER MAAG CIE, Motorola, Piercom Ltd, QAD Ireland Ltd, Silicon & Software Systems, Microsoft, Symantec, Dai Nippon Printing, Alchemy, VistaTech, Traslan, SpeechStorm, Changing Worlds, Critical Path, Ericsson, Foster-Miller, IBM, Fidelity Investments and Vodafone.

In order to provide impetus to the overall objectives of the SSTI, SFI, in addition to its existing established range of programmes, added a number of new initiatives in 2007 to achieve the specific human resource capacity objectives. On 13 November 2007, the then Minister announced SFI research investment awards of €71 million to support 12 Strategic Research Clusters (SRCs). The award recipients work in the fields underpinning Biotechnology (Bio) and Information Communication Technology (ICT) involving 48 companies, both multinational and indigenous SMEs. Intel, GSK, Pfizer, Eli Lilly, Alcatel-Lucent, Microsoft and many SMEs – Sigmoid Biotechnologies and Opsona Therapeutics, are some of these. Up to 490 highly qualified personnel including Principal Investigators, Post Doctorates and PhD students will participate in cutting edge research projects under this programme.

In addition, the new Stokes Professorship and Lectureship Programme was designed to allow the strategic recruitment of research active faculty staff in the short term and ultimately to assist SFI in meeting its SSTI targets. In December 2007, a total of 31 Professorships and 37 Lectureships were awarded funding at a total commitment of €57million. In line with the SSTI goals, the programme has been successful in attracting highly skilled research active individuals to Ireland - 49 of the 67 approved candidates are foreign-based researchers. Awardees are required to submit an application for a Principal Investigator award in their own name within the first 18 months of taking up their Stokes position, thereby increasing the pool of potential Principal Investigators in Ireland.

The Programme for Research in Third Level Institutions (PRTLI)

The PRTLI contributes very significantly to the attainment of the goals and objectives the SSTI. The PRTLI not only provides the bedrock for the expansion of research in the higher education system but also the bedrock to enable the education of researchers who will work throughout the economy and society. This is very much in line with the role the Programme has played to date, since its inception in 1998/99, in the national research and innovation system. In addition to contributing directly to achieving national objectives, the Programme is also a key enabler for the achievement of their goals by other research funders and stakeholders, both public and private. Thus it is a key instrument within the SSTI.

Since the start of the SSTI, the Minister for Education and Science has announced the fourth cycle of the PRTLI, with an allocation of €230 million, which is set to deliver 819 spaces and circa 600 highly qualified research personnel including Principal Investigators, Post Doctoral Researchers and PhD students under the 17 projects funded. 7 of these programmes involve industry and private sector partnerships. A further €30 million, in addition to the exchequer €230 million, will be attracted to the cycle 4 programmes from non-exchequer sources. A number of national initiatives, specifically national collaborations, in areas of strategic interest to Ireland will be formed as a result of Cycle 4. This will further enhance the work done in earlier cycles of PRTLI to develop critical mass in areas of importance for Ireland. Examples include NanotEire (a national nanotechnology initiative), FoodIreland (a national food initiative) and NPBPS (formation of a biopharmaceutics 'corridor' between Belfast, Dublin and Cork). Cycle 4 has funded the formation of Molecular Medicine Ireland, an expansion of the PRTLI enabled Dublin Molecular Medicine Centre (DMMC) which was, in 2007, successful in attracting Wellcome Trust funding for the establishment of a Clinical Research Centre

in Dublin. A particularly exciting development under Cycle 4 is the establishment of the first new Clinician Scientist Fellowship Programme to train the next generation of academic medical leaders in Ireland. This received funding of €10million from the PRTLI Cycle 4 and will be organised on a national basis by Molecular Medicine Ireland. This will comprise at least 22 Fellows competitively selected from medical graduates at registrar level who wish to undertake PhD training and will help to address a national need identified in the HEA/Forfas Research Infrastructure Review and in the ASC report on Health Research in Ireland. The PRTLI Cycle 4 investment builds on previous rounds of the PRTLI Cycles 1-3, under which some 1600 researchers and 33 new Research Centres were supported, facilitating investment by other funders.

The HEA and Forfás Research Infrastructure Review 2007 benchmarked research infrastructure and identified gaps. A number of elements of key national infrastructure and workspaces had been delivered by Cycles 1-4 of PRTLI and by 'Kelly' *(4)* places . The call for PRTLI 5 is due to be launched in the near future and it is expected that this will include an additional space provision infrastructure focus.

Based on the funding profiled under the NDP, it is clear that the target of 3,525 new/additional researcher places will be met by 2013. The programme for delivery to date, however, has led to a divergence of places in 2007 and 2008. In view of this divergence, the HEA recently held a call for proposals under the Research Facilities Enhancement Scheme (RFES) to meet some of these researcher places. It is envisaged that these initiatives will provide for additional places to come on stream between 2008 and 2010.

It will be an ongoing focus of the SSTI to ensure a match between places created by the PRTLI and the capacity of the higher education system to absorb SFI, PRTLI and other agency supported teams. Funders are preparing projections as to their human capacity targets under the following headings: PIs, Researchers (PhD+), Research Assistants, Technicians, PhD student places, other (admin, technical manager etc). In this regard, there has been an intensive round of consultation between HEA, SFI and other funders in the context of preparing the PRTLI cycle 5 Call. Ongoing synergy between agencies in this regard will allow infrastructure need and delivery to be aligned with system requirements.

Key Action: Enhance postgraduate skills through a graduate schools mechanism

Arising from a graduate education forum sponsored by HEA, IRCSET and IRCHSS in early 2006, a set of key guiding principles was adopted to be implemented in the HEIs. The guidelines specify, for example, that arrangements for supervision and assessment should be based on a transparent contractual framework of shared responsibilities between students, supervisors and institution and that graduate education should enable the provision of generic skills training to researchers.

Eight programmes in areas of strategic interest to the economy and society were funded in PRTLI Cycle 4 e.g. Structured Programme in Creative Arts and Media. The first structured national programme for clinician scientists was also funded in Cycle 4.

The HEA is conducting a review with a view to determining a baseline for structured PhD programmes across the HEI sector. This review should be completed later this year and presented to HERG which will allow for informed stakeholder discussion on relevant metrics to assess PhD candidate's uptake of a generic or transferable skills module. Examples include agreement and implementation of a research and professional development plan and conducting a case study.

(4) Review and Prioritisation of Capital Projects in the Higher Education Sector, HEA 2004

The IUA is also playing an important role in delivering this important objective. The term "third level" is widely known to refer to higher education. "Fourth level" is the new umbrella term coined to represent the more structured approach to graduate studies and research in Universities and other higher education institutes.

Supported through the DES/HEA's Strategic Innovation Fund (SIF) the IUA have developed a Fourth Level Ireland Network of Deans of Graduate Studies. This group will develop a framework and policies to support PhD students build successful careers by providing access to skills development opportunities in the form of skills training and work placements. Additionally, students will receive support from doctoral supervisory teams in this structured PhD programme. The Network is currently engaged in the development of an Irish Universities' Graduate Student Skills Statement'. This skills statement will serve to communicate to employers and students what skills and abilities students should possess on successful graduation. It will also aid the further progress in additional skills development opportunities for PhD students.

In February 2008, the IUA, the Irish Business and Employers' Confederation (IBEC) and the Institutes of Technology Ireland (IOTI) organised an event to commence a dialogue with employers on how PhD students' skills relate to their business. Also on the agenda was the issue of work placements and how, within PhD programmes, they might facilitate students' skills development and increase employers' awareness of PhD graduates' abilities.

The Fourth Level Network includes the Deans of Postgraduate Education. For many universities the appointment of a Dean for Graduate Studies is a new initiative and demonstrates the increasing importance of graduate education.

The PRTLI 5 is expected to focus on funding the early stage flow into the pipeline, postgraduate students and early stage researchers, in contrast with the majority of other funders who focus on funding senior researchers to conduct research in sectoral areas. Both approaches are complementary. Well trained young researchers, who are required both for the public and private sectors, will be a key focus of the Programme.

Key Action: Develop sustainable career paths for researchers

This key Action is being actively pursued through detailed study by the Advisory Science Council (ASC), which will, in turn, feed into overall work by HERG, including consultation with all key stakeholders. The ASC statement was completed in April 2008 and presented to the HERG for consideration by its relevant working group. The findings of this deliberative process will then be reported back to the Cabinet Committee on STI by the end of 2008, with agreed recommendations to be pursued through the appropriate structures.

Key Action: Enhance the mobility of researchers

In building a knowledge economy and increasing the proportion of GDP spent on R&D, Ireland has substantially increased the size of its research community. Under the SSTI, there is a commitment to further double the numbers of PhD graduates while maintaining quality. Building up the required number of researchers will not be achieved by organic growth alone. Researchers will need to be attracted to Ireland in greater numbers than before and the SSTI highlights the need to remove any remaining obstacles to their entry. Significant progress has been made in removing barriers to entry for researchers from third countries. The EU Directive concerning the entry conditions for third country researchers was transposed into Irish law on 12 October, 2007. Furthermore, the Department of Enterprise, Trade and Employment acts as the body responsible for accrediting research

organisations. The Irish Researchers Mobility Office will host a database of individual researcher 'hosting agreements' and act as Irish validation point for immigration authorities.

At the same time, it is acknowledged that mobility, both nationally and internationally in all sectors, is essential for research excellence and opportunities should be provided to ensure that Irish researchers have the opportunities to gain valuable research training and experience abroad. However, as Ireland has increasingly become a more attractive place to do research, the drive for people to leave the country in order to gain valuable research training and experience and build international research networks has been reduced. Accordingly, the goal of ensuring that Irish PhD output should, over the long term, find work in Ireland has to be tempered by an awareness that Irish researchers should travel abroad to gain experience. While it is a complex task to track the numbers leaving the country, work is underway to see if it is possible to develop a mechanism for this purpose.

Key Action: Double the number of PhD graduates by 2013

The challenge is not simply to double the output of PhDs but to do so while retaining quality and targeting increased output in areas of strategic relevance to Ireland. It is also critical to ensure, through structured PhD development programmes, that graduate PhDs also acquire broader skills of relevance to research and non-research careers across both public and private sectors in Ireland.

As SFI builds world class research teams in strategic areas of scientific endeavour relevant to future industry needs, the output of PhDs under the supervision of the PIs thus funded will correspondingly be focussed in areas of strategic importance to Ireland. Targeted research funding of the research councils and sectoral funders will also build capacity in areas of greatest need. As reflected earlier, much is in place or planned to develop structured PhD programmes. The PRTLI 5 is expected to focus on funding the early stage flow into the pipeline, postgraduate students and early stage researchers as a complementary action.

The SSTI target to thus double the output of PhDs by 2013 over the 2005 base is advancing significantly.

Projections for Post Graduate Numbers

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
SET PhD Graduates*	543+	606+	660	724	801	881	919	958	997
HSS Output PhD Graduates/ Postdocs**	187+	284+	234	285	282	300	306	306	315

*In the same period, 1815 additional postdocs will have undertaken four years of study in supported research teams

** HSS data groups PhDs and Postdocs as Postdocs awards are an integral part of the completion cycle in HSS

+ Figures based on best estimates at time of publication of strategy

The HEA collects data annually on PhD outputs for both University and IoT sectors. This data is broken down by gender and field of study. The most recent data show total outputs rising from 808 in 2005 to 976 in 2006 which is well on track for achieving the overall goal of exceeding 1,300 by 2013. Increasing cumulative PhD Student Places by 235 in 2006 rising to 1,775 by 2013 are factored into planned infrastructure provision.

While tracking the numbers of PhD graduates is a function of the HEA, CSO data can enrich this information by collection and analysis of information on PhD holders, notably through questionnaires on career destinations of PhD holders. Proposals are being formulated to ensure that this analysis will be conducted during the period of this Strategy. This analysis will, for example, help with the identification of any appropriate measures to be pursued to enhance career planning for doctorate holders.

3 Capturing, Protecting and Commercialising Ideas and Knowhow

The return from the significant investment in Ireland's science base may be assessed in terms of three separate impacts viz. the creation and absorption of human capital, the improved effectiveness in attracting inward investment and the general utilisation of new research outputs. As is clear from Chapter 2, an immediate and critical output from the investment in Ireland's science base is the human capital being created. World class researchers and research teams, PhD and Masters graduates, technicians and assistants will impact across the economy through direct engagement, collaboration, and taking up of direct employment in the Irish enterprise base. The absorption of human capital is a most effective means of knowledge transfer to enterprise.

Another critical measure of return on investment in the science base is the capacity of IDA Ireland to win internationally mobile R&D investments for which the quality of the science base is an important attractor. The exponential increase in the number and value of IDA client R&D investments in recent years is telling. This increased from €140million in 2004 to €260million in 2005, and in 2006 fifty-four R&D projects were supported by IDA Ireland involving a total investment of almost €470million.

The third area of return is the direct generation, capture, protection and exploitation of the knowledge and technology created, encompassing intellectual property (IP) into the market place. The Strategy noted the underdeveloped state of IP in Higher Education Institutions (HEIs) and advocated a two-pronged approach to upgrade our performance. This involves strengthening the IP/Commercialisation function within the HEIs and supporting this, where relevant, with a central source of specialist expertise. This strategy is being implemented and will be supplemented by the development of a range of measures supported by Enterprise Ireland to develop collaborative links between industry and academic researchers.

Progress to Date

In the light of the challenges outlined above, the following outlines progress made in implementing the Key Actions listed in Chapter 3 of the Strategy.

Key Actions:

- ***Ensure that HEIs encompass IP management and commercialisation as a central part of their mission, equal to teaching and research.***
- ***Strengthen institutional competence at TTO level and among researchers.***
- ***Establish competitive fund administered by EI to assist strengthening of IP manage ment function.***
- ***Establish a new function in EI providing centralised support to HEIs thereby maximis ing the commercialisation of IP.***

Significant resources are now devoted through Enterprise Ireland's science and technology funding to assist HEIs to realise the goal of making IP management a central part of their mission. This funding strand, aimed at realising the commercial potential of Ireland's research community comprises the Technology Transfer Strengthening Fund, Commercialisation Fund, the Intellectual Property Fund, and the Incubator Space Scheme. At end 2007, just over €73 million had been provided for these schemes.

Technology Transfer Strengthening Fund

The initiative to maintain and strengthen Technology Transfer Offices in Higher Education Institutions is focussed on increasing the transfer of intellectual property to industry from research in the HEIs. In 2006 a call for proposals to strengthen Technology Transfer Offices in HEIs issued. The objective of the call was to increase the level and quality of intellectual property transferred to industry from research in HEIs and to facilitate the development of high quality and effective systems and policies to ensure that the intellectual property is identified, protected and transferred, where possible, into companies in Ireland. As a result, 9 institutes have been approved for funding totalling €15.6million (NUIG, UCD, DCU, UCC, NUIM, TCD, RCSI , DIT and WIT). This investment in 29 trained technology transfer professionals will ensure that over the next 5 years Ireland's technology transfer offices are adequately resourced to effectively carry out their role of capturing research results for economic benefit, as an integral part of the research environment.

A new function has been established in Enterprise Ireland to provide centralised support to the Technology Transfer Offices in HEIs. In conjunction with this centralised support, the Technology Transfer Strengthening Fund supports a network of dedicated staff placed within the commercialisation function of the Universities and working directly in conjunction with them to ensure that best use is made of research outputs with commercial potential.

