Forfás

State Expenditure on Science & Technology and Research & Development

2005 and 2006

THE NATIONAL POLICY AND ADVISORY BOARD FOR ENTERPRISE, TRADE, SCIENCE, TECHNOLOGY AND INNOVATION

State Expenditure on Science & Technology and Research & Development

2005 and 2006

Promoting Enterprise, Trade and Science, Technology & Innovation for Economic and Social Development.

Science & Technology Budget

REVIEW OF STATE EXPENDITURE ON SCIENCE AND TECHNOLOGY
AND RESEARCH AND DEVELOPMENT 2005 AND 2006

Incorporating financial expenditures in 2005 and allocations for 2006 by Government to institutions engaged in any activity related to science and technology.

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Abbreviated list of Acronyms*

AAGR	Average Annual Growth Rate
BERD	Business expenditure on R&D
CSF	Community Support Framework
FTE	Full Time Equivalent
GBAORD	Government Budget Appropriations and Outlays on R&D
GERD	Gross Expenditure on R&D
GOVERD	Government Expenditure on Intramural R&D
HERD	Higher Education Expenditure on R&D
OST	Office of Science and Technology - Department of Enterprise, Trade and Employment
R&D	Research and Development
RSE	Researcher
S&T	Science and Technology
SSH	Social Sciences and Humanities

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* Full list of Acronyms in Appendix 3

Executive Summary

The following are the main findings of the 2006 science budget:

- The Government Budget Allocation to R&D rose to an estimated €829 million in 2006. This represented an 18.1% increase in real terms compared to the previous year.
- In international terms Ireland ranks second out of 36 countries for growth in Government funding of R&D (GBAORD) over the last decade.
- GOVERD as a percentage of GNP fell to 0.09% in 2006 from 0.12% in 2002. Ireland is positioned at the lower end of 31 countries benchmarked.

The total science budget for 2006 totalled an estimated €2.3 billion which is an increase of 10% over the 2005 outturn. Expenditure on S&T activities has increased almost threefold between 1996 and 2006 from €830million to €2.3 billion. The greatest share of the science budget is spent on education and training. In 2006 this amounted to €1.1 billion, making up 46% of the total State S&T spend.

The next largest category of S&T spending is for Research and Development (R&D). This accounts for an estimated €784 million in 2006. The R&D share of total S&T expenditure has increased from 24% in 2001 to 35% in 2006. In real terms stripping out inflationary effects, R&D spending has increased by 65% from €475 million in 2001 to €784 million in 2006. Expenditure on technology transfer has increased from €6 million to €105 million in the same period.

Civil GBAORD[1] amounted to €829 million in 2006. Internationally, Ireland ranks highly with an average annual growth rate (AAGR) of 14% for civil GBAORD over the last decade, increasing to 18% in the period from 2002 to 2006. The positive outputs of increased GBAORD have already been captured in the Survey of R&D performed in the Higher Education Sector 2004. HERD increased by 52% (€170 million) over the 2002 figure.

In relative terms, GBAORD as a percentage of GNP has increased from 0.36% in 1996 to 0.55% in 2006. This compares with an OECD average of 0.50% in 1996 and 0.56% in 2006. The differential has narrowed considerably bringing Ireland in line with the OECD average.

Total GOVERD [2] for 2006 is an estimated €139 million. Almost two thirds of GOVERD is performed by Teagasc and the Marine Institute. Agricultural and natural sciences research accounts for almost 80% of research performed in the Government sector, most of which is applied research.

GOVERD as a percentage of GNP fell to 0.09% in 2006 from 0.12% in 2002. Ireland is positioned last out of 31 countries benchmarked. This is due to a reduction of 1% in expenditure on R&D performed in the Government sector coupled with a 20% increase in GNP in 2006 over 2004.

Finally the Science Budget analysed Human Resource data across State performed S&T activities. Researchers (FTEs [3]) accounted for 38% of total R&D personnel in 2006. Almost two-thirds of Government sector researchers are PhD holders. Two-thirds of male and over half of female researchers have doctoral qualifications. Female researchers account for 36% of total researchers in the government sector. Ireland ranks 17th out of 30 countries in this area.

1 GBAORD is the international metric used to compare public funding of R&D. Civil GBAORD eliminates the defence R&D component thereby improving data comparability with Ireland which has no budget for defence R&D

2 Expenditure on in-house R&D in the Government Sector

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Preface

Increased investment in science and technology, and in particular research and development, is a vital part of Ireland's plan to become a more knowledge-driven economy. Increased and continuing investments in these key areas will be crucial to maintaining future economic stability, improving Ireland's competitiveness position on the international stage through higher productivity, and sustaining high levels of future employment.

Increased public and private investment in R&D in recent years has placed Ireland in a strong position to become a more knowledge-driven economy which delivers high value added activities. One of the key driver's of this improving performance has been a significant rise in State investment and spending for S&T and R&D activities performed in the higher education, business and state sectors of the economy.

In this context, measurement and analysis of relevant indicators of Science and Technology allow policymakers to assess the progress being made on developing a strong knowledge economy.