A dedicated programme for the Institutes of Technology with an annual research spend of less than €10 million has been devised and will be implemented in 2008. This will supply Technology Transfer support to the institutes by providing financial support, case management support, training for staff associated with technology transfer and training for researchers. A TTSI contact point will be appointed in each institute to assist the industrial liaison officer with technology transfer activities.

Achievement/Target

Year	2006	2007	2008(est)
Institutes approved for TTO support (cumulative)	0	9	10
Number of Trained Technology Specialists (cumulative)	20	43	52

These figures are subject to minor fluctuations due to movement and temporary vacancies in the system.

Commercialisation Fund

The Commercialisation Fund supports academic researchers to take the outputs of research with commercial potential and bring them to a point where they can be transferred to industry. This is of particular significance given the need to achieve economic benefit from the investment in research infrastructure that has taken place. The Commercialisation Fund has seen an increasing level of application and it is anticipated that this will continue. Particular emphasis is being given to the final stages of support to ensure that transfer actually takes place to the benefit of the receiving company and in a manner that encourages the researcher to participate in the process in the future.

Year	2005	2006	2007	2008(est)
Commercialisation Fund	140	155	160	150

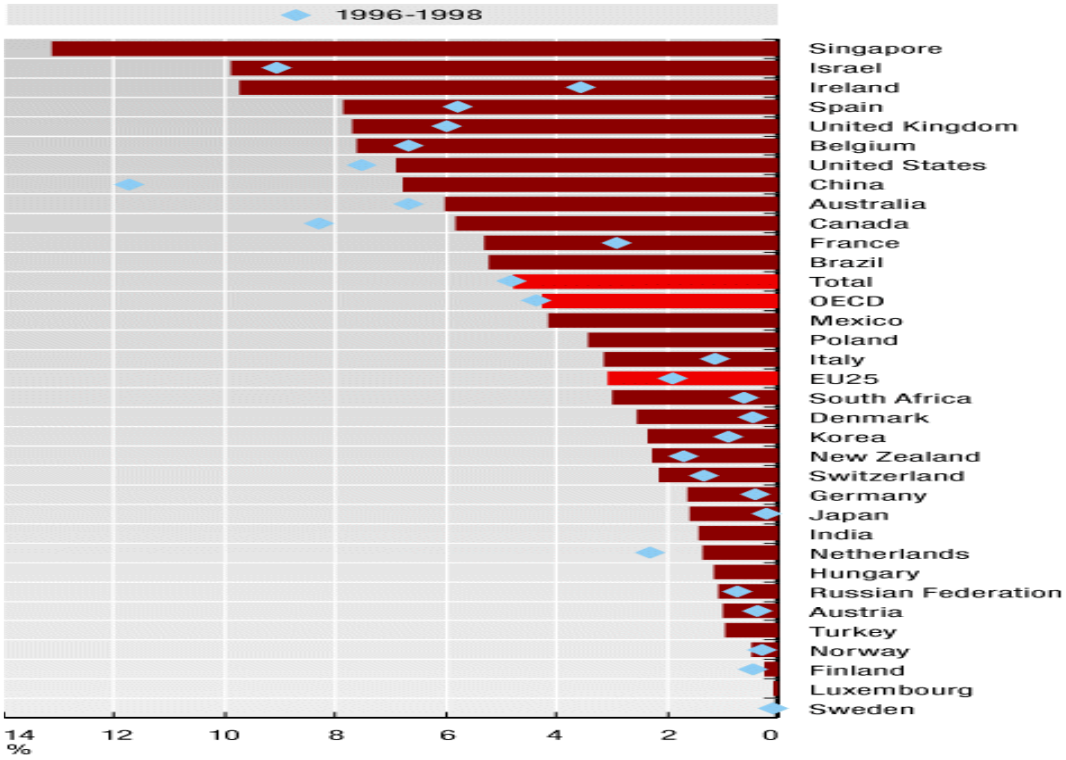
Intellectual Property Fund

The Intellectual Property Fund supports third level institutions and industrial concerns to assist with the protection and management of patents. In the academic context, it is part of a coherent package of supports to ensure the best possible level of technology transfer from research. In the industrial context, funding is given towards the costs of patent protection.

Year	2004	2005	2006	2007	2008(est)
Patents Supported	N/A	33	112	120	140 (59 to end may)

The OECD Science, Technology and Industry Scoreboard 2007 showed that among OECD countries, Ireland has the highest proportion of patenting by universities (9.7%), a noticeable increase over the mid-1990s when the proportion of patents patented by Universities was 3.5%. In Australia, Belgium, China, Spain, the United Kingdom and the United States, the higher education sector accounts for 6 to 8% of all international patent applications.

Chart 7: Share of patents filed under PCT 1 owned by universities . 2002-04 *(5)*



Campus Incubation

Within the context of the SSTI, Enterprise Ireland has driven the establishment of incubation centres on higher education campuses. Such centres have been supported by Enterprise Ireland to the tune of approximately €50 million, with support from the European Regional Development Fund. The investment is aimed at increasing the number of campus start-up companies – both spin-ins to the region as well as spin-offs from institutional research activity – and resultant high-value jobs across Ireland. This financial assistance translates into support for twenty business incubation centres on 16 Institute of Technology (or equivalent higher education institutions, i.e. the National College of Ireland) campuses, and four universities, as well as for six bio-incubation facilities linked to the universities.

The centres provide critical space for knowledge-intensive start-up companies who can access assistance and institutional resources to aid their growth. Their development is also supported through a suite of related Enterprise Ireland initiatives including collaborative R&D funding and entrepreneurship training. With the commencement of more centre operations in recent years

(5) OECD Science, Technology and Industry Scoreboard 2007 http://puck.sourceoecd.org/vl=1231902/cl=19/nw=1/rpsv/sti2007/index.htm

and the growth of their reputations as hubs of entrepreneurial activity, the realisation of the ultimate objective of related employment growth can be seen in the table below:

Year	2005	2006	2007	2008(est)
Institutes of Technology	150	373	584	620

In addition, a further 319 people were employed in University based campus incubators in 2007 and in 2008.

Outputs from Commercialisation Activity to date

The SSTI noted that the then underdeveloped state of Intellectual Property within the Higher Education Institutes was reflected in the absence of accurate data on patent filings and grants. Accordingly, a series of targets were set in the SSTI for each research performing institution based on their research orientation and norms in leading international institutions. These targets relate to the following areas:

- Financial and human resources devoted to technology transfer, IP management and other commercialisation activities;
- Number of invention disclosures reported;
- Number of patents applied for and granted;
- Number of patents generating revenue;
- Number of licence agreements with companies;
- Total revenues from licensing and fees from royalties;
- Number of actively trading spin-off firms established and their survival rates;
- Private sector investments in public research spin-offs;
- Number and size of industry-commissioned projects.

Data to monitor the achievement of these targets is now being collected and future reports will chart progress in accordance with the target parameters. Since the SSTI was launched, a positive trend in licences and start-ups is developing as follows:

Year	2003	2004	2005	2006	2007 Target (& Outturn)	2008 Target
Start Ups	7 (est)	7 (est)	5	8	15(13)	13
Licences from State Funded Research	15	24	21	28	55	52
Disclosures	n/a	n/a	135	190	264	230
Patents Filed	n/a	n/a	83	107	137	135

Note: 2006 is the first year on which data on start-ups was collected and 2005 is the first year in which data on licences was collected

Data to hand shows that in 2007, 55 technology transfer licences were agreed with industry, 13 high-potential start ups were created through State-funded research activities and there were 40 company to company transfer of technology licences. As with 2007, it is expected that the 2008 targets (set in 2006) will be exceeded.

The data for 2007 represents 9 licences per €100 million spend and 2.6 start-ups per €100 million spend. While these outputs are below EU averages of 10 licences and 8 start-ups account must be taken of the relatively low historic levels of State investment in research and the time lag in commercialising research. Our start-up ratio compares favourably with the United States ratio of 2 start-ups per €100million spend.

There can be a very substantial time lag before a commercial outcome may be seen from technology developed through research. For example a number of licences recently agreed by Enterprise Ireland are based on technology developed in the mid 1990s. Expenditure on higher education R&D in 2006 was €601 million but only €238 million in 2000. Applying a simple time lag calculation will more than double the output per €100million.

4 Research and Development for Enterprise Innovation and Growth

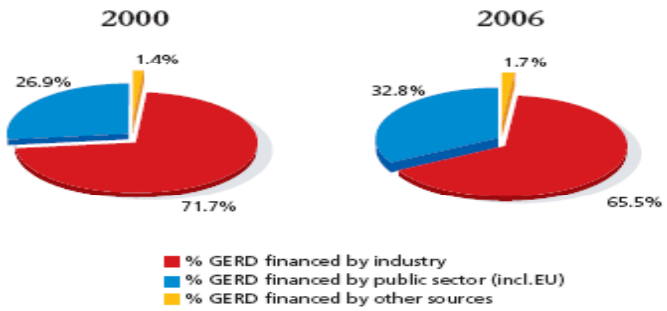
The SSTI highlights the significant role played by manufacturing and international services industry in enhancing economic growth and productivity in Ireland. Accordingly, the Strategy commits the development agencies to working with companies to strengthen the Research, Technological Development and Innovation base of the enterprise sector. Clear targets, which will bring about transformational change in company attitudes to R&D, and achieve the target of growing BERD to €2.5 billion by 2013 (€3.4 billion in 2008 terms), are outlined. The SSTI calls for fully joined up thinking across the range of state support agencies in order that these goals can be achieved and calls for a new structure, Technology Ireland (TI), to be established to drive this.

The key elements of the new approach outlined in the Strategy include:
(i) raising awareness and increasing the number of firms doing R&D,
(ii) improving soft supports to develop technology strategies in firms,
(iii) achieving step increases in quality and quantity of R&D activity,
(iv) building in-company technology capability,
(v) increasing inter-company and industry-HEI collaboration and
(vi) simplifying the administrative and operational procedures of programmes.

In addition, R&D grant supports must be simpler; support for technology transfer must increase and industry led networks must be grown and developed. Regional innovation must be supported in conjunction with the Institutes of Technology. The Strategy acknowledges that industry-led research needs to be supported by appropriate infrastructure and, to this end, supports the development of competence centres.

The Strategy also highlights the role played by the R&D tax credit in attracting more research intensive activity to Ireland and states that the operation and take up of the tax credit will be regularly reviewed, monitored and modified as necessary, to support business R&D performance.

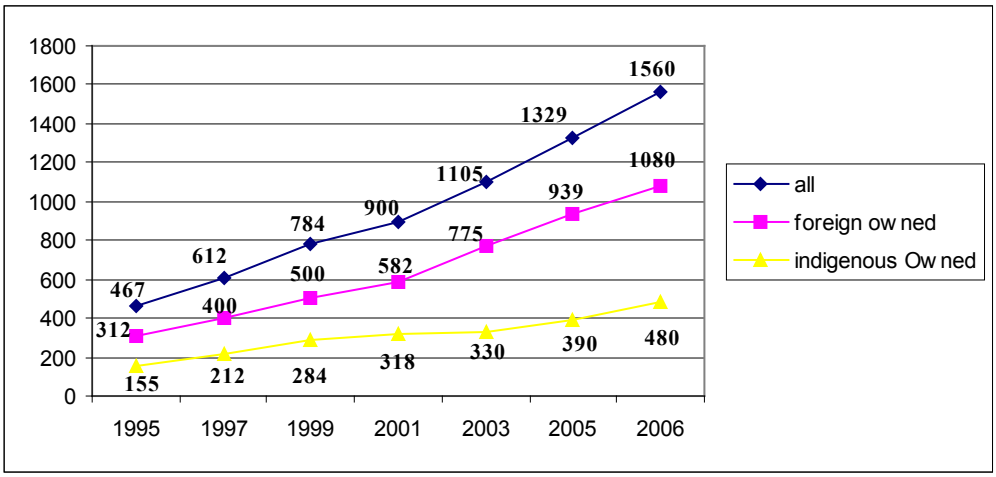
In 2006, two thirds of total spend on R&D in Ireland was by the private sector. As Government investment in public sector research increases this most desirable 2:1 ratio of private to public sector investment should be retained.



Progress to Date

R&D performed in the business sector (BERD) rose to an estimated €1.56 billion in 2006, almost double the level recorded in 2000 (Chart 7 below). The 17.3% annual increase between 2005 and 2006 facilitated a rise in the BERD intensity ratio to 1.05% of GNP. While this represents a significant achievement, our level of expenditure is still below the OECD average of 1.54%. Nevertheless, the trends are positive and the enterprise development agencies, Enterprise Ireland and IDA, continue to work closely with companies to strengthen the research and technological base of the enterprise sector to underpin future competitiveness and quality employment and thereby driving forward the target of growing BERD to €2.5 billion by 2013 (€3.4 billion in 2008 terms). In doing this, the agencies are also making significant progress in building upon the base of companies performing R&D in Ireland and the specific targets set in this regard in the Strategy:

- Number of indigenous companies with meaningful R&D activity (in excess of €100,000) to reach 1,050 by 2013;
- Number of indigenous companies performing significant R&D (in excess of €2 million) to reach 100 by 2013;
- Number of foreign affiliate companies with minimum scale R&D (in excess of €100,000) to reach 520 by 2013; and
- Number of foreign affiliates companies performing significant levels of R&D (in excess of €2 million) to reach 150 by 2010



Key Action: Maintain commitment to strengthening manufacturing in Ireland into the long term

The recent Report of the High Level Group on Manufacturing (March 2008) further reiterates the need for investment in leading edge technology to drive productivity. It highlights the need for innovation, including non-technological innovation, across all elements of business functions to gain a competitive edge through differentiation. It recognizes that continuous investment in people is vital in today's business environment - in continuous learning, reskilling and in developing management capability for the innovative organization.

The core of ongoing R&D support for companies is provided through Enterprise Ireland and IDA Ireland. Supports provided through schemes such as Innovation Vouchers to introduce small firms to the innovation process, the €500million simplified R&D supports by EI and IDA to assist firms, the establishment of industry led Competence Centres to establish centres of research excellence which target specific industry needs, and, as outlined earlier, the development and growth of Science Foundation Ireland's Centres for Science, Engineering and Technology and Strategic Research Clusters, are all designed to foster an innovation culture and to encourage business to enhance expenditure on R&D. Progress made in implementing these schemes is outlined in detail in the paragraphs below.

Key Action: Establish Technology Ireland as a virtual entity and mobilise practical structures required to make it work

Technology Ireland (TI) was established on a formal basis on publication of the SSTI in July 2006. As such, TI has been in place from the earliest days of the Strategy to provide guidance and ensure joined up thinking across agencies in relation to its implementation. Meetings are held monthly, and are attended by senior policy executives with responsibility for STI in Enterprise Ireland, Science Foundation Ireland, IDA Ireland, Forfás, the Higher Education Authority and the Department of Enterprise, Trade and Employment. TI has played a vital role in coordinating new STI policy initiatives, including the introduction of a revised simplified R&D grant scheme and the development of policy on the introduction of Competence Centres. It is currently working on a wide range of issues essential to the successful implementation of the Strategy.

Key Action: Rationalise and simplify enterprise R&D grant structures to make them more accessible to firms

Following negotiations with the European Commission in relation to revised State Aids rules, the Minister for Enterprise, Trade and Employment launched a new €500 million revised and simplified R&D grant scheme in January 2008. This Scheme is administered by Enterprise Ireland and the IDA. The principal features of the new scheme are aligned to the recommendations of the SSTI. In particular:-

- The new scheme takes account of new State Aids guidelines; these eased some restrictions and expanded the definition of expenditure that may be assisted;
- The various Agency funding supports have been streamlined to make the whole programme less confusing and onerous for companies;
- There is a clear progression in support, from R&D novices right up to those with considerable R&D experience;
- Repayability of R&D grants has been abolished; and,
- There is a new focus on R&D funding for service innovation (for eligible clients).