This publication details the actual and allocated spending by the Government on S&T activities in 2005 and 2006 respectively as well as providing analysis of performance over the last decade. The report has a strong R&D focus particularly in relation to Government funding of R&D across all sectors, and also to performance of R&D in Government departments and agencies. This enables benchmarking of the objectives set out in the Lisbon agenda, which aims to increase the European Union's R&D and innovation performance in order to compete with strong knowledge economies like the US and Japan.

The Strategy for Science, Technology and Innovation[4] was launched in 2006 by the Department of Enterprise, Trade and Employment to facilitate the continuing transition to a strong knowledge intensive economy. It is a targeted seven year plan to promote and increase S&T activities in Ireland and will lay a strong foundation from which future economic growth can develop. It was developed to implement the goals of the Lisbon agenda and the National Action Plan and commits to spending €2.7 billion of exchequer funds to 2008 on S&T activities with a particular focus on R&D. It also aims to build up Ireland's research base by

- Increasing the numbers of students taking science subjects from primary school to PhD level
- Providing supports for businesses to perform research, from inception to commercialisation of ideas
- Fostering a collaboration culture in Ireland across sectors and within sectors i.e.
  - industry/academic linkages
  - through clusters and networks.

We would like to thank the 41 Government agencies and departments that participated in this survey. Further methodological information on the survey is contained in Appendices 1 and 2.

4 Strategy for Science, Technology and Innovation 2006-2013 Department of Enterprise, Trade and Employment http://www.entemp.ie/publications/science/2006/sciencestrategy.pdf

Introduction

Forfás annually publishes the 'Science and Technology Budget' report which provides a comprehensive account of State expenditure on S&T and other performance indicators gathered from the survey. The Science Budget is a mandatory survey which is compiled from returns from 41 Government agencies and Departments that fund or undertake science and technology (S&T) activities.

It details expenditure on research and development (R&D); education and training; technical services; technology transfer and other S&T activities. Details are given of the allocations made by Government to all S&T activities undertaken by the public and private sectors. Some 41 government departments and agencies were involved in allocating the total S&T budget in 2006.

The science budget data is comparable with R&D surveys of the Government sector in other OECD and EU countries and is harmonised using OECD definitions. The survey is conducted in strict adherence to the OECD Frascati manual guidelines and in accordance with Eurostat directives. Further classifications of R&D such as gender, field of science, type of R&D and GBAORD[5] have been added to this year's report.

There have been some changes to the questionnaire and report this year reflecting a greater focus on the R&D component of the S&T budget. Three of the four chapters are dedicated to R&D, one each to funding, expenditure and personnel. A copy of the questionnaire is contained in the Appendix 2 and the accompanying CD contains details of individual Government agencies' and departments' S&T programmes.

5 Government Budget Appropriations and Outturns on R&D

1 Science and Technology Budget

This chapter provides details of the total S&T budget allocations for 2006 and the final outturn for 2005. The trend in S&T expenditure over the last decade and the component S&T activities are also examined here in more detail.

1.1 Total Science Budget

The 2006 Science Budget records the total spending on S&T in 2005 and the funds allocated for 2006. The total Science and Technology budget for 2006 is €2.3 billion and covers the following five activities:

1 Research and development;

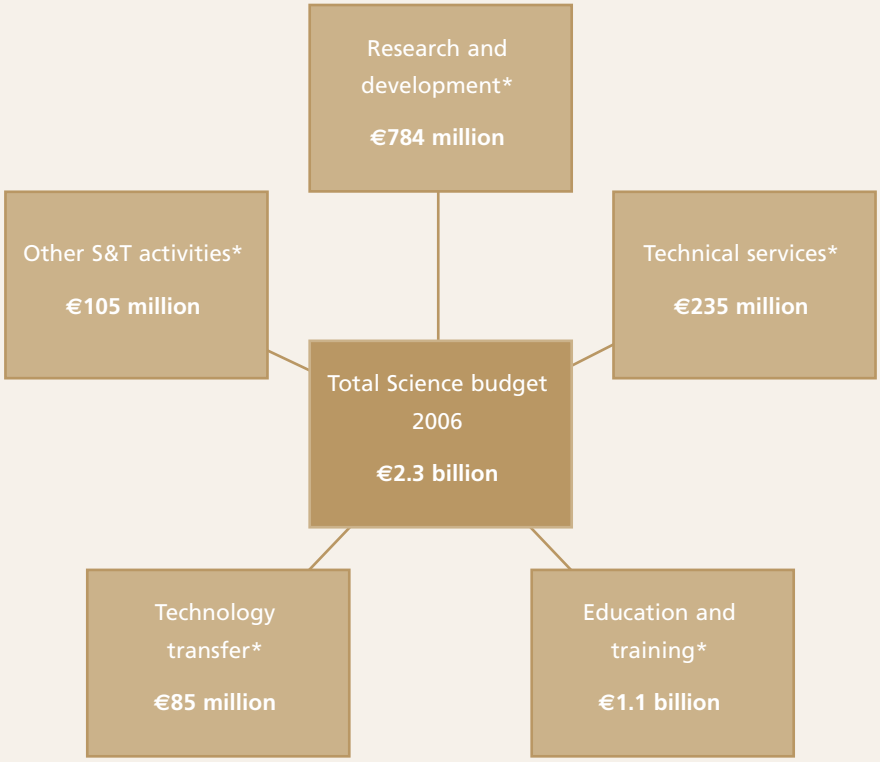
2 Technical services;