Key Action: Launch new Enterprise Ireland awareness campaign including seminars and direct engagement with client firms

Enterprise Ireland continues to operate its R&D Advocates initiative. This is a highly proactive programme in which R&D consultants make direct approaches to companies to engage them in practical R&D for the first time. Through its R&D Awareness programme, Enterprise Ireland offers 3-day consultancy support to clients to help formulate R&D strategy.

Following directly on the launch by the Minister for Enterprise, Trade and Employment of the simplified R&D funding, Enterprise Ireland has begun an aggressive R&D promotion campaign. This campaign will:

- advocate the importance of R&D as a means of securing future business profitability and export sales;
- highlight the financial incentives available for R&D investment from Enterprise Ireland in cluding grant support for existing and strong R&D performers, as well as new measures (such as the R&D stimulation grant) for first time R&D performers;
- promote the R&D tax credits available to companies in respect of approved R&D expendi ture;
- Promote the use of design as an important innovation tool.

The campaign will comprise direct briefings to clients, industry groups, consultants, professional bodies and other stakeholders who can influence indigenous industry together with media promotion, in national and regional press & radio, and trade press.

Key Action: Continue IDA international promotional and marketing programme "Knowledge is in Our Nature"

IDA Ireland is committed to supporting its clients to establish and grow R&D activities in Ireland. By engaging in R&D activity, companies stand to win a competitive edge in the market place, access to new products and services, corporate ownership of lucrative patents, industry recognition for ground breaking innovation and increased business opportunities.

Long-established partnerships with global corporations have been at the core of Ireland's success in attracting leading edge R&D activities. One of the most satisfying aspects of these investments are the extent and depth of sophisticated R&D projects now being won by Ireland.

Investment in research and development continues to increase since the Strategy was published in 2006. 54 R&D investment projects were supported by IDA Ireland in 2006 involving a total investment of almost €470million. The corresponding values were €140million and €260million in 2004 and 2005 respectively. CISCO, GlaxoSmithKline, PepsiCo, Intel, IBM, Bristol-Myers Squibb are corporations who are actively supported by renowned global research organisations located in Ireland, such as Georgia Tech Research Institute and Bell Labs.

In 2007 IDA concluded negotiations for 114 new investments, 40% of which were in the area of R&D. DePuy Ltd, Thermoking, Vistakon and Zimmer Holdings, Genzyme, Lanacaster laboratories, Teva Pharmaceutical, Citco Funds Services, Unum, Eyewonder, ServiceSource and Beckman Coulter are just some of the IDA supported companies who have invested in R&D activities in Ireland since 2007.

The 2007 results show that the determined national policy to establish a substantial foundation of world class science and technology has come to fruition in a series of significant industrial and academic research collaborations that would not have been possible in the not so distant past. GlaxoSmithKline initiated a research and development collaboration on Alzheimer's disease with the Institute of Neuroscience in TCD and NUIG. Smith and Nephew united with NUIG REMEDI Centre to develop pioneering new treatments for orthopedic joint diseases and Intel established the Technology Research for Independent Living (TRIL) Centre focused on the use of technology to support independent living for the elderly in consortia with TCD, UCD and NUIG. Genzyme invested in new process development facilities in Waterford and 2007 also saw new R&D investments for Galway by Nortel and a new R&D centre proposed by Fidelity Investments.

IDA Ireland has a broad role in ensuring that the skilled researchers and the facilities required by new and existing investors are in place. IDA also acts as a link between Irish research institutes and international business and research centres and internationally promotes the exciting new research capabilities now available in Ireland.

Ireland's Centres for Science, Engineering & Technology (CSETs) link scientists and engineers in partnerships across academia and industry. One such CSET is CRANN, the Centre for Research on Adaptive Nanostructures & Nanodevices. CRANN's mission is to advance the frontiers of nanoscience. It provides the physical and intellectual environment for world-class fundamental research, and has partners in Irish and overseas universities. The number of sophisticated research centres that have developed in recent years is a testament to the impact of the greatly enhanced funding of the sector since 2000.

Key Action: Increase absorptive capacity by strengthening technology skills in firms new to R&D

A number of programmes under Enterprise Ireland's revised R&D Grant Scheme will have a positive influence on the absorptive capacity of firms. In particular, the R&D Capability Scheme provides support for companies to invest in major R&D programmes, and is targeted at a range of indigenous enterprises including high potential start ups, established clients and large R&D performers.

Spend on R&D capability increased from €19.5 million in 2006 to € 20.5 million in 2007. In addition, the Innovation Management Initiative aims to increase the innovation performance (both technical & non-technical) of Irish based companies by providing training and consultancy in innovation and R&D management. During 2007, these training courses were attended by representatives from 307 companies. Expenditure under Innovation Management in 2007 was €1.9 million, up from €1.4million in 2006.

Key Action: Strengthen measures to assist firms with licensing in technology

The SSTI recognises the role played by technology transfer in allowing companies to locate partners and acquire new products, and acknowledges the role of the TechSearch initiative in facilitating this process. The Strategy recommended that this activity be expanded and focused particularly on the needs of SMEs, while also working with multi national corporations and other large companies to access their patent portfolios.

The TechSearch service was relaunched in September 2006 with a new website, TechSearch.ie, which is designed to provide companies, in particular SME's, with tools and information to investigate licensing. The site provides companies with information on how to sell their intellectual property in other markets as well as to license intellectual property from overseas firms to create new revenue opportunities. To coincide with the launch of the new site, two guides on the tax and legal implications of technology licensing were published in conjunction with Pricewaterhouse Coopers and Beauchamps Solicitors.

TechSearch achieved 35 licensing agreements in 2006 with a further 40 agreements in 2007. TechSearch also organised Enterprise Ireland's Innovation Conference in 2007. Entitled "Innovating the Business Model" this event was well attended by over 135 participants. Prof Henry Chesbrough from the University of Berkeley gave the keynote presentation along with speakers from Nortel, Multis Group and Arvetica (Switzerland). TechSearch also organised a number of Technology Roadmap Seminars in areas such as Next Generation Networks, Location Intelligence and Licensing in the Food Industry.

Key Action: Strengthen measures to increase interaction between firms and higher education institutions nationally and regionally

Key Action: Promote the formation and advancement of inter-company networks

Innovation Partnership Programme

The SSTI recommends that the Innovation Partnership Programme be modified to encourage larger projects and encompass additional activity created as a result of the Industry-led Networks. The Innovation Partnership Programme is designed to generate collaboration between companies and researchers in the third level sector. The key to this initiative is that companies can avail of the opportunity to develop new innovations, which will lead to greater market share while reducing their technical and commercial risk. Continued expansion and promotion of the Innovation Partnership Programme has led to a doubling of the average project size over the past 3 years. In addition, 10% of proposals submitted are now over €500,000. In 2007, 62 projects with a total costing of €12.1

million were approved for funding. 46 of the companies participating are SMEs. In 2004, the project costing was up to €190,000, averaging at €100,000. By 2007, the project costing has increased to €800,000, averaging at €190,000. The scope of the Innovation Partnership Programme has been widened to include multi-partner projects and research and application of new technologies in the services sector e.g. financial services.

Industry Led Research Networks

With the aim of encouraging Industry led research activities, Enterprise Ireland invited self-forming industry groups to come together to develop their vision of the future having regard to their market challenges and the products and processes needed to address them. These networks aim to solve technical challenges faced by industry in Ireland to an agenda set by the industry sector groups. Enterprise Ireland then supports academic researchers to deliver scientific and engineering solutions that are sufficiently robust, seen to address the relevant industry development plan and not encumbered by intellectual property considerations. Enterprise Ireland has been supporting the formation of a number of inter-company networks through its Industry Led Networks Programme. These include:

- The Point of Care Immuno-Technology (POCit) Industry-Led Research Programme, dealing with diagnoses based on small quantities of whole blood;
- The Bioprocess Monitoring Technology which monitors cellular processes in bioreactors;
- The E-Learning Ireland Technology (ELITe) which deals with the streams of next generation e-learning tools;
- The Mobile Internet Protocol Multimedia System Services (IMS) Programme which devel ops tools for creation of mobile IMS services;
- The Power Electronics Industry Group (PEIG) Programme which relates to solving power electronics problems; and,
- The Wireless Sensors Enterprise Led Network (WiSen) Programme; aims to develop tech nologies to facilitate Wireless Sensor Networks.

These projects are allowing Irish based companies to specify and lead research projects in academic research teams and helping to grow commercialisation opportunities.

Enterprise Innovation Networks Initiative

In March 2008 Enterprise Ireland launched its Enterprise Innovation Networks initiative. This initiative will grant funding of up to €200,000 per annum, over 3 years, to four successful industry representative groups to establish an Enterprise Innovation Network amongst their member companies. Each network must identify a research theme or technology that is of direct relevance to their members. Applicants should outline what new initiatives they will undertake to promote R&D and innovation under this chosen area to their members. The initiative is an Enterprise Ireland programme aimed at increasing the levels of strategic R&D and innovation in companies based in Ireland.

Key Action: Develop additional competency centres in strategically important technologies, with significant expansion of industry linkages

Following the establishment of an expert group consisting of agency and Departmental representatives, considerable work was undertaken to define optimum models for the establishment of Competence Centres. This included visits to established centres in other countries and the definition of structural and operating parameters designed to ensure the centres would represent best practice in market led, industry directed and focused research.

A joint call for Expressions of Interest from industry issued from both Enterprise Ireland and IDA following the launch of the Competence Centre Programme in March 2007. 25 expressions of interest from diverse industry groupings were received by the closure of the initial call. These applications were assessed by both agencies involved and seven proposals were subsequently selected for further development. This involved the development of detailed descriptions of needs (DDNs) for each proposal with assistance from outside consultants. These DDNs will form the basis for a call for proposals to the research community to meet these defined needs. This call is expected to take place later this year. Proposals arising from this call will be evaluated with a view to making funding decisions which will allow for the establishment of the first centres before the end of this year.

Key Action: Examine the operationalisation of the Taskforce on Small Business recommendations in respect of Innovation Vouchers and Knowledge Acquisition Grants

The Innovation Voucher Initiative

The Innovation Voucher Initiative was introduced by Enterprise Ireland in April 2007. The objective of the Initiative is to drive an on-going innovation cultural shift within small enterprise by promoting and encouraging a transfer of knowledge between Ireland's public knowledge providers and the small business community and creating greater synergies between the two. Under the Initiative, vouchers worth €5,000 are allocated on a semi-competitive basis to small businesses whose proposals, to work with public knowledge providers on specific innovation questions, meet basic criteria.

There were three calls for proposals in May, July and October 2007 during the pilot phase of the Initiative. As a result, 428 companies had received vouchers by the end of the 2007 with a total grant allocation of €2.14million. During the first quarter of 2008, a further 102 vouchers were issued; the target for the year is 350. Interest and engagement by companies has been satisfactory and the initiative will continue, with a heightened profile, in 2008 when five calls for applications will be issued.

Feedback from companies suggests that the application procedures, level of funding, the low level of bureaucracy and the timing of calls are welcome features on the Initiative. In the course of rolling out the initial calls under the scheme, Enterprise Ireland has seen a need to assist and support the engagement of companies with the third level sector. Enterprise Ireland is continuing to update the operation of the Initiative to assist both the companies and the Knowledge Providers in the realisation of successful projects.

Innovation Vouchers Issued and Redeemed

Year	2007	2008 (Q1)	2008 Target
Vouchers Issued	428	102	350
Vouchers redeemed		11	

Knowledge Acquisition Grants

Enterprise Ireland has developed a suite of supports specially designed for the particular needs of manufacturing and internationally-traded service companies. This includes an R&D Stimulation grant to encourage companies that have not carried out R&D in the past, or who have done so on a sporadic basis, to develop the establishment of a sustainable R&D activity. Within the context of the new R&D Stimulation Grant Programme, Enterprise Ireland will deliver the Knowledge Acquisition Grants Scheme, which will allow grants of up to €50,000 to be paid on a once-off basis for projects up to 1 year.

Key Action: Review and modify, as appropriate, the R&D Tax Credit scheme

The Irish R&D tax credit scheme was introduced in 2004. On introduction a 20% tax credit was allowed against Corporation Tax on incremental qualifying R&D expenditure. A separate 20% R&D tax credit was also available for capital expenditure on R&D building facilities. The Finance No.2 Bill 2008 provides for an increase of the rate to 25%. This will apply to accounting periods commencing on or after 1 January 2009.

The 2007 Finance Act enhanced the tax credit in a number of ways, in particular by fixing the base year at 2003 for seven years until 1st January 2010. The Finance Act 2008 further amended this by fixing the base year at 2003 until 2013 and then applying a ten-year rolling basis, beginning in 2014. The Finance No.2 Bill 2008 provides for the base year to remain as 2003 for all future accounting periods which greatly enhances the attractiveness of the scheme.

The costs incurred by a company subcontracting R&D to a third party are considered as qualifying expenditure in the current R&D tax credit scheme. Expenditure by companies on sub-contracting R&D work to unconnected parties qualifies to a limit of ten percent of qualifying R&D expenditure in any one year and sums paid to universities or institutes of education in the EEA to carry out R&D qualify for relief up to a limit of five percent of R&D expenditure incurred by the company or group.

The Finance No.2 Bill 2008 also enhances the credit to provide the full benefit of the credit to companies (including small and start up companies over 3 years). Companies will have options for the carry-back of unused tax credits for set-off against corporation tax paid in the previous year and to allow for any remaining unused credit to be refunded in instalments over a 3 year period by way of a payable credit. The Scheme will also now allow for a proportion of the expenditure on new or refurbished buildings used in part for R&D purposes to qualify for a tax credit.

The R&D tax credit scheme now assists, along with other incentives, in making Ireland a very attractive location for companies to carry out R&D and also helps Ireland retain existing activities in an increasingly competitive international environment.

Year	Number of Cases	Total Cost
2004	73	€70.4 Million
2005	135	€65.2 Million
2006	181	€74 Million Provisional

Source: Revenue Commissioners

To date, the above provisional data has been obtained from the Revenue Commissioners describing uptake and value of the scheme to enterprise in its first three years, 2004 - 2006.

5 Science Education and Society

The SSTI outlines how, if we aspire to build a sustainable knowledge economy and become world leaders in STI, we must build strong foundations in primary and second level education and how our system needs to develop to make this happen. Interest in science must be stimulated at an early stage and fostered throughout the educational system. At primary level, the reintroduction of science into the curriculum is a significant development which has been accompanied by in-service training of teachers. However, the SSTI calls for a strengthening of the link between the primary and secondary cycles. This should be complemented by course development in the Colleges of Education where more emphasis needs to be placed on science teaching methodologies and on awareness of scientific issues. These issues will have to be addressed in the context of the primary science curriculum review.

At second level, a revised Junior Certificate science syllabus was introduced recently based on a more investigative approach and some 86% of students study science at this level. However, some key concerns remain relating to the uptake of science generally, particularly in relation to the uptake of physics and chemistry at Leaving Certificate level. The strategy proposes to increase participation rates in the science subjects by: (i) reforming the science syllabuses for leaving certificate, (ii) investment in continuous professional development and networks for teachers, (iii) awareness promotion and the provision of guidance materials, (iv) rebalancing the content of the science curriculum in the direction of problem solving and (v) revisiting the issue of technical assistance for schools to facilitate practical coursework.