3 Education and training;

4 Technology transfer; and

5 Other S&T activities.

Figure 1: *Total Science Budget 2006*

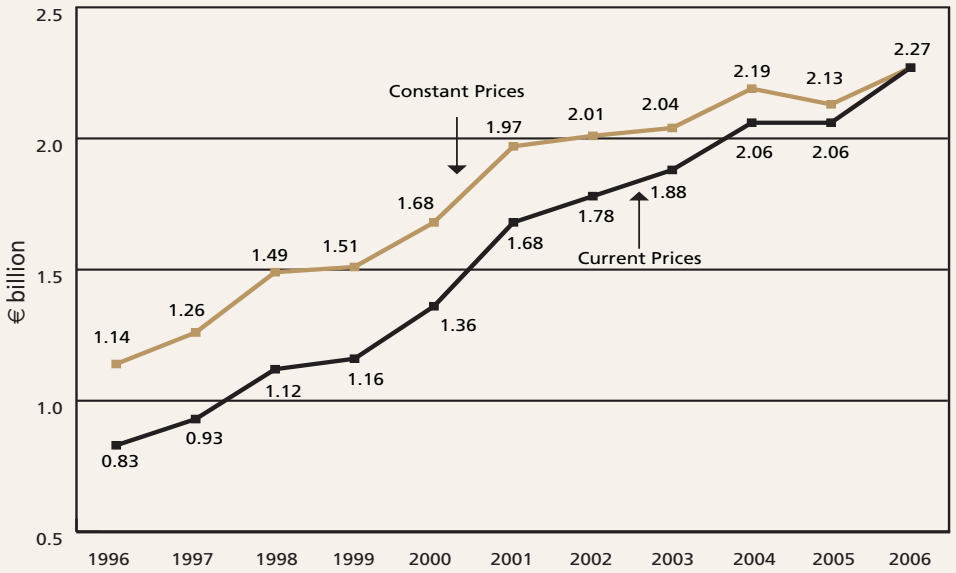


** Definitions in Appendix 3*

1.2 Trends in S&T expenditure

Figure 2 shows the increase in spending on science and technology in the State sector in the last decade. The two trend lines show spending in current and constant [6] terms.

Figure 2: *Total science and technology expenditure in the State sector, 1996 -2006 (current and constant prices)*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

The graph shows that expenditure on S&T activities has increased almost threefold between 1996 and 2006 in current prices. The annual average growth rate between 1996 and 2001 in S&T spending was 15%, which slowed between 2002 and 2006 to 6%. The total S&T budget remained static for a number of reasons between 2004 and 2005.[7]

It is anticipated however that the total S&T budget will increase by 10% in 2006 in current prices to total €2.27bn. In real terms this represents a 6.6% increase compared to the previous year. Of this total, the greatest share is spent on education and training. In 2006 this amounted to €1.06 billion, making up 46% of the total State S&T spend. Spending on education and training for S&T activities increased by 11.9% between 2005 and 2006.

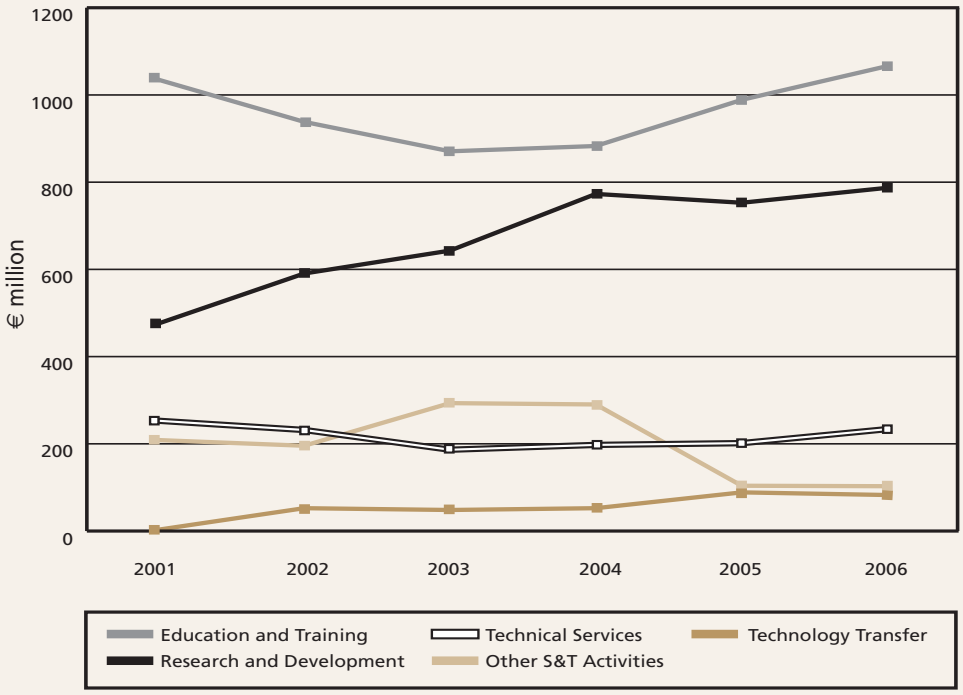
The next largest category of S&T spending is in the Research and Development category (R&D). This accounted for an estimated €784 million in 2006, an increase of 8.4% from the previous year. Spending on technical services rose by 19.9% between 2005 and 2006, totalling €235mn in 2006.

6 Data is converted to 2006 prices using the consumer price index which incorporates the effects of inflation

7 S&T spending was static as a result of downward effects from:

1. A reduction of €71 million in 2005 over the 2004 figure due to a change in the methodology for calculating the S&T portion of the block grant for the HEA;
2. A drop of €47 million in capital expenditure for the OPW due to the completion of the Dept of Agriculture Laboratory;
3. A fall of €22 million for the Dept of Communications over 2004 - mainly capital expenditure for upgrading the broadband network; and
4. Reductions in expenditure of €8 million and €4 million for Media Lab Europe and the NSAI respectively.

Figure 3: *S&T spending by activity since 2001 in constant prices*

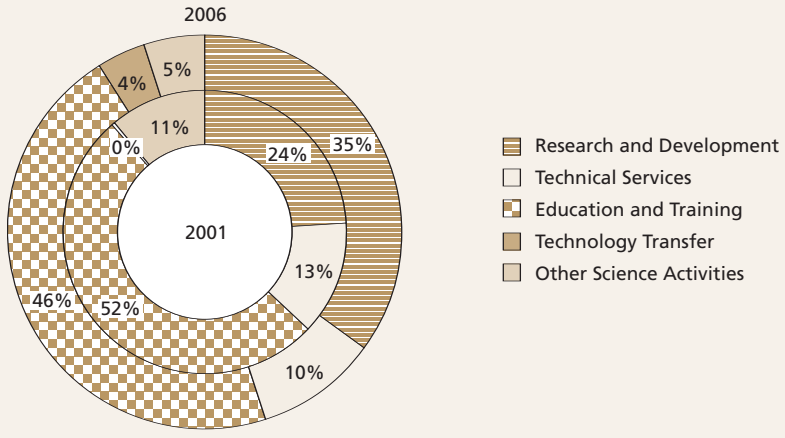


Source: Forfás Survey of State Expenditure on S&T activities, 2006

Since 2001 R&D expenditure increased in real terms by €308 million indicating an annual growth rate of 11% over the period. Expenditure on technology transfer has increased from €6 million to €105 million and spending on other S&T activities has halved in real terms from €210 million in 2001 to €105 million in 2006.

The R&D share of total S&T expenditure has increased from 24% in 2001 to 35% in 2006. In real terms stripping out inflationary effects, R&D spending has increased by 65% from €475 million in 2001 to €784 million in 2006. Expenditure on technology transfer has increased from €6 million to €105 million in the same period.

Figure 4: *Distribution of S&T expenditure by activity*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

Figure 4 shows the R&D share of total S&T expenditure has increased from a quarter in 2001 to more than a third in 2006. This highlights the importance placed on R&D in Ireland over the 5 year period. Total R&D expenditure in 2006 is expected to reach €784 million. The HEA will fund €253 million and SFI will fund €132 million.

Technology transfer makes up 4% (€85 million) of the total budget which is up 4 percentage points since 200l. Teagasc and Enterprise Ireland account for €45 million and €33 million respectively.

Table 1: *Total expenditure on science and technology 2001, 2005 outturn and 2006 allocation, current prices (€million)*

	2001 Outturn	2005 Outturn	2006 Allocation
Current funds	1,431	1,848	2,084
Capital funds	246	208	185
Total	1,677	2,056	2,270

Source: Forfás Survey of State Expenditure on S&T activities, 2006

The majority of spending in the Science Budget takes place under the category current spending. Table 1 shows that current expenditure accounted for €2.08 billion of the total science budget in 2006, alongside the €185 million in capital expenditure.

The 2006 Science Budget totalled €2.3 billion, an increase of 35% over the 2001 figure driven mainly by large increases in funding for R&D from SFI, the Department of Education and Science, the HEA and the research councils (IRCSET and IRCHSS). It is anticipated that 2006 will yield an increase of €213 million over the 2005 outturn.

The major increases in S&T programmes in 2006 over 2005 are:

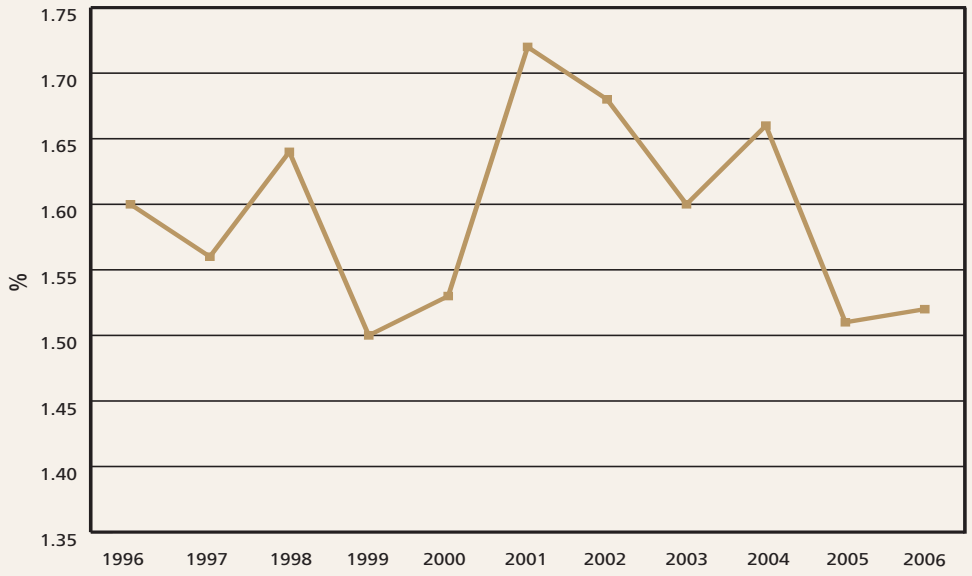
1. €111 million - Dept of Education and Science comprised of the following programmes:
   - €43 million - Institutes of Technology
   - €40 million - Science and Technological Education (Investment) Fund
   - €12 million - Third level research and development activities
   - €7 million - Third level grants
2. €39 million - CSO mainly attributable to the 2006 census
3. €17 million - HRB research award schemes
4. €14 million - Department of Communications Marine and Natural Resources for the continued upgrading of Ireland's broadband network
5. €11 million - Dept. of Social and Family Affairs for technical services
6. €10 million - SFI to support research excellence in biotech and ICT

1.3 S&T intensity trend

It is also important to calculate the S&T spending performance in relative terms to changing levels of economic activity. Gross National Product (GNP) is the more meaningful metric used for economic activity comparison purposes in Ireland as Gross Domestic Product (GDP) is distorted[8] by profit repatriations from large multinational firms. Figure 5 shows total S&T spend as a percentage of GNP (S&T intensity) over the last decade.

8 The difference between GDP and GNP is now estimated to be 19% in Ireland

Figure 5: *Total S&T expenditure as a percentage of GNP, 1996 – 2006*

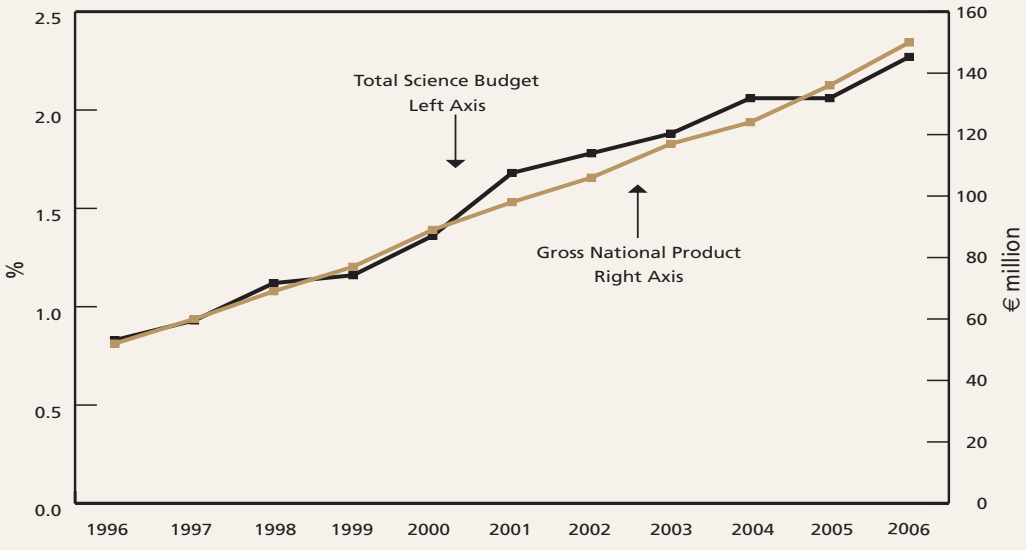


Source: Forfás Survey of State Expenditure on S&T activities, 2006

Despite an almost trebling of expenditure on science and technology activities over the last decade, the S&T intensity ratio has fallen slightly from 1.6% of GNP in 1996 to 1.52% of GNP in 2006. The variability in S&T intensity is partially due to large increases in GNP over the last decade.

There has been strong growth in GNP over the last decade with an annual growth rate of over 11%. The annual growth rate of total S&T spend has remained constant at almost 11% as shown in Figure 6.