The SSTI states that the above actions will be supplemented by the work of Discover Science and Engineering (DSE) which will complement the developments in the school system through enhanced awareness measures, improved teacher training initiatives, enhanced internet based support materials, careers information and guidance, and pilot initiatives on awareness and teaching methodologies.

Progress to date

Teacher Training

The SSTI calls for the higher education institutes to consider broadening of choice of subjects for matriculation purposes so as to give greater support to science and for the issue of science graduates training as second level teachers to be examined. The strategy proposes to increase participation rates in the science subjects by investment in continuous professional development and networks for teachers.

One area that the STI Strategy emphasized was the case for course development in the Colleges of Education where more emphasis needs to be placed on science teaching methodologies and on awareness of scientific issues. It will be necessary to undertake a survey of the Colleges of Education to determine how and to what extent they are making progress on integrating science awareness and science teaching methodologies as a core area for their student teachers. The Teaching Council, the body with the statutory responsibility for the accreditation of courses of teacher education, has begun a review of all pre-service in Ireland. This will give effect to the related commitment in the SSTI to review the coverage of science and maths in B. Ed. Degrees and would allow for evaluation of whether changes need to be made in the B. Ed. courses.

While it will be important to review methodologies for teaching science across the teacher training area it is also relevant to note initiatives which are taking place. These include, notably, STEPS to Engineering and Discover Science and Engineering run workshops for all second year students studying for their Bachelor of Education in St Patrick's College, Dublin. These workshops are organised annually to provide these student teachers with resources and information on why it is vital for the economy to promote science and engineering to students. In addition, the DES continues to direct considerable resource towards the inservice of teachers in relation the relevant subject areas. In time, with the commencement of the relevant parts of their act, the Council will have a role in relation to the CPD requirement of teachers.

With regard to the proposal that Higher Education Institutions would require candidates for admission to have a science subject in order to obtain their matriculation the Department of Education and Science has written to the Irish Universities Association, the Institutes of Technology in Ireland and the Dublin Institute of Technology seeking their views on this key action and a response is expected shortly.

The SSTI also committed to an examination of the number of science graduates training as second level teachers, with a view to increasing the numbers of teachers available in science and maths, and establishing "quotas" for specific subject areas as necessary to ensure that the subject needs of the curriculum are adequately met. This can be addressed in the context of the information that will be available from the Teaching Council registration database. This data will provide granular information on existing teachers and their qualifications and can be matched to other internal data to provide more subject oriented supply information. Such information is very pertinent to the roll out of any SET subject curriculum reform – for example, the optimal roll out of the new Maths curriculum would likely be compromised if there were a shortage of teachers with the competences and capacity to teach Leaving Cert Higher level Maths.

The Second Level Support Service (SLSS) is a key delivery mechanism for science education as it offers school based support, staff development programmes, regional cluster based support and modular courses. A feature of support is a focus on generic areas such as teaching and learning methodologies, the curriculum aspect of school development planning, as well as subject specific issues in regard to science. The Primary Curriculum Support Programme also provides key supports in this area and has collaborated pro actively with Discover Science to enhance teacher training in science. The interface between SLSS and PCSP with Discover Science and Engineering will be addressed in the evaluation of DSE, see below for more information. This evaluation has commenced and it is intended that it will be completed shortly.

The Department also provides direct financial support for Teachers' Professional Networks involving all teachers of a particular subject, including those who may be members of an existing subject association. These focus on improving teaching and learning, including teachers' own Continual Professional Development, along with capacity building of 'expert' teachers in regions based on the twenty one Education Centres. Maths and Science teacher professional networks are subject groups receiving support.

A more direct form of support comes in the form of the Science Foundation Ireland (SFI) STARS programme which offers teachers places on research projects so that they can pass on the excitement of science to their students.

Primary School Science

The current Science Curriculum was implemented in 2003/2004 for all children in primary school from junior infants to sixth class. A basic understanding of scientific principles and methods, and a foundation of knowledge and concepts in the domains of physics, chemistry and biology and botany, are also provided for. A key objective is to encourage children to be active agents in their own learning, to engage in collaborative active learning, to develop high order thinking skills, to be able to observe, collate and evaluate evidence, question, summarise, analyse and interpret, and to develop problem solving skills. Implementation of the curriculum is being reviewed on an ongoing basis. An evaluation of the first phase of the review was published in 2006 focusing on Maths, English and Visual Arts. A phase 2 review is now under way focusing on Social Personal and Health Education, Gaeilge and Science, and publication is expected early in 2009.

A key action of the strategy was to the effect that DES would review the implementation of the primary science curriculum to ensure the new curriculum and teaching methodologies were stimulating interest in and awareness of science at a very young age.

The Inspectorate has undertaken a detailed evaluation to report on the quality of teaching and learning in Science in primary schools. The evaluation was conducted in 40 schools throughout 2007 and aimed to answer two key questions:

- Is the science curriculum being implemented effectively?
- What actions would improve the quality of teaching and learning in science?

In particular, the evaluation attempted to establish if pupils were achieving the learning objectives of the Science curriculum. Therefore, as well as gathering evidence of the teaching approaches used, the evaluation gathered evidence of pupil achievement in Science.

During the evaluation a total of 215 classroom setting were evaluated. Lessons were observed in each strand of the curriculum: Living Things, Energy and Forces, Materials, and Environmental Awareness and Care. A quarter of all lessons included a Designing and making focus. The inspectors administered science tasks to assess the pupils' conceptual and procedural understanding. Over 2800 pupils completed conceptual tasks designed to establish if pupils had achieved the objectives of the four content strands of the Science curriculum. In second, fourth and sixth classes 1813 pupils completed procedural tasks designed to ascertain pupils' scientific investigation skills.

The data is being analysed and the Evaluation Support and Research Unit of the Inspectorate and the report of the evaluation is due for publication in early 2009.

The Strategy also made the case for strengthening the linkage between the primary and post-primary curricula to enable a gradual deepening and widening of science and scientific issues from one level to the next.

Second level – Junior Cycle

A revised junior cert science syllabus was introduced in 2003. It contains three areas – biology, chemistry and physics. Both ordinary and higher level students study all three areas. Junior Certificate Science provides a suitable preparation (but is not a requirement) for the study of one or more science subjects at senior cycle. The revised syllabus has an increased emphasis on an investigative approach to teaching and learning, on science process skills and on hands-on student practical work. A major innovation in the revised syllabus is the allocation of some 35% of the marks in the Junior Certificate examination to an assessment of student practical work. The introduction of the revised syllabus has been supported by a comprehensive five-year programme of in-career development for teachers.

OECD PISA Study

PISA is the OECD's Programme for International Student Assessment which is implemented on a three-yearly cycle. It is one of the largest international studies of student achievement in the world, with almost 400,000 students taking part in 57 countries. PISA is designed to measure how well students can apply knowledge and skills considered to be important for their future lives. It does not aim to measure students' mastery of specific curricular content.

In December 2007, the Minister for Education and Science launched the publication Ready for Tomorrow's World - the Competencies of Ireland's 15-year-olds in PISA 2006. The report focuses on the third cycle of PISA which took place in March/April 2006. Over 4,500 Irish 15-year-olds, in 165 schools, took part in one of the largest surveys of its kind ever carried out. Students were assessed using a mixture of multiple-choice items and open answer questions. Students and School Principals also completed questionnaires, which allowed student and school characteristics to be linked to student achievement.

The report shows that Irish 15 year-old students are amongst the top performers when it comes to reading literacy, significantly above average in Science and in line with the average across the OECD in Mathematics.

Across PISA, Ireland maintained rather than improved its relative country ranking from 2003. Across all three domains, the results for Ireland indicated that differences in achievement between schools were lower than in most OECD countries.

With regard to science, Ireland ranked 14th out of the 30 OECD countries and 20th out of the 57 participating countries. As in the previous two cycles of PISA, Ireland's mean score in science was significantly above the OECD average. However, across the board the survey also revealed widespread pessimism among secondary school students about environmental challenges and limited enthusiasm for scientific careers. Ireland was the country showing the strongest correlation between advantaged socio-economic background and general interest in science.

PISA 2006 particularly focused on students' abilities in comprehending and tackling scientific problems. It also assessed students' attitudes to science. Students in Ireland had the highest mean score of all PISA 2006 countries on one of the three attitudinal indices that could be compared cross-nationally - awareness of environmental issues. Students in Ireland achieved scores close to the OECD average on the other two - general value of science and self-efficacy in science (self-judgement in own ability to succeed).

In relation to mathematics, Ireland's mean score in mathematics was not significantly different from the OECD average, raking 16th of the 30 OECD countries and 22nd of 57 countries. There were fewer lower achievers and higher achievers than the OECD average, with the majority of Irish pupils scoring in the mid range of achievement. Ireland's performance levels for mathematics in 2006 were largely unchanged compared with the previous two cycles of PISA. This may reflect a focus on mass rather than excellence in the second level education system but it is somewhat worrying as an indicator for the domestic pipeline of candidates for SET courses at Third and Fourth level.

Studies such as PISA provide important information on the performance of the Irish education system in the context of international trends. The results also present challenges and directions for the continued development of the system and the improvement of the educational experience of our students. The full national report on PISA 2006 was published in April 2008. It includes a more detailed analysis of performance and of variables associated with performance. Among the topics discussed in report is the relationship between achievement and factors such as gender and the home environment. The report found that in Ireland, we don't find gender differences in overall science performance, but there are large differences in some aspects of science. Females seem to be better at broad scientific understanding – what is the nature of science – while males seem better on knowledge of scientific facts, particularly knowledge of physics. The Educational Research Centre is undertaking a number of follow-up studies, including a multi-level modelling analysis of variables that contribute to science performance and an investigation of the relationship between performance in science and the study of geography and home economics, both of which have significant scientific components.

Transition Year

Transition Year is an important nodal point in the study of science at second level. It literally marks a transition from nearly universal study of science subjects to a figure of 60% of the Leaving Cert cohort taking a science subject or subjects. It makes sense to use Transition Year in part to introduce school students to sampler modules with a scientific orientation and to engage in informed discussion on potential careers in the sciences, and the Second Level Support Service are providing supports for schools in this area. Most schools offer science in transition year usually as modules

of physics, chemistry or biology rather than as an integrated subject. Frequently, courses include significant amounts of Leaving Certificate material. Some schools also offer courses in, for example, research skills; applied science or sports science and many science courses incorporate project work.

For that reason important priorities for the SSTI are to optimise the Transition Year experience of science including:

- interaction between the Transition Programme and relevant industries and third level research sites, through school visits, work placements and other measures.
- pursuing short courses in science, as envisaged in the NCCA's proposals for sen ior cycle reform. (It is anticipated that DSE in particular could play a significant piloting and catalysing role here).

The Strategy also made the point that where students are following a transition year programme, the choice of subjects they wish to take for the leaving certificate should be delayed until the end of Transition Year.

Second Level – Senior Cycle

The SSTI set out the case for reform of the science curricula in Leaving Certificate, particularly physics and chemistry subjects, to ensure a continuum from Junior cycle with the emphasis on project-based hands-on investigative approaches and the completion of practical coursework. In addition, in line with proposals generally for reform of senior cycle, the aim was that the science subjects should be reviewed with a view to re-balancing of content, greater emphasis on problem solving, and modernisation, to the extent feasible in order to allow a better embedding of key skills and an applied focus.

The current position is that the NCCA is reviewing the Leaving Cert Physics and Chemistry syllabuses which were introduced in 2000 and the Leaving Certificate Biology syllabus which was introduced in 2002. All three syllabuses are being developed to a common template. The revised syllabuses will have a greater emphasis on an investigative approach to teaching and learning and on science process skills, bringing them more into line with the revised Junior Certificate science syllabus. The content of the syllabuses is also being updated to include modern developments in the subjects and a greater emphasis on everyday applications. The NCCA is also developing a model for the assessment of students' practical work; currently such work is assessed only through the medium of the written examination paper. Revised draft syllabuses in these three subjects will be circulated for consultation later this year.

The Maths curriculum is being revised following approval by the Minister of proposals to strengthen the emphasis on real life applications The main features of Maths reforms proposed at Junior and senior cycle are designed to:

- Provide a bridging framework from the revised primary curriculum into second level
- Promote greater maths literacy across the school population

- Bring changed emphasis in the mathematics learnt and, in particular, a strong focus on context and applications and problem solving in a general move towards a strengthened emphasis on "real mathematics education" and a greater ICT dimension
- Encourage greater take up at higher level
- Provide a solid foundation which prepares students for careers in science, technology, en gineering, business or humanities options
- Provide for an innovative professional development model under which change would be implemented in various areas of maths on a phased basis in a rolling programme of reform. Lesson plans and exemplars would be developed and piloted in schools, then go on a national website and the examination system in that area would change at that stage

For schools involved in the initial implementation from September 2008, students will experience mathematics in a new way. Teachers will be provided with classroom materials to enable them to adopt the new approaches and will be supported professionally in embracing change. These materials and supports will include lesson plans, with teacher guides and student worksheets, online exemplars and a range of assessment materials. Examination questions will also be changed for these students. The changes will be phased over 3 years, initially in the project schools, beginning in September 2008. In mainstream schools, the changes will begin in September 2010, preceded by professional development for teachers the previous year.

The SSTI also indicated that developments at senior cycle science would be informed by a further survey of pupil/teacher attitudes to be undertaken in 2006 in the light of the first cohort of students completing the revised junior cycle syllabus. Outcomes would inform the ongoing process of curricular reform at Senior Cycle being undertaken by the NCCA.

The results of the third cycle of the Programme for International Student Assessment (PISA) 2006 were publicised in December 2007. As part of PISA 2006 students completed a questionnaire on their attitudes to science. When the PISA 2006 survey was carried out in March/April 2006 just over half of the participating students had almost completed their study of the revised Junior Certificate science course, the first cohort of students to do so. In conjunction with the administration of PISA, the Education Research Centre (ERC) also carried out a survey of science teachers in the participating schools. A summary report of this survey, Implementing the Revised Junior Certificate Science Syllabus: What Teachers Said, was distributed to all second-level schools in 2006.

That report makes interesting reading. On the positive side the teachers of the junior cycle curriculum report greater use of investigative approaches by both themselves and their students, and improved student ability to apply scientific processes. More worrying is the apparent disconnect between the junior cycle and primary cycle at one end and the junior cycle and senior cycle at the other. Most teachers in the survey (all teaching Junior Cycle students) described themselves as unfamiliar with the science content and processes in primary school science. While most teachers of Leaving Certificate biology felt that Junior Cycle science provided adequate preparation for that course, less than half of the teachers of Leaving Certificate physics or chemistry felt that students were adequately prepared for their courses.

A composite report, based on subject inspections in science at junior and senior cycle level, will also be published shortly. These various reports and the findings therein should inform policy develo-

pment on all three curricula – primary, junior and senior so that we ensure continuity, consistency and incremental learning in our first and second level systems.

There was also an undertaking in the SSTI that in the context of the plans for assessment of science practical coursework as part of the overall examination the issue of technical assistance for schools would be revisited. Preliminary consideration of this issue suggests that the cost of providing technical assistance for science and technology subjects would be very considerable and could not be accommodated at present due to other urgent demands on funds for education.