Figure 6: *S&T budget and GNP in constant prices, 1996 – 2006*

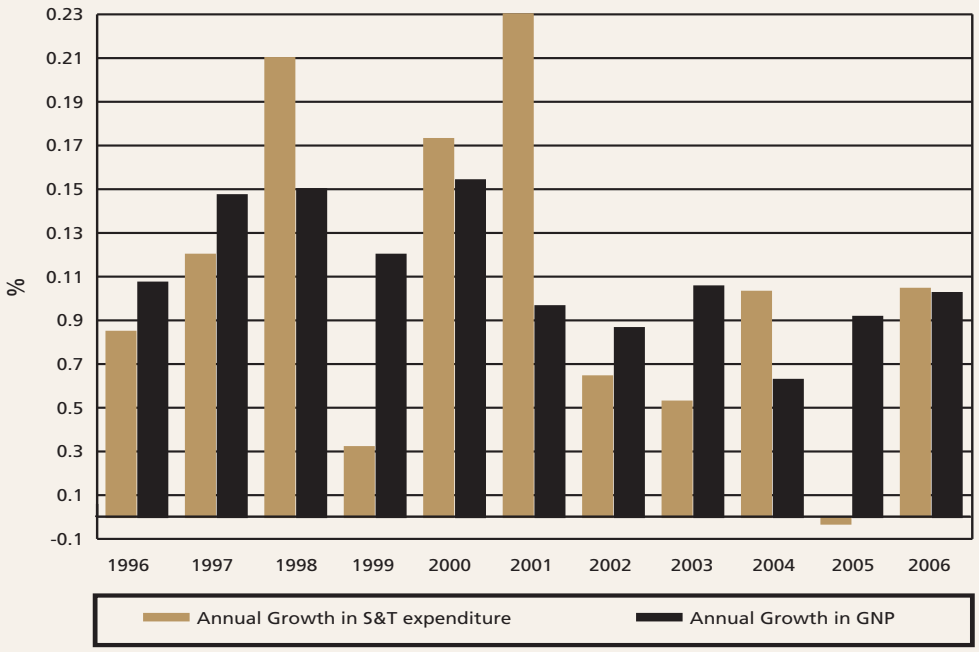


Source: Forfás Survey of State Expenditure on S&T activities, 2006

As a result there has been no improvement in the S&T intensity ratio in the past decade. The minimum S&T intensity ratio was 1.5% in 1999 and the maximum was 1.72% in 2001.

Figure 7 shows the annual percentage differences in GNP and S&T spend since 1996. In 2001, S&T spend increased by 22 % on an annual basis, far outpacing the recorded 10% growth in gross national product. This yielded the highest S&T intensity of the decade at 1.72%. However in 2005 the S&T intensity dropped to 1.52 % as a result of S&T spending remaining flat whilst economic growth accelerated to 9.3%.This intensity level remained static in 2006 as S&T spending growth quickened once more to 10.4%, marginally ahead of anticipated GNP growth of 10%.

Figure 7: *Annual percentage differences in S&T expenditure and GNP growth, 1996 -2006*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

2 Funding of Research and Development

2.1 Introduction

This chapter focuses further on the most important part of the total Science Budget spend – Research and Development. Research and development is a key driver of economic growth. Strong investment in R&D by the State will facilitate Ireland's transition to a knowledge economy and build a foundation for future economic stability. This will enable Ireland to compete effectively with established and emerging knowledge economies.

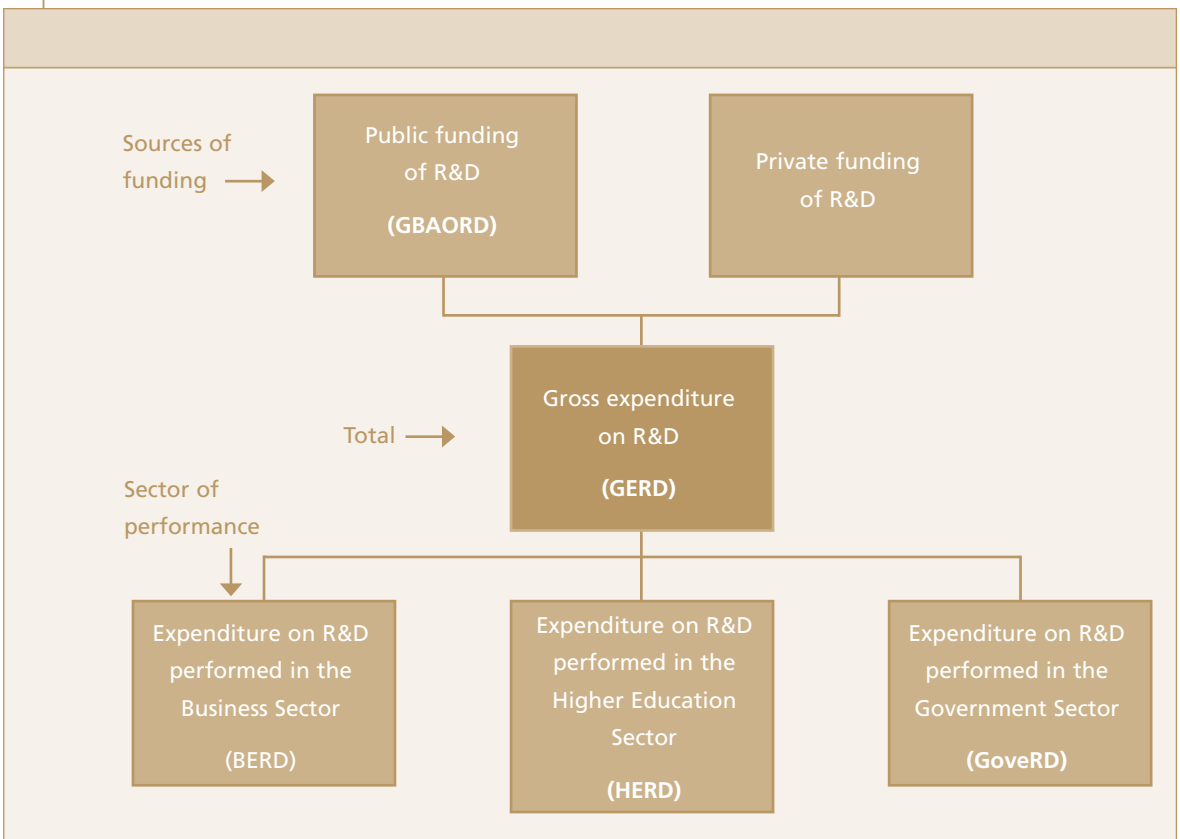
Research and development, as defined by the OECD "*comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.*" (Frascati Manual, OECD, 2002).

The importance placed on R&D by the Government is measured by taking Government funding as a proportion of economic activity. This is an internationally comparable metric and Ireland ranks second out of 36 countries.

The Science Budget has a particular focus on research and development and yields the following two R&D indicators.

1. GBAORD – Government Budget Appropriations or Outlays on R&D
2. GOVERD – Measure of R&D performed in the Government sector (chapter 3)

Figure 8: *R&D funding and performance system*



GOVERD (chapter 3) is the total expenditure on R&D **performed** on site in government agencies and departments for example, Teagasc and the Marine Institute. It does not include R&D contracted out to a third party.

GBAORD is the measure of Government **funding** of R&D in all sectors, and includes for example:

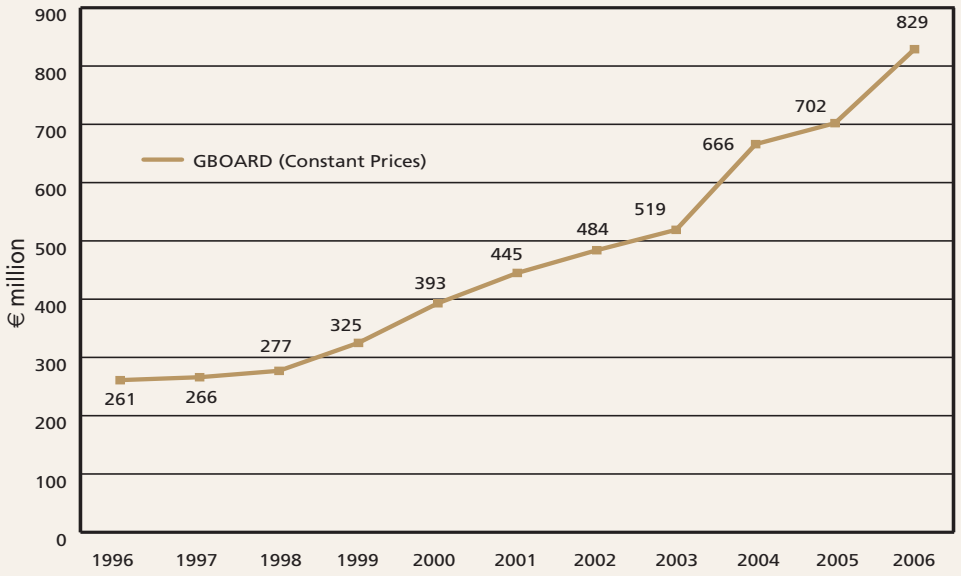
- IDA and EI funding for business sector R&D
- Funding for the higher education sector administered by the Department of Education and the HEA
- Funding for Government sector performed R&D for example, Teagasc

2.2 Public funding of R&D and GBAORD

The main focus for the science budget is public financing of research and development which comprises exchequer and EU funds. The internationally recognised indicator for benchmarking State funding performance of R&D is GBAORD (Government Budget Appropriations or Outlays on R&D).

The GBAORD indicator includes all publicly funded R&D including social sciences and humanities. (The science budget does not request data on social sciences and humanities, the HEA provide this component and it is added to the Public R&D estimate calculated from the Science Budget).

Figure 9: *GBAORD trend in constant prices, 1996-2006 (constant prices)*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

Figure 9 shows that GBAORD has increased substantially in Ireland over the last decade, a positive indication of the value placed on R&D by the Government. Total GBAORD amounted to an estimated €829 million in 2006 and the public allocation of funds for R&D is €771 million. This represents an 18.1% increase in real terms compared to the previous year, and a 22.6% year-on-year rise in current prices. Internationally, Ireland ranks highly with an average annual growth rate (AAGR) of 14% for civil (non-defense) GBAORD over the last decade, increasing to 18% in the period from 2002 to 2006. The positive outputs of increased GBAORD have already been captured in the Survey of R&D performed in the Higher Education Sector 2004. HERD increased by 52% (€170 million) over the 2002 figure.

Table 2 provides a breakdown of public R&D funding by main Government departments/key agencies. [9]

Table 2: *Government departments and agencies funding R&D activities, 2006*

Funding Department/Organisation	Public R&D (€m)
Education and Science	366
Enterprise, Trade and Employment	206
Agriculture and Food	61
Communications, Marine and Natural Resources	54
Health & Children	41
Social & Family Affairs	17
Environment	13
Finance	6
Community Rural and Gaeltacht Affairs	3
Office of Public Works	2
Central Bank	1
Taoiseach	1
Arts, Sport and Tourism	0.4
Transport	0.1
Total	**771**

Source: Forfás Survey of State Expenditure on S&T activities, 2006

The State currently invests in a wide range of R&D programmes including:

- €132 million – Science Foundation Ireland for a range of programmes promoting research excellence in the biotechnology and information communication technology (ICT) sectors;
- €81 million - the Dept of Education and Science for third level R&D activities;
- €58 million - the Higher Education Authority for the Programme for Research in Third Level Institutes (PRTLI);
- €37 million - the Health Research Board for research award schemes;
- €44 million - Enterprise Ireland to support indigenous companies undertaking R&D activities;
- €21 million - IDA Ireland to encourage foreign–owned companies to perform R&D in Ireland;
- €18 million – The Irish Research Council for Science, Engineering and Technology to fund R&D in Science, Engineering and Technology in third level institutes; and
- €8 million – The Irish Research Council for Humanities and Social Sciences to fund R&D in the Humanities and Social Sciences in third level institutes.