At Leaving Certificate Level approximately two thirds of students study at least one of the three main science subjects. By far the larger proportion of these study biology, with almost 54% of the cohort studying the subject in the academic year 2007/08. The corresponding figures for physics and chemistry are 14.0% and 14.3%, respectively. In the Leaving Cert examination the majority of students take these subjects at Higher level; in 2007 some 83% of chemistry candidates, 72% of physics candidates and 68% of biology candidates took the subject at Higher level. While the uptake of chemistry has increased steadily from a low of 11.1% in 1999 the uptake of physics, which increased following the introduction of the revised syllabus in 2000, has fallen steadily in recent years and is now well below its pre-2000 value of 15.4%. The significant gender imbalance in physics remains, with males outnumbering females in the ratio of three to one.

The SSTI indicated that concerted efforts will be made to increase the proportions of students generally who study science subjects at Leaving Cert Ordinary level and to encourage a better gender balance in the take up of Physics, where females are under–represented at both ordinary and higher level. A key goal in the strategy is to increase the percentage taking Chemistry and Physics subjects at Leaving Certificate generally to 20% of the overall cohort by the conclusion of this Strategy.

Take up of science subjects at second level and beyond

The SSTI drew attention to the fact that a greater awareness among students of career opportunities in science, engineering and technology was needed. To that end the strategy called for promotion of information brochures, guidance materials and resources and awareness initiatives in collaboration with the Discover Science and Engineering Programme, and effective linking of this with school guidance services, targeting in particular transition year students to encourage more students who perform well in science in senior cycle to choose science options in third level and to pursue careers in this area.

One recent positive development in this area is the development of the online careers portal, www.careersportal.ie, supported by Discover Science and Engineering (DSE). This allows the individual student to map out a possible career, chosen by reference to values, abilities, and interests.

Awareness Programmes: Discover Science and Engineering

The DSE Programme was launched on 30 October 2003. The Programme aims to bring together the many science, engineering, technology and innovation awareness activities managed by different bodies, public and private nationwide, including:

-The Science, Technology, Innovation Awareness Programme, formerly managed by Forfás;

-The National Skills awareness Campaign, also formerly managed by Forfás;

-The STEPS to Engineering Programme, managed by Engineers Ireland; and

-The Discover Primary Science Programme, managed by Forfás.

The DSE Programme is located within the Science, Technology and Innovation Policy and Awareness Division of Forfás. Its budget is provided by the Department of Enterprise, Trade and Employment. The total DSE expenditure in 2007 was €5 million. DSE operates under the guidance of a high level Steering Committee that includes representatives of the Department of Education and Science.

DSE provides career guidance materials to schools and has formed a strategic partnership with STEPS to Engineering towards this end. STEPS to Engineering provides students, teachers and parents with a wide range of publications to inform them about engineering as a career. A website has also been developed. At the same time, the Department of Education and Science has a high degree of interaction with the National Centre for Guidance in Education.

Future developments in regard to this key action will be determined by the outcome of the evaluation of DSE.

Since the launch of this Strategy in June 2006, DSE has continued to expand its range of awareness activities. Discover Primary Science, which is designed to introduce students to science in a fun and interactive way, supports teachers in delivering the Social, Environmental and Scientific Education curriculum. This programme complements and supports the introduction of science into primary schools by providing ongoing teacher supports and by providing teacher induction in their delivery. Following an extremely successful first year pilot (approximately 550 schools participating), the Discover Primary Science Programme recorded some very impressive results in 2007:

-494 participating schools achieved Awards of Science Excellence;

-The Discover Primary Science Programme was offered to all 3,300 national primary schools; and,

-The Programme was taken up by 3,110, or over 90%, of schools.

A contributory factor in the success to the success of the Programme has been the role played by the Regional Education Centres in the facilitation of the Induction Days for teachers and the provision by the Department of Education and Science of substitution cover for these teachers while on induction. Future developments in regard to this key action will be determined the outcome of the evaluation of DSE.

At second level DSE is promoting the use of sensor technology in schools. This project, Discover Sensors, is implemented in partnership with the Department of Education and Science's Junior Science Support Service, the National Centre for Technology in Education and the Education Centre Network. This project, as well as promoting the use of ICT in science teaching, also supports the investigative approach required by the revised Junior Cert science syllabus. Approximately 200 schools are currently participating in this project.

The SSTI envisaged DSE as having a particular role to play in complementing the developments in the school system through:-

- Continuing awareness measures with primary schools, accompanied by enhanced supports for second level schools;
- Increasing the number of participating primary teachers/schools in the DSE teacher training initiative;

- Extending the reach of this initiative to the second level sector in line with curricular reforms in collaboration with the second level support service and higher education institutions as appropriate;
- Providing enhanced internet based support materials and resources for teachers at both levels of the system;
- Provision of information and guidance on careers in science, which will feed into school guidance programmes;
- Supporting pilot initiatives with schools in disadvantaged areas promoting innova tive approaches to awareness initiatives and teaching methodologies in science. Experience in this area will also inform the development of further modules and short course options in science in the Transition Year Programme.

Evaluation of Discover Science and Engineering (DSE)

DSE's mission is to contribute to Ireland's continued growth and development as a society that has an active and informed interest and involvement in science, engineering and technology. DSE's overall objectives are to increase the numbers of students studying the physical sciences, to promote a positive attitude to careers in science, engineering and technology and to foster a greater understanding of science and its value to Irish society. The target audience for DSE includes students at all levels, with a particular focus on primary and post-primary, their parents and teachers, as well as the wider public. The programme also works closely with third level institutions and with other influencing stakeholders such as industry and the media.

The Department of Enterprise, Trade and Employment and Forfás agreed that, having regard to the range of outreach activities and the expanded budget for the programme, a comprehensive and independent evaluation of the programme would be undertaken. The evaluation commenced in late 2007 and is on target to be completed shortly. Its findings will be applied to inform the future orientation of DSE in a way that maximises its contribution to the goals of the SSTI.

Trends emerging in Third Level Discipline Choices

Examining the third level discipline choices and, in effect, the career choices of Leaving Certificate students provides important indicators for the development of a knowledge economy. The HEA Report Discipline Choices and Trends for High Points CAO Acceptors 2006 examines these choices for a particular group of these students i.e. those achieving 450 - 600 points in their Leaving Certificate and accepting CAO places in 2006 and illustrates some trends in their choices since 1998. These "high-point" students are more likely to receive their first or a high preference course and have the highest range of choices in the points admission system. In fact, in 2005 66% were offered and accepted their first choice through the CAO. Their choice of discipline and career therefore affects the choices of their contemporaries.

The HEA Report states that in 2006, 5,666 level 8 honours bachelor degree acceptors accepted places on Technology courses. Of these, 2,186 (over one third) had 450 + points and, of these, almost half accepted courses in Science. When compared with results since 1998, some trends emerge which will need to be addressed in the context of this Strategy, as follows:

- Technology acceptors decreased their proportion of high-point acceptors in 2006 to 23.7%. This is a decline of 8.7 percentage points since 1998;
- Computing attracted 5.7% of high-point acceptors in 1998. This decreased to 1.2% in 2002. This decline which has continued and deepened was the major factor in the decline of Technology acceptors between 2000 and 2006. A slight increase was seen in 2006;
- Engineering/Construction has declined in popularity from 11.6% in 1998 to 10.0% in 2006. However in absolute numbers there was an increase from 875 to 929 acceptors:
- Science high-point acceptors declined from 14.0% in 1998 to 11.3% in 2006.

The HEA Report also provides some useful data relating to gender breakdown of high-point technology acceptors:

- Females constitute 57.4% of the high-point level 8 honours bachelor degree Science acceptors in 2006. This proportion has remained constant since 1998. If Science is broken into Physical and Life Sciences, males comprised 60.6% of Physical Science high-point acceptors in 2006;
- In 2003 females with high-points almost abandoned Computing courses. In 2006 their proportion of Computing acceptances has almost trebled returning to its proportion in 2000;
- In Engineering/Construction the female proportion in 2006 at 20.4% was the lowest in recent years.

The Results of the curriculum reviews will be considered together with the results of most recent PISA study, the findings of the DSE evaluation and the HEA Report Discipline Choices and Trends for High Points CAO Acceptors 2006. All of these reviews will inform the development of future policy and will be considered in HERG later this year.

Other Awareness Initiatives

Irish Council for Bioethics

The Irish Council for Bioethics is an independent, non-statutory, advisory body whose function is to consider the ethical issues raised by developments in bio-medicine and to promote informed public awareness of same. The Council is funded by the Department of Enterprise, Trade and Employment.

A significant element of the Council's 2008 work programme was the publication of an Opinion on Stem Cell Research consequent to a public consultation on this topic in 2007. The Council's Opinion recommends, inter alia, the establishment of a state-funded regulatory authority, which would function independently and transparently to oversee embryo research and supports the carefully regulated use of supernumerary in vitro fertilised embryos that are otherwise destined to be destroyed, for purposes of embryonic stem cell research aimed at alleviating human suffering.

A May 2005 report of the Commission on Reproductive Health also considered policy in this area of research. The Government referred that report to the Oireachtas Joint Committee on Health and Children (OJC) so that that Committee could consider and report in due course on its views of the recommendations of the Commission. The ICB has also forwarded its report to the OJC to assist in that deliberative process.

Science Gallery

In January of this year Science Gallery, located in the Naughton Institute in Trinity College Dublin, opened to the public. The Gallery is ideally suited supporting the science awareness goals of the Strategy for Science, Technology and Innovation 2006-2013. It provides a venue for a variety of science exhibitions and events and aims to present science in new and stimulating ways. While open to all, the primary target audience for Science Gallery is young adults in the 15-25 age bracket. It aims to present science and engineering as attractive educational and career options to young people at a stage when critical decisions about subject choice, third level options and future careers are being made.

Exploration Station

Exploration Station, a purpose built interactive learning centre designed specifically for Ireland and dedicated to providing a hands-on learning and discovery experience focused predominately on science and technology, is planned as part of the Heuston Gate development in Dublin. This centre will be aimed primarily at younger children and will also help to realise the awareness goals of the Strategy for Science, Technology and Innovation.

6 Research in the Public Sector

Across the sphere of Government there are important areas of civil and sectoral research which have a great potential to lead economic and social progress. Agriculture and food, health, environment, marine and energy are sectors which have the potential to yield innovations which make tangible improvements to our quality of life. The Strategy outlines priority actions for each of those areas within the national system of innovation.

Agriculture and Food

The development of a sustainable food and agriculture sector is crucially important to Ireland's future development. In a rapidly changing business, economic and regulatory environment the current level of RTDI in this sector is low, mainly due to the large incidence of SMEs in the sector, which do not have the resources, background or culture to engage in R&D. At the same time, the publicly-funded agri-food R&D system is well integrated. DAFF is the primary funding agency for agri-food research, and it uses a variety of funding mechanisms, both competitive and core grant-in-aid. The priority under the Strategy is to build a knowledge economy in agri-food so as to provide a scientific foundation and support for a sustainable, competitive, market-oriented and innovative agriculture, food and forestry sector.

Progress to Date

Significant progress is being made by DAFF and its agencies in building a knowledge economy in agri-food. By effectively implementing its public good competitive research programmes (FIRM, RSF and COFORD) and collaborating with its agencies, other Government Departments and agencies, DAFF is successfully addressing the key actions listed below:

Key Action: DAF will ensure that its public good competitive research programmes, (FIRM, RSF and COFORD) will be focused on the needs of the sector and will continue to increase collaboration and capacity building in Irish research centres

Key Action: DAF will ensure that agricultural production research supports a competitive profitable farming sector that is sustainable in relation to soil, water, air quality and biodiversity, supporting a vibrant rural economy

Key Action: DAF will build on existing R&D expertise and excellence to underpin the contribution of forestry to the sector

Key Action: DAF will ensure that food research provides a base of knowledge and expertise in generic technologies to support a modern, innovative and consumer focused food industry, with attention to food safety and quality issues

Key Action: DAF, through Teagasc and its own competitive research programmes, will support the building and strengthening of a research capability in new technologies, and to exploit their application to natural resources including agriculture, food and non-food land uses

Key Action: DAF will continue to strengthen co-operation with other Departments, State Agencies and Funding Bodies to avoid duplication and create synergies within agri-food R&D and contribute to building a knowledge economy in agri-food

Key Action: DAF will link with the Environment sector in carrying out research on agri-environment issues such as soil quality, nutrient efficiency and nutrient loss, air and water quality, biodiversity and ecology to enable the farming sector to operate in a sustainable manner in compliance with environmental requirements

Key Action: DAF will link with the Energy sector on research into energy crop production at farm level and the use of existing forests for wood energy production

Key Action: DAF will ensure that the new DAF Agricultural and Veterinary laboratories will operate as science based centres and will seek to collaborate and integrate them into the national research infrastructure

Key Action: DAF will continue its links with Enterprise Ireland to achieve a strategic and seamless approach to food and forest products R&D funding, from the basic pre-commercial research funded by DAF to the near market research funded by EI

With regard to the food sector in particular, the then Minister for Agriculture, Fisheries and Food, in 2007, established two high level committees to advise on policy for development of the food industry and a group to advise the Department on research matters. This latter group also acts as the Irish Platform to interact with the EU Technology Platform 'Food for Life' under the Seventh EU Framework Programme for Research and Technological Development (FP7) 2007-2013.

Developments under the Food Institutional Research Measure (FIRM) Programme

In 2006, 58 collaborative research projects, to the value of €31million, were funded under FIRM in all areas of food research including food safety, food quality & manufacturing, food and health and the food supply chain. Highlights of collaborative projects funded under the Programme include:

- The €1.1 million Food Graduate Development Programme, which was launched in March 2008, aims to develop the skill sets of Food MSc and PhD students;
- Three Networks were funded in 2007 in the areas of microbial quantitative risk assessment: - the genomics of gram negative, food poisoning bacteria of animal origin; and phytochemicals - a farm to fork approach;
- Funding of €2.9million was provided for new equipment in the areas of Microscopy, Functional Foods and High Resolution Nuclear Magnetic Resonance, in Teagasc and some Universities;
- A call for research proposals in the area of Marine Functional Foods in collaboration with the Marine Institute has taken place and a consortium led by Teagasc, Ashtown was the successful consortium. The value of the award is €5.2m, with €2.6 being provided under FIRM;
- A joint call for proposals with HRB, DOHC and DAFF in the areas of Nutritional Health in the Elderly, Food Safety - Monitoring & Surveillance, Food Consumption Databases and Nutritional Phenotype Database took place in August 2007. Four proposals - one in each area - was each awarded funding of €5million;
- DAFF, in collaboration with the HRB, co-funded a Health Research Centre in Diet & Health particularly in the area of consumer cognitive response to food. The total value of DAFF input was €500,000 over two years;
- DAFF continues to work with Enterprise Ireland to develop a strategic and seamless ap proach to the funding of R & D in the food industry.

Developments under the Research Stimulus Fund (RSF) Programme

In the agricultural production area, 79 research projects have commenced since 2006 arising from approx. €42million grant aid provided under DAFF's Stimulus Programme. This research, which will be conducted by Teagasc, the universities and the IoT's over a 3/4 year timescale, is aimed at underpinning sustainable agricultural production practices and policies. The RSF call took due cognisance of the commitment to sustainable agriculture with dedicated topics devoted to Agri-Energy, Agri-Environment, Plant Biosciences, and Agri-Economics and Policy Research on sustainable agricultural production relating to Air, Soil, Water & Biodiversity that guides policy development and enables the farm sector to better comply with its environmental obligations was funded. In particular, the impacts of intensive farming and forestry on soils and vulnerable groundwater environments, trans-boundary greenhouses gases, farming aspects of biodiversity and Co-existence and use of conventional, organic and GM crops were areas that received support.

Developments in the National Council for Forest Research & Development (COFORD)

In recognition of its objective to support the development of a competitive, knowledge-based forest sector that will contribute to national economic, social and environmental policies and goals, COFORD agreed a joint programme of research on forests and water with the EPA, which will be part funded under the SSTI, COFORD's funding and by the EPA. Three projects have been selected for funding, at a total cost of €3.2 million, over a five-year period. COFORD has also collaborated with SEI in forest energy research specification, with one project approved in 2007, with a budget of €1.4 million.

Since the beginning of 2007 COFORD has put in place research programmes in climate change and forests, biodiversity, forests and water, forest planning and management, forest policy and economics, totalling 27 projects at an estimated cost of €13 million to 2012. COFORD is also funding the Forest Energy 2007 programme which is geared towards the development of cost effective wood fuel production from young forests.

DAFF's Role in Developing a World Class Research System in Ireland

The SSTI outlines the following specific key action relating to the development of centres of excellence and the recruitment of Principal Investigators:

Key Action: Teagasc will restructure its research activities and resources into Centres of Excellence and will recruit 50 new researchers including fifteen Principal Investigators to underpin the needs of a bio-economy in agri-food

Plans for Centres of Excellence in the areas of Animal Science, Plant/Crop Science and Environment and Rural Research Centres are at or near planning permission stage. Plans for extra Functional Foods laboratories at Moorepark, Co. Cork and Ashtown, Co. Dublin and a large animal facility at Moorepark, Co. Cork are well advanced. Teagasc is awaiting Department of Finance approval to recruit a further 50 new researchers, including 15 PI's.

All Island and EU Research Initiatives

Key Action: DAF and Teagasc will foster and build on the level of North/South Collaboration that already exists in agri-food and forestry research

Collaboration between Northern and Southern research institutions is encouraged in both FIRM and RSF projects.

Key Action: DAFF will promote and assist participation by Irish researchers in EU research initiatives such as FP7, ERA-Nets and other collaborative arrangements

The group of representatives of key stakeholders, which was established in 2007 to advise the Department on research matters, also acts as the Irish Platform to interact with the EU technology

Platform 'Food for Life' under the Seventh EU Framework Programme for Research and Technological Development (FP7) 2007-2013.

DAFF provides national representation for the Food, Agriculture and Fisheries and Biotechnology Theme of FP7. The National Contact Point and National Delegate continue to offer hands on support to Irish researchers participating in FP7, and to promote FP7 in Irish research institutes and universities.

Health

The SSTI outlines the need for a strong research culture if the health service is to offer a world-class standard of care to patients and retain professionals of the highest quality. It acknowledges that the system also needs to harness research to find better ways of improving the health of the population and delivering more efficient and effective healthcare. The success in growing the pharmaceutical and medical devices industries' presence in Ireland at a faster rate with a higher level of foreign direct investment than in other countries is highlighted. These healthcare industries are increasingly dependent on high quality clinical research provided by specialists in well-equipped centres. Efficiency and effectiveness in the operation of ethical committees and of clinical trials is also a potential strength which should be developed.

The SSTI, in commenting upon how other countries have realised the importance of linking their health services to their science and industrial development priorities and are investing in initiatives to bring them closer together, calls for Ireland to do likewise by building the R&D potential within the health service and linking this with its investments in basic sciences.

Progress to Date

In the light of the challenges outlined above, the following outlines progress made in implementing the Key Actions in the health sector listed in Chapter 6 of the Strategy.

Key Action: Develop health research as a frontline health service to guarantee world class health care for patients, to resolve health problems facing the population, and to attract and retain health professionals of the highest quality and to improve efficiency and effectiveness to the health sector

In accordance with the recommendations of the report of the Advisory Council for Science, Technology and Innovation entilted *Towards Better Health: Achieving a Step Change in Health Research in Ireland,* a Health Research Group has been established under the auspices of the Interdepartmental Committee on Science, Technology and Innovation. This group's task is to formulate and oversee implementation of a national health research policy and strategy, including health services research and epidemiology with clearly defined objectives and priorities.

Since the Group commenced its work in May 2007, it has encountered difficulties in gathering information on the scope and scale of expenditure on health research due to the number of agencies and groups involved, coupled with an absence of clarity surrounding the criteria for classifying health research expenditure. The HSE is the largest supplier of health services but does not at present have an identifiable research budget within its €15 billion allocation, although it clearly supports research in the main via hospital budgets. Accordingly, an additional senior management

representative from the HSE was co-opted onto the Group given the importance of the research policy and strategy of the HSE in this area.

While some information has been collected, the Group agreed that it would be necessary to conduct a hospitals survey with a view to quantifying this substantial area of health research. A survey questionnaire is currently being undertaken by Forfás to improve the information base in this area. The results of this survey will be available later this year. When read together with BERD and HERD surveys, the data emerging will allow, for the first time, for the mapping of R&D in the health sector. The data emerging from this survey will also facilitate strategic decisions on priorities in health research, including informed decisions regarding population health policy.

Key Action: A strong research culture to be built in the health services through targeted investments, on the basis of competition and peer review, and by a strong corporate commitment to research by the Health Services Executive and other health agencies

In 2007 the HSE published a strategy document on its research priorities and on medical education and training. The HSE is to appoint a Director of Health Research this year. This Director will function, inter alia, as a central contact point for all issues related to the conduct of health research in the HSE.

The Common Contract for consultants, which is being finalised with the HSE and medical bodies, will include requirements on research time and intellectual property rights. These actions, together with application of learning from the hospitals survey referred to above, will help to embed a strong research culture in the health services.

Key Action: The R&D pillar of the health research strategy (MKWH) also needs strong support to ensure that the crucial 'population health' element of the Health Strategy has a sound research base to underpin appropriate disease prevention measures, redress social inequalities in health status and to ensure best practice in health service delivery and policy development

The HRB is commissioning an audit of population health research in Ireland with a view to strengthening research capacity in this area. An international Steering Group is being invited to oversee the project, which will be completed by end 2008. Improving the data on the extent and nature of health research so as to complete the picture of the totality of health research, as instanced above, will also inform appropriate application of population health criteria to policy decisions.

Key Action: Develop a number of centres of world significance in translational health research, each of which has strong foundations in both academia and the health services and which will act as a magnet to the pharmaceutical and medical devices industry, nationally and internationally. Build these centres through strategic investment in research infrastructure, people and programmes by competitive, peer reviewed awards through the HRB and other funding agencies

Three clinical research facilities (CRFs) are being developed, one each at St James's Hospital, Dublin; University College Hospital Galway; and, Cork University Hospital. The aim of these Health Research Board (HRB)/ Health Service Executive (HSE) Clinical Research Facilities is to provide the

infrastructure - the physical space, facilities and the experts - needed to support patient-focused research studies.

The CRF being developed in University College Hospital Galway will support all patient focused research including cancer. A special emphasis of the facility will be on regenerative medicine, with specially developed infrastructure provided to enhance this area of translational medicine. The investment by the HSE and the HRB will be of the order of €20million over five years. When fully operational, the CRF will employ a staff of 20. The research programme to be carried out at the facility will be through a partnership between NUI Galway researchers and clinician scientists from University Hospital Galway.

In February 2008 the Health Research Board (HRB) and the Health Service Executive (HSE) announced that they would jointly fund a new CRF in Cork. The investment by the HSE and the HRB will be of the order of €11million over five years. The facility will be built at Cork University Hospital and it is anticipated that it will be completed in 2010. When fully operational, it is anticipated that the new facility will employ 15 people. The research programme will be conducted in a partnership approach between researchers at University College Cork, clinician scientists from Cork University Hospital as well as clinician scientists from throughout the city and the region. These new facilities will concentrate on patient-focused research. Medical doctors and nurses will work with other scientists to improve our understanding of cancer, heart disease and bowel disease and nutrition. Researchers will develop new tests and provide patients with access to the latest advances in treatments to help tackle these diseases.

The CRF at St James's Hospital, Dublin is part of an Ireland /UK Clinical Research Collaboration. This initiative has brought together the Health Research Board in Ireland along with major health-related charities, Government funding bodies and health departments in the UK. It includes the Wellcome Trust, British Heart Foundation (BHF), Cancer Research UK, the Wolfson Foundation, the Medical Research Council (MRC) and Health Departments in England, Northern Ireland, Scotland and Wales. Ireland's share of the investment will be of the order of €20 million over the next five years and will come from the Health Research Board and the Wellcome Trust.

The centre will provide patients with access to the latest advances in diagnosis and treatment of diseases such as cancer, neuro-psychiatric disorders and infectious diseases. It will also connect with new and emerging facilities at other Dublin teaching hospitals through the establishment of a citywide clinical research network which is being established to help ensure a greater number of patients can benefit from clinical research in the most cost effective manner.

Key Action: Maintain the confidence of the public in health research by observing the highest ethical standards in research and provide for greater public engagement in relation to the benefits of health research and the complexities of undertaking such research

The underlying principles and context of research ethics committees has been clearly articulated by the Irish Council on Bioethics:

Impartial ethical review is designed to maintain ethical standards of practice in research, to protect participants in research and research workers from harm or exploitation, to preserve the subject's

rights, including the right to privacy and to provide reassurance to the public that all of this is being done. In promoting these goals Research Ethics Committees should be mindful that appropriately regulated, ethically acceptable, rigorous research benefits society as a whole. The primary task of Research Ethics Committees is the protection of the welfare and the rights of participants in research. Another important role is to facilitate and support the progress that the research community seeks to achieve. *(6)*

A corollary to ethical rigour is that its application should be efficient and effective. As an issue, this impacts not only on the efficiency of research but on national competitiveness, a point made with some eloquence by IBEC's Medical Technology Council to the Health Research Group. This issue was identified in the ASC Report "Towards Better Health: Achieving a Step Change in Health Research in Ireland" as requiring attention and is a matter for current discussion in the Health Research Group.

Environment

The SSTI states that the future strategic direction of environmental research will be to anticipate and respond to changing circumstances and to engage in research to generate new knowledge of the environment and environmental technologies. Meeting international environmental obligations will demand continued engagement in such areas as climate change, biodiversity loss, environment and health, the urban environment, air pollution, waste management and water quality. An environmental research centre is being developed as a centre of excellence within the EPA in close cooperation with the HEIs to build capacity in environmental data handling, modelling, assessment and guidance. This centre has the potential to become a key environmental component of the knowledge economy and will be the cornerstone of future environmental research.

Progress to Date

The SSTI outlines one Key Action for implementation:

Key Action: The research programme funded by DEHLG will be reviewed with the aim of maximising its value with particular regard to potential synergies between the different components of the programme

The Science, Technology, Research and Innovation for the Environment Programme (STRIVE), which is administered by the Environmental Protection Agency, employs a strategic and targeted approach to protecting and improving the natural environment through the provision and accumulation of scientific research and knowledge, particularly in relation to air quality, waste management, water quality, and in the overall support of environmental policy development. STRIVE is the successor programme to the Environmental Research, Technology, Development and Innovation Programme (ERTDI) under the National Development Plan 2000- 2006. €93 million has been allocated to the Programme under the current National Development Plan, with €8.495 million of this drawn down in 2007. Additional funding of €8 million has also been allocated for 2007 – 2008 under the SSTI focused on research into climate change, transboundary air pollution and observation systems (GMES).

(6) Operational Procedures for Research Ethics Committees Guidance 2004, Irish Council for Bioethics

A key development in 2007 was the establishment of a new Climate Change Research Programme with thirteen projects and four fellowships to be awarded immediate funding from the overall budget of €8.7 million. One of the key areas that the Programme will focus on is research to support achievement of Ireland's 2020 GHG emissions target. In addition, further research was advanced on projects dealing with air quality, water quality and protected soils while the ongoing research into the sustainable use of resources continued with 22 organisations now being funded and significant economic and environmental improvements being achieved in the areas covered by the Cleaner Greener Production Programme (CGPP) and the National Environmental Technologies Action Plan (ETAP). In total, 29 research reports were published in 2007. In addition, 28 PhD, 7 Masters, 13 fellowships and 1 Fulbright were awarded. 2007 also marked the milestone of the 100th grant awarded through the programme since its inception. 4 large-scale multi-disciplinary projects were awarded in the area of soils, water and biodiversity.

In 2008, research and funding under STRIVE is being stepped up, both to facilitate new projects and to ensure that the projects already commenced can be satisfactorily completed. In line with the ever-increasing pressures on our environment, coupled with diminishing natural resources, it is likely that there will be increased calls for new and more eco-friendly and sustainable technologies to be developed and, importantly, utilised in the coming years.

Marine

The SSTI highlights the importance of the marine sector to the Irish economy and describes the active marine research sector in Ireland. Research and services are carried out by the Marine Institute which co-ordinates and works in partnership with Higher Education Institutions. There is also close interaction with the enterprise development agencies, particularly Enterprise Ireland, and with individual companies.

Investments under the NDP 2000-2006 have seen positive developments in the infrastructure for Marine Research. The Marine Institute's new facilities at Oranmore and Newport, coupled with the world-class research vessels, databuoy network and the ongoing oceanographic, biological and environmental survey programmes represent a unique asset. These, together with integrated data and information management systems, offer the opportunity to develop Ireland as a global monitoring centre for climate change assessments through the medium of marine and freshwater ecosystems. A key objective of the SSTI is to raise the profile and international standing of key Irish facilities and to afford Ireland a major opportunity to play a lead role at the hub of global environmental research.

Progress to Date

In the light of the challenges outlined above, the following outlines progress made in implementing the Key Actions in the marine sector listed in Chapter 6 of the Strategy.

Key Action: Conduct a survey of marine research and researchers on an all-island basis with particular emphasis on research underway outside of the Marine Institute, (2006)

A database of marine researchers compiled by the Marine Institute in 2005 is currently updated on an ad hoc basis arising out of information collated from research funding initiatives. In 2008 a

more focused approach is being taken to this action via the establishment of a centralised system to administer research funding and track marine research activity funded across the full range of initiatives.

Key Action: Development of research discovery programme in Marine Biotechnology; Marine Biodiversity; Marine Technologies (2007-2013)

Marine Biotechnology/Marine Biodiscovery

The emphasis on activities in this area has been on the establishment of a national Marine Biodiscovery Programme directed towards novel bioactive materials with applications in drug discovery, biomaterials and neutraceuticals. This is overseen by a Sea Change Advisory Group comprising representatives of leading research groups, industry and national agencies. The initial mechanism under which this programme is being implemented is the Beaufort Marine Research Awards in Biodiscovery. These seven year awards, to two institutions, totaling €7.23million will fund a Principal Investigator, six post-Docs and 12 PhDs. The Marine Institute is funding 3 PhD fellowships, through IRCSET, in the related fields of disease screening and chemical structure elucidation. The central sample collection and processing facility is being equipped and activated in the Marine Institute and work is commencing on a central data management mechanism for the Programme.

Marine Technology

Activity in the Marine Technology Programme in 2007 focused on monitoring and managing the outputs from investments made in 2006 under the Marine Institute's and Environmental Protection Agency's previous NDP funding, which funded 6 projects in this area (e.g. SmartCoast and SmartCatchment Projects). These investments have helped to build a multi-disciplinary, industry-oriented research capability in this area.

Investment in the programme was further boosted by the announcement of the Beaufort Marine Research Award in Marine Sensors and Communications, resulting in a €2.5million investment in the Programme over a 7-year period, a Principal Investigator, 1 Post-Doc and 5 PhDs. This investment will further enhance research capacity in this priority area, focusing on the field of sensors, sensor systems and related telemetry, communications and data management, related to monitoring water quality and the marine environment.

Key Action: Establish Ireland as an Internationally recognised centre for Ocean renewable research (2006-2013)

Key elements of the National Ocean Energy Strategy are being implemented. A critical mass research and technical support team is being developed at the Hydraulics and Maritime Research Centre, UCC. This is being funded under the Blue Power Initiative by the Marine Institute and through a Parsons Energy award. The latter award targets €3.5million in research funding over seven years to support four post-Docs and three PhDs.

Other significant developments include: (1) Irish researchers have been sucessful in attracting FP7 research funding of €1.5 million for renewable ocean energy; (2) A quarter scale Test Site for prototype devices, developed by Irish industry, are currently deployed for testing on the site; (3) planning is at an advanced stage for the development of an offshore grid-connected test site to accommodate full-scale wave energy devices, to be developed following their trials in Galway Bay and (4) An industry forum for this emerging sector has been created and is meeting on a regular basis.

Key Action: Establish a SMARTBAY system for the observation, monitoring and management of coastal and ocean environments and the testing of new advanced technologies, (2006-2008)

SmartBay is primarily a Research and Development infrastructure project, designed to test and demonstrate new technologies for monitoring freshwater and marine environments, and to link and demonstrate the emergence and availability of these technologies with a wide range of moni toring and management applications. Following a detailed location study, Galway Bay has been identified as the location for SmartBay. Consultations have taken place with leading stakeholders and an Environmental Desk Study is being completed. A detailed bathymetric survey of the bay has been completed, the route for the cable has been surveyed and engineering studies are commencing. Research partnerships are already in place and will be extended to other groups. Agency partnerships have been put in place with the Environmental Protection Agency, Enterprise Ireland and IDA and industry collaboration agreements have been created with IBM, Intel and Transas

Key Action: Develop Ireland as a global monitoring centre for climate change assessments in the context of the North Atlantic Gulf Stream, unique marine and other ecosystems and SMARTBAY system, (2007-2012)

The National Climate Change Co-ordination Group incorporates marine expertise. In addition, an external advisory group for the Sea Change Rapid Climate Change Research Programme has been established and the Internal Marine Institute Climate Change Group has been established. Significant investment is being made via ERDF and PRTLI in oceanographic and atmospheric research infrastructure to assist in the monitoring and assessment of climate change.

Key Action: Use the data derived from the Irish seabed survey and the new Infomar programme to place Ireland in a position of competitive advantage in a range of areas including participation in International research programmes (2006 –2013)

Data derived from the Irish Seabed survey and INFOMAR has enabled the Marine Institute and/or the GSI Irish to participate in the following international research projects:

- HERMES- Hotspot Ecosystem Research on the Margins of European Seas (FP7);
- General initiatives with the Newfoundland Partnership;
- A Petroleum Infrastructure Programme (PIP) project on the use of marine electromagnet ics and geohazard investigation;
- The Integrated Ocean Drilling Project (IODP);
- MESH – Mapping European Seabed Habitats IMAGIN - Irish Sea Marine Aggregates Initia tive; and,
- HABMAP – Habitat Mapping for the conservation and management of the Southern Irish Sea

Key Action: Stimulate greater involvement by Irish seafood Industry in marine related research. Prioritise development of marine health foods. (2006-2013)

A Marine Functional Foods Initiative (MFFI) steering group, comprising BIM, Teagasc, Enterprise Ireland, Marine Institute and a representative from the research providers, has been established. In 2007 an industry-research workshop on MFFI identified priorities in marine algae, extraction from waste streams and aquaculture. Agreement was then secured from DAFF to co-fund the MFFI, a seven-year research initiative valued at €5.32 million, aimed at setting up a cross-institute research consortium. Following a competitive process and evaluation by an international panel, a Teagasc led consortium was awarded the contract. The funding will support two Principal Investigators, seven Post-Docs and seven PhD students.

Key Action: Target a significant increase in FP7 participation and seek EU support for the Climate Change monitoring centre (possible European demonstration project 2006-2013)

During the Sixth EU Framework Programme for Research and Technological Development (FP6) 2002-2006, Ireland was successful in 59 marine projects receiving over €10.6 million in grant-aid. Against that background, Ireland's approach to this key action is not to increase the level of participation per se but rather to increase the quality of participation, with Ireland taking a more strategic and leadership role in (i) the definition of FP7 topics, and (ii) the leadership and/or a more significant role in individual FP7 projects.

Ireland played a leading role in having marine sciences and technologies recognised as a priority cross-cutting theme in FP7. Ireland was pro-active in supporting the science and technology pillar of the EU Maritime Policy and in drafting the Aberdeen Declaration, both of which have a key role in ensuring that marine science and technology topics will be broadly based and inclusive across the FP7 Programme and, indeed, in other funding programmes related to Structural Funds and Regional Development.

Nine marine projects with Irish participation were approved for funding in the first round of the FP7 Cooperation Programme. Total grant-aid to Irish partners is estimated to be in excess of €4.9 million and two major projects are led by Irish research institutions.

Proposals to seek EU support for the Climate Change Monitoring Centre will be formulated in the light of the outcome of the preparatory elements undertaken as part of the SSTI funded Marine Climate Change Programme.

Energy

The SSTI outlines the importance of the energy to the national infrastructure and its exceptionally high dependence on imported fuels and international environmental obligations. These drivers require Ireland to develop a more competitive contribution from renewables together with improvements in energy efficiency. The SSTI highlighted the need for enhanced coordination and alignment of energy, economic and innovation policies and placed the focus on improving security of supply, increasing the efficiency of energy use and bringing forward promising renewable energy technologies. It calls for the adoption of an all-island approach to take advantage of the obvious potential synergies in this area.

Key Developments in the Energy Research Area

Energy Policy White Paper

Since the SSTI was published, the Government, in March 2007, published its national energy policy in the Energy Policy White Paper *(7)* and set out a number of recommendations on energy research.

(7) Government of Ireland: Delivering A Sustainable Energy Future For Ireland: the Energy Policy Framework 2007-2020

Energy Innovation Forum 6 March 2008

An Energy Innovation Forum involving 5 Ministers, together with relevant Departments and Agencies and Industries from the Irish energy sector, took place on 6 March 2008. The objective of the Forum was to demonstrate a 'whole of Government approach' to energy and energy research. This was achieved by the presence of An Taoiseach, who delivered the key note address, five Cabinet Ministers and two Ministers of State, in the presence of 428 participants, the vast majority coming from Irish industry.

At the forum, the Minister for Enterprise, Trade and Employment announced details of the agreement with the Minister for Communications, Energy and Natural Resources to combine resources and to target a world-class research capacity investment through SFI of €90 million in the areas of sustainable energy and energy efficient technologies, over the period to 2013. This was in accordance with the commitment given in the Programme for Government 2007-2012. On 6 May 2008, the Minister signed into law new Regulations to give legal effect to this commitment. The Regulations prescribe sustainable energy and energy-efficient technologies as strategic areas of scientific endeavour in addition to the areas of ICT and biotechnology specified in section 7(3) of the Industrial Development (Science Foundation Ireland) Act 2003. The signing into law of these regulations will allow SFI to build a world-class research capacity in these areas and will provide a solid basis to address Ireland's challenges in the sustainable energy field.

The Minister for Communications, Energy and Natural Resources reconstituted the Renewable Energy Development Group to provide focus and coordination of research and other support mechanisms and better linkages between government and industry. He also announced the establishment of a National Ocean Energy Unit to be based at Sustainable Energy Ireland. This unit will manage the recently announced Ocean Energy Research and Technology Initiative.

The Forum also provided an occasion for the announcement of a joint venture between the Irish company Wavebob Ltd. and Vattenfall International in the area of Ocean Energy research and wave farm development off the Mayo coast.

Against this background of these broad policy developments, the following paragraphs outline progress made in implementing the Key Actions in the energy sector listed in Chapter 6 of the Strategy.

Key Action: Establish (2006), an Energy Research Council which will advise on the setting of priorities for Irish energy research to the year 2013. The Council will take a leading role in linkage with key national bodies (as well as EU and international programmes and bodies); coordinate existing RTDI; provide policy advice and analysis, and support strategic research initiatives and capacity building, complementary with existing initiatives

The Irish Energy Research Council was established by the then Minister in June 2006. The functions of the Council are to establish priorities for Irish energy research up to 2013 and beyond, coordi-

nate energy RTDI activities in Ireland and advise the Minister on the development of policy for energy research. The Council meets regularly. It discusses issues of relevance to energy research, such as the need for capacity building and Ireland's participation in EU funded energy research programmes.

The Energy Research Council was mandated by Government in the Energy Policy White Paper to publish a comprehensive Energy Research Strategy 2008-2013. This development took place in the context of a range of sectoral and policy factors. The Council commenced work on this task in 2007, supported by an external consultant. The Council's Strategy was published in May 2008. A public consultation process is currently being undertaken to inform the development of an overall energy research strategy framework.

Key Action: Establish an all-island inventory of energy research and researchers (2006 and annually thereafter)

Sustainable Energy Ireland (SEI) has published an inventory for 2006. This is the fourth consecutive Energy Research, Development and Demonstration (RD&D) Inventory. The report outlines the level of energy RD&D activity in the Republic of Ireland, highlighting the energy related products, systems, practices and services currently in development and their influence in forming sustainable energy policies for the future. The data gathered for 2006 shows that a total of €28.3 million was spent on energy R&D on 321 projects which represents a substantial increase in activity compared to the previous year.

Key Action: Target significant levels of participation in FP7 and other international research programmes (2007-2013)

The Hydraulics and Maritime Research Centre (HMRC) in University College Cork has been a centre of excellence for research into ocean energy systems for over two decades. It houses the only laboratory facilities for small scale physical model testing in Ireland, as well as having a capability for computer modelling. The ocean wave basin, which is 25metres long and 18metres wide, is one of the unique facilities in a university laboratory in Europe. It is capable of simulating model sea conditions with a variety of characteristics representative of open ocean wave behaviour.

In December 2006, Dr. Tony Lewis (Director HMRC) was awarded one of the Charles Parsons Energy Research Awards by the Department of Communications, Energy and Natural Resources. This award was in the field of ocean energy and provides for 4 additional Postdoctoral Researchers for a duration of 7 years, together with Ph.D. studentships. The value of the award is €3.5 million over 7 years.

One tangible result of this additional funding and increased human capital has been the recent award of an FP7 contract from the European Commission. This is the first time that HMRC has been a coordinator of a project in the Framework Programmes. The project, CORES (Components for Ocean Renewable Energy Systems), aims to provide research into components for wave energy devices to support ongoing development. There are 13 partners from a total of 6 European countries - HMRC Coordinator, Queen's University Belfast, Inst. Superior Tecnico, Lisbon (Portugal), University of Exeter (UK), University of Aalborg (Denmark), ISET, University Kassel (Germany), Robotiker Technalia (Spain), MCS International Ltd. (Ireland), University of Bologna (Italy), Kymaner Technologies (Portugal), Ocean Energy Ltd (Ireland), University of Limerick, Wave Energy Centre (Portugal). The project will run from 2008 to 2011 with a total cost of €4.49 million and an EU contribution of €3.45 million.

The aims of this project are to research and test the components for a floating wave energy device. These components will include moorings, electrical power systems, air turbine systems and data monitoring. The Ocean Energy Buoy Hull will be used at the Galway Bay test site in 2010 to test these components at sea to verify the laboratory results. The outcome from this research will provide enhanced knowledge of specific components which can support the successful development of floating wave energy converters. These results will be generalised to all floating wave energy converters even though the specifics of the tests will be related to air chamber type devices.

The funding for ocean energy R&D announced by Minister Ryan on 15 January, 2008 has provided support for the facilities at HMRC to be upgraded and modernised. In fact it has been designated as a National Facility and will be a key component of the Maritime Campus in Ringaskiddy. This is an excellent example of how funding from the SSTI can have a catalytic effect and significantly stimulate the development of a national facility which has as its mission the support of the emerging Irish Ocean Energy Industry sector.

Key Action: Develop all-Island initiatives and optimise collaborative proposals under FP7 as a practical means of furthering collaboration (2006-2013)

The Charles Parsons Energy Scheme has an all-island dimension, inviting applications for funding from the 32 counties. Following a competition in which applicants were evaluated by an international peer review, seven projects were recommended for funding in 2007, two of which were from Higher Education institutions in Northern Ireland. The funding of €20 million under this scheme will provide support for 208 students and researchers over 7 years.

Key Action: Develop a range of cross-sectoral research initiatives including climate change, enterprise, agriculture and transport (commencing 2006)

The development of cross–sectoral research initiatives, including in areas such as climate change, enterprise, agriculture and transport, will be addressed under the Energy Research Strategy.

Key Action: Progressively enhance the active engagement of Irish energy industries with R & D programmes (2006-2013)

Enterprise Ireland has reviewed opportunities across the value chain for the Irish energy sector, as required by the Energy Policy White Paper. It supports appropriate investment opportunities in energy enterprises and research that have the potential to deliver new innovative products and services, informed by its review in 2007 of the international market for greener technologies products and services.

The issue of further initiatives on the active engagement of Irish energy industries with R & D Programmes will be addressed in the context of the Energy Research Strategy.

7 All-Island and International STI

The SSTI acknowledges the benefits that transnational collaboration in the research area has brought to the Irish research effort since the mid 1990s. Collaboration has driven frontier research and helped avoid unnecessary duplication of effort, while affording access to international state of the art facilities for Irish researchers. The Strategy outlines the positive outcomes that have resulted from engagement in the international research arena under the EU Framework Programmes, the European Space Agency, involvement with Intergovernmental Research Organisations (IGROS) and, more recently, enhanced research engagement with the US, India and China. The SSTI calls for continued engagement with the EU institutions and appropriate international organisations to ensure the optimum return for our research sector. The EU Framework Programme, in particular, will remain a central focus of our attention.

Collaboration on an all-island basis is a central tenet of the Strategy ensuring that all potential synergies are harvested to the benefit of the population of the whole of the Island. The Strategy acknowledges the policy level engagement and interaction that has been underway for many years, highlighting the collaboration that was clearly evident in the establishment of the Ireland/US R&D partnership.

Progress to Date

In the light of the challenges outlined above, the following outlines progress made in implementing the Key Actions in Chapter 7 of the Strategy.

Key Action: Strengthen and complement the national research infrastructure through linking the research system to centres of excellence internationally and foster partnerships through involvement in international research teams

International linkages are fostered primarily through the promotion of Irish participation in EU Framework Programmes for Research and Technological Development and through our membership of the European Space Agency (ESA) and Eureka . *(8)*

(8) EUREKA is a close-to-market R&D programme involving 37 European countries. Its principal objective is to strengthen the productivity and worldwide competitiveness of European countries

Irish research teams, with support from funding agencies, are involved in the development of a number of new research infrastructures being developed at European level. During 2007, the European Commission provided funding to seven groups in Ireland for the preparatory actions associated with these infrastructures. The infrastructures in which Irish teams are involved include clinical trials and biobank facilities, ocean exploration infrastructures, social science databases and infrastructures associated with research in the humanities.

A study tour of Competence Centres in Sweden and Austria was undertaken by officials from the Department of Enterprise, Trade and Employment and related agencies in June 2007. In addition, Ireland is chairing an EU CREST *(9)* Working Group for mutual learning on Industry Led Competence Centres under the fourth cycle of Open Method of Coordination (OMC).

In the area of high performance computing, recent investments in Ireland, including the IBM Blue Gene supercomputer acquired in 2007, have been designed in such a way that Irish facilities will connect to other global facilities giving benefits to the research community in Ireland and ensuring the maximum synergy from national investments.

All infrastructure funding projects announced in 2007 under PRTLI 4 must take into account connections with facilities and networks internationally to avoid unnecessary duplication of facilities and to ensure that centres in Ireland can be integrated with centres of excellence overseas.

An audit of Ireland's international S&T agreements and partnerships was undertaken in 2007 and identified a wide range of activities covering all fields of science. More than 150 programmes and partnerships were identified ranging from general programmes such as the EU Framework Programme, other large-scale activities such as Ireland's membership of the European Space Agency and European Molecular Biology Laboratory through to smaller scale activity in specific fields of science . These international activities and partnerships are contributing to many of the SSTI targets identified throughout this document (e.g. increasing the output of skilled researchers, strengthening the research capacity of the enterprise sector etc.).

Preliminary statistics on success rates for the first year of the Seventh EU Framework Programme for Research and Technological Development (FP7) 2007-2013 show that Irish researchers account for €57 million out of a total of €5.1 billion associated with successful proposals within the first 54 calls for proposals. Irish researchers are associated with 222 proposals retained for funding. The Irish success rate - 222 out of 950 proposals submitted with Irish involvement, which is equivalent to 23.4% - is ahead of the overall average for all countries (21.2%) and this is a positive indication of the prospects for Irish participation in FP7 generally. Successful organisations span Ireland's multinational corporations, indigenous industries and academia (including the institutes of technology).

Key Action: Increase the access of the enterprise base to international leading edge technology networks and collaborations with leading companies and research centres in relevant sectors worldwide

(9) Scientific and Technical Research Committee. This is an advisory body whose function is to assist the European Commission and the Council of the European Union in performing the tasks incumbent on these institutions in the sphere of research and technological development

In the Information and Communication Technologies (ICT), Health and Nanosciences, Nanotechnologies, Materials and new Production Technologies (NMP) thematic areas of FP7, enterprise participation accounts for greater than 30% of the funding with SMEs accounting for a large proportion of this activity. This suggests that enterprises in Ireland are already responding to the positive measures such as increased financial contribution for SMEs put in place by the European Commission. This pattern is maintained within the SME-specific part of the programme where Ireland's SMEs Ireland received 2.75% of the total SME programme budget.

New opportunities for enterprise participation in European research networks emerged at the beginning of 2008 with the launch of new public-private research partnerships (Joint Technology Initiatives) in nanoelectronics, embedded systems, innovative medicines and aeronautics. A new fund to support SME-led projects built on the "Eureka" model, Eurostars, has also been put in place in recent months. Irish enterprise participation in these new schemes will be reported in the years ahead.

Key Action: Achieve scientific excellence, improved competitiveness and innovation through cooperation between researchers and industry and maximise Irish participation in EU Research Framework Programmes, including on an all-island collaborative basis. Implement a new National Support Structure for the Framework Programme

In November 2006, a new National Support Network for FP7 was put in place. A National Director for FP7, who leads a team based in Enterprise Ireland, heads the network. This new support structure aims to ensure that Ireland achieves the maximum benefit from the opportunities in the programme and that a coordinated and coherent approach towards FP7 is adopted across all of the government departments, agencies and other organisations involved. Through this support structure, a mix of guidance, advice and financial assistance is available to encourage researchers and enterprises, where appropriate, to avail of the opportunities within the programme.

During 2007 the National Support Network established a set of indicators by which Irish participation in FP7 would be monitored and proposed a new, more detailed set of targets that should be set for Irish participation in the programme up to the end of 2013. Based on the work undertaken in 2007, the Cabinet Committee on Science, Technology and Innovation approved a proposal to increase the total share of Community funding to be targeted by Ireland over the lifetime of FP7 from €400 million to €600 million. This revised target is considered realistic, yet sufficiently challenging, and takes into account the potential for Irish participation in different parts of the programme.

Key Action: OSTI, assisted by Forfás, will continue monitoring and evaluating Irish engagement with international programmes. Key indicators of success will be the numbers of international collaborative engagements by Irish firms and institutions and the share of Irish research and development (public and private) supported by international sources. Data on promotion and collaboration of international programmes will be reported upon in agency annual reports.

Promotional and client handholding activities have been in keeping with this target with 700 attendees at seven general FP7 training events and more than 2,200 attendees at 43 theme-specific information events in the past 12 months. The provision of a central web-based infrastructure to the National Support Network for FP7 member organisations gives a single shared resource for all Network activities for the first time.

Day to day promotion activity continues to include multiple client-specific meetings facilitated by the National Contact Points and the Northern Ireland (NI) Coordinator for FP7 to encourage and facilitate All-Island involvement in project proposals. The Advisory Science Council (ASC) has commenced a study in order to help elaborate a strategy for Ireland's international engagement in science, technology and innovation. The outcome of this study, which is expected to be completed later this year, will help to guide decision making on the international research organisations in which Ireland should seek closer involvement.

Key Action: Links will be developed between the IDC and ASC and their Northern counterparts, to ensure synergies and avoidance of duplication

Links have been established and are being developed with the NI Inter Departmental Working Group on Innovation (chaired by DETI) and with MATRIX (NI Science Industry Panel). The ASC and MATRIX Chairs held an exploratory meeting in Belfast in September 2007. The purpose of the meeting was for the Chairs of MATRIX and ASC to meet on an informal exploratory basis and discuss possible areas of future work between the ASC and MATRIX.

Key Action: Sectoral N/S cooperation in R&D will be supported and its further development will be encouraged

The intention to set up a North / South Innovation Fund was announced in March 2007 consequent to the agreement on restoration of institutions and devolved government in NI. The contribution to the Innovation Fund from the Republic Of Ireland side has been set at €60million over the lifetime of the fund, to be sourced from within the overall envelope of NDP committed investment in R& D. On the Northern Ireland side there is a global provision of £90million, comprehending innovation both within Northern Ireland and on a collaborative all-Ireland basis. The fund will run for 3 years.

Officials from both sides met on 4 March 2008 for a useful exchange of views on potential collaborative projects and on cooperative mechanisms. Following from these discussions, the All Island Innovation Vouchers Scheme, which is administered in Ireland by Enterprise Ireland and in Northern Ireland by Invest NI, was launched on 27 May, 2008. Further meetings are planned to develop other collaborative projects.

Science Foundation Ireland (SFI) has invited applications from existing SFI award holders for supplementary funding for collaborative projects with scientists in Higher Education Institutions in Northern Ireland. SFI is also to carry out a future CSET Call on an all island basis.

Collaborative approaches are also being developed institutionally, through FP7 and through the Ireland / USA R & D Partnership. An inventory of All-Island Cooperation on R&D is being drawn up as an aid to identify potential areas of enhanced cooperation.

Key Action: The full potential of US Ireland R&D Partnership will be realised

Progress continues to be made in working towards the realisation of the full potential of the US/ Ireland R&D Partnership. The Guidance documents for participation in research and development partnerships have been completed and the Memorandum of Understanding between the US National Science Foundation and the Irish agencies has been signed. The equivalent document with the National Institutes of Health (US) has also been signed. At the most recent meeting of the Partnership's Steering Group in May 2008, there was agreement that the immediate challenge was to stimulate a number of high-quality applications in the priority work areas of Diabetes, Cystic Fibr-

osis Nanotechnology and Sensors. The secretariat indicated that they would consult with funding providers regarding any proposed extension of priority programme areas, and that any such extension would be underpinned by portfolio analysis as to what is already happening. An agreed programme calendar would be drawn up encompassing workshops, calls, etc. and that work would be progressed at t the next meeting which is scheduled to take place in October 2008.

Key Action: In promoting FP7, National Contact Points will make cross-border collaboration with NI a priority

National Contact Points for FP7, together with the National Director, are working actively with counterparts in Northern Ireland to promote the FP7 Programme on an all-island basis. All of the FP7 promotional events are open to researchers and enterprises from Northern Ireland and National Contact Points have been invited to participate in events run in Northern Ireland. The coordinator for FP7 in Northern Ireland attends meetings of the Irish FP7 network with maximum information sharing taking place. One of the FP7 indicators that will be monitored as more detailed results on FP7 become available is the number of European collaborative projects with joint North-South participation and the funding associated with such projects.

Appendix 1: Acronyms

AFBI: Agri-Food Biosciences Institute. Northern Ireland body which carries out scientific research and development in the agriculture sector.

ASC: Advisory Science Council. The government's high-level advisory body on Science, Technology and Innovation policy issues.

BERD: Business enterprise expenditure on research and development

CGPP: Cleaner Greener Production Programme. EPA programme which encourages Irish organisations to implement greener practices.

CIT: Cork Institute of Technology.

COFORD: National Council for Forest Research and Development. Department of Agriculture agency responsible for the development of national forest research and development policy and priorities.

CREST: Centre for Research in Engineering Surface Technology. Enterprise Ireland backed research centre based in DIT.

CRF: Clinical Research Facilities.

CSET: Centre for Science, Engineering and Technology. SFI run programmes which link scientists and engineers across academia and industry to address crucial research questions.

CSO: Central Statistics Office. Government body responsible for compiling Irish official statistics.

DAFF: Department of Agriculture, Fisheries and Food

DCENR: Department of Communications, Energy and Natural Resources.

DCU: Dublin City University

DIT: Dublin Institute of Technology

DOHC: Department of Health and Children.

DSE: Discover Science and Engineering. Ireland's national science promotion programme.

EI: Enterprise Ireland. Government agency responsible for the development and promotion of the indigenous business sector.

EPA: Environmental Protection Agency.

ERA-Nets: European Research Area Networks. Networks of national research funding programmes on specific subjects.

ERC: Education Research Centre. Centre based in St Patrick's College, Dublin that aims to widen the scope of research efforts in Ireland.

ERDF: European Regional Development Fund. EU fund targeted at less developed European regions

ERTDI: Environmental Research, Technology, Development and Innovation Programme. Predecessor to STRIVE.

ESA: European Space Agency.

ETAP: Environmental Technologies Action Plan. EU Programme to promote eco-innovation.

FDI: Foreign Direct Investment

FIRM: Food Institutional Research Measure. Department of Agriculture programme which supports innovation and product development in the Irish food industry.

FP7: Seventh Framework Programme for Research and Technological Development. European Union's main instrument for funding research in Europe.

FSAI: Food Safety Authority of Ireland. Department of Health Agency with responsibility for food safety.

FSPB: Food Safety Promotion Board. Department of Health Agency.

FTE: Full Time Equivalents

GBAORD: Government budget appropriations or outlays for research and development

GERD: Gross domestic expenditure on research and development

GMES: Global Monitoring for Environment and Security.

GOVERD: Government sector performed research and development

HABMAP: Habitat Mapping for the conservation and management of the southern Irish Sea. Research project part funded by the EU.

HE: Higher Education

HEA: Higher Education Authority. The statutory planning and development body for higher education and research in Ireland.

HEI: Higher Education Institute

HERD: Higher education expenditure on research and development

HERMES: Hotspot Ecosystem Research on the Margins of European Seas. FP7 funded research project.

HMRC: Hydraulics and Maritime Research Centre. Research centre based in UCC.

HRB: Health Research Board. Government agency which supports and funds health research.

HSE: Health Service Executive.

ICT: Information Communication Technology.

IODP: Integrated Ocean Drilling Project. International marine research program that explores the Earth's history and structure as recorded in seafloor sediments and rocks

IDA: Industrial Development Agency. Agency responsible for the attraction and development of foreign investment in Ireland

INSS: Irish National Seabed Survey. Research project managed by geological survey of Ireland and the Marine Institute.

IP: Intellectual Property

IRCHSS: Irish Research Council for Humanities and Social Sciences. Research funding and monitoring body established to promote research in the humanities and social sciences field.

IRCSET: Irish Research Council for Science, Engineering and Technology. Research funding and monitoring body established to promote science and engineering research in Ireland.

MATRIX: Northern Ireland Science Industry Panel. Counterpart to Advisory Science Council.

MESH: Mapping European Seabed Habitats. Research programme participated in by several European countries.

MI: Marine Institute. Government agency responsible for Marine Research, Technology Development and Innovation.

MKWH: Making Knowledge Work for Health: a Strategy for Health Research. The R&D pillar of the Health Research Strategy, Department of Health and Children, 2001

NCCA: National Council for Curriculum and Assessment. Organisation responsible for school curriculum reform in Ireland.

NDP 2000-2006: National Development Plan which involved an investment of €57 billion of Public, Private and EU funds in numerous projects and initiatives throughout the country.

NUIG: National University of Ireland Galway.

NUIM: National University of Ireland Maynooth.

OECD: Organisation for Economic Cooperation and Development

PCSP: Primary Curriculum Support Programme. Department of Education Programme which mediates the Primary School Curriculum for teachers towards enabling them to implement it in their schools.

PI: Principal Investigator

PIP: Petroleum Infrastructure Programme. DCENR programme to promote hydrocarbon exploration and development activities.

PICA: Principal Investigator Career Advancement Award

PISA: Programme for International Student Assessment. Three yearly international study of student achievement.

PIYRA: President of Ireland Young Researcher Awards.

PRO: Public Research Organisations

PRTLI: Programme for Research in Third Level Institutions which provides integrated financial support for institutional strategies, programmes and infrastructure and ensures that institutions have the capacity and incentives to formulate and implement research strategies.

QUB: Queen's University Belfast.

RCSI: Royal College of Surgeons Ireland.

RFES: Research Facilities Enhancement Scheme. HEA scheme which will enable higher education institutions to undertake the necessary refurbishment, conversion and/or upgrade of their facilities, to enable the undertaking of high-quality research.

RSF: Research Stimulus Fund. Department of Agriculture programme which supports research into aspects of sustainable agricultural production.

RTDI: Research and Technological Development and Innovation.

SEI: Sustainable Energy Ireland. Ireland's national energy agency.

SET: Science, Engineering and Technology

SFI: Science Foundation Ireland. Government Agency with responsibility for investment in academic researchers and research teams who are most likely to generate new knowledge, leading edge technologies and competitive enterprises.

SLSS: Second Level Support Service. Department of Education programme dedicated to supporting the development of teachers in second level schools.

SME: Small and Medium Enterprises. Enterprises with fewer than 250 employees and with an annual turnover not exceeding €50 million or an annual balance sheet not exceeding €43 million.

SSTI: Strategy for Science, Technology and Innovation

STARS: Secondary Teacher Assistant Researchers. Science Foundation Ireland collaborative programme endeavours to disseminate new skills and knowledge to teachers which can be passed on to their students.

STEPS: Science, Technology and Engineering Programme for Schools. Programme established to promote SET in schools.

STRIVE: Science, Technology, Research and Innovation for the Environment Programme. EPA Programme which supports R&D in the Environment sector.

S&T: Science and Technology

TCD: Trinity College Dublin

TPN: Teacher Professional Networks. Department of Education funded teacher organisations which afford professional peer support to members.

TTO: Technology Transfer Office. Offices based in HEIs which technically and commercially evaluate all forms of IP generated by researchers and staff and then advise on the most appropriate means of protection and commercialisation.

UCC: University College Cork.

UCD: University College Dublin

UL: University of Limerick

UUJ: University of Ulster Jordanstown.

WIT: Waterford Institute of Technology.