9 Table 1, Appendix 1

2.3 GBAORD classified by area of spending in the economy

The total GBAORD for 2006 - €829mn can be classified into 11 types of economic areas as shown in Table 3. More than half of Irish GBAORD in 2006 (€466 million) is earmarked for performance in the Higher Education sector. This includes funding from direct sources of funding such as Science Foundation Ireland, Higher Education Authority PRTLI schemes and also from Enterprise Ireland and other sources of research funding to the higher education sector. The GBAORD total aimed at the Higher Education sector also includes an estimate of indirect funding from the HEA block grant. The amount calculated is the academic portion of the block grant spent on teaching salaries of S&T researchers. This is calculated using a time use ratio and unit cost methodology.

Table 3: *GBAORD classifications for Ireland, 2006*

Civil GBAORD classifications	Spend (€million)
Exploration and exploitation of the earth	48
Infrastructure and general planning of land-use	1
Control and care of the environment	8
Protection and improvement of human health	41
Production, distribution and rational utilization of energy	0
Agricultural production and technology	76
Industrial production and technology	72
Social structures and relationships	29
Exploration and exploitation of space	0
Research financed from general university funds (GUF)	466
Other civil research	0
Non-oriented research (unclassified)	89
Total expenditure	**829**

Source: Forfás Survey of State Expenditure on S&T activities, 2006

The positive outputs of increased GBAORD have already been captured in the survey of R&D performed in the higher education sector 2004. Expenditure on R&D in the higher education sector (HERD) increased by 52% (€170 million) in 2004 over the 2002 figure. Funding for R&D in this sector can come from private sources, alongside direct and indirect funding from the Government.

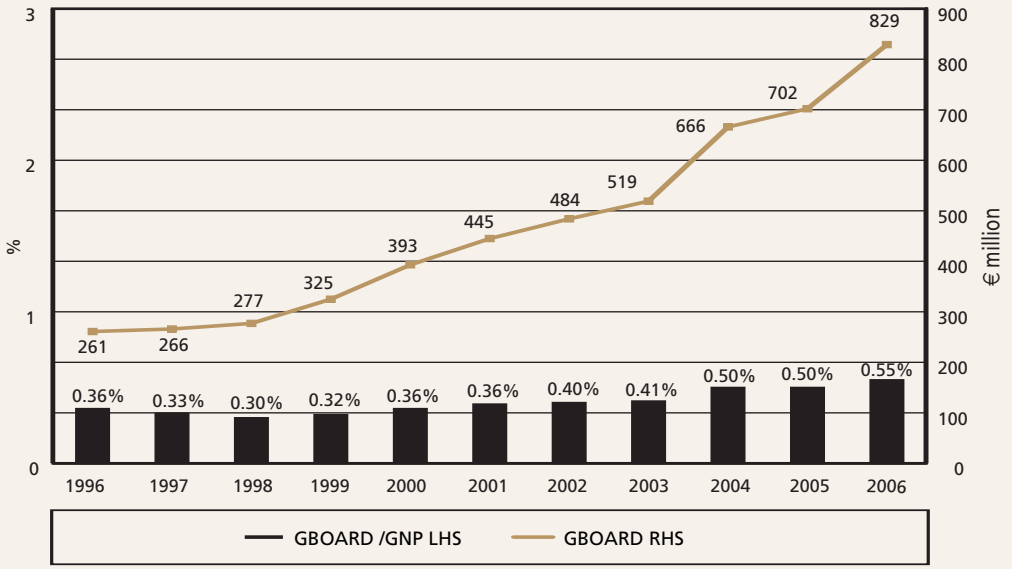
The next largest area of economic performance of State funding for Research and Development across all sectors of performance is the €76mn directed toward the agricultural production and technology area. This is closely followed by the €72mn invested in the industrial production and technology area.

A residual €89mn of funding is unallocated to any economic category.

2.4 GBAORD as a percentage of GNP and international comparisons

The relative importance placed on R&D by the Government can be measured by GBAORD as a percentage of economic activity (Gross National Product). Figure 10 shows strong growth in GBAORD signifying the firm commitment by Government to increase the levels of R&D in Ireland.

Figure 10: *GBAORD and GBAORD as a percentage of GNP, 1996 -2006*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

GBAORD as a percentage of GNP has increased from 0.36% in 1996 to 0.55% in 2006. Comparing this with an OECD average of 0.50% in 1996 and 0.56% in 2006 the differential has narrowed considerably bringing Ireland in line with the OECD average (Table 4).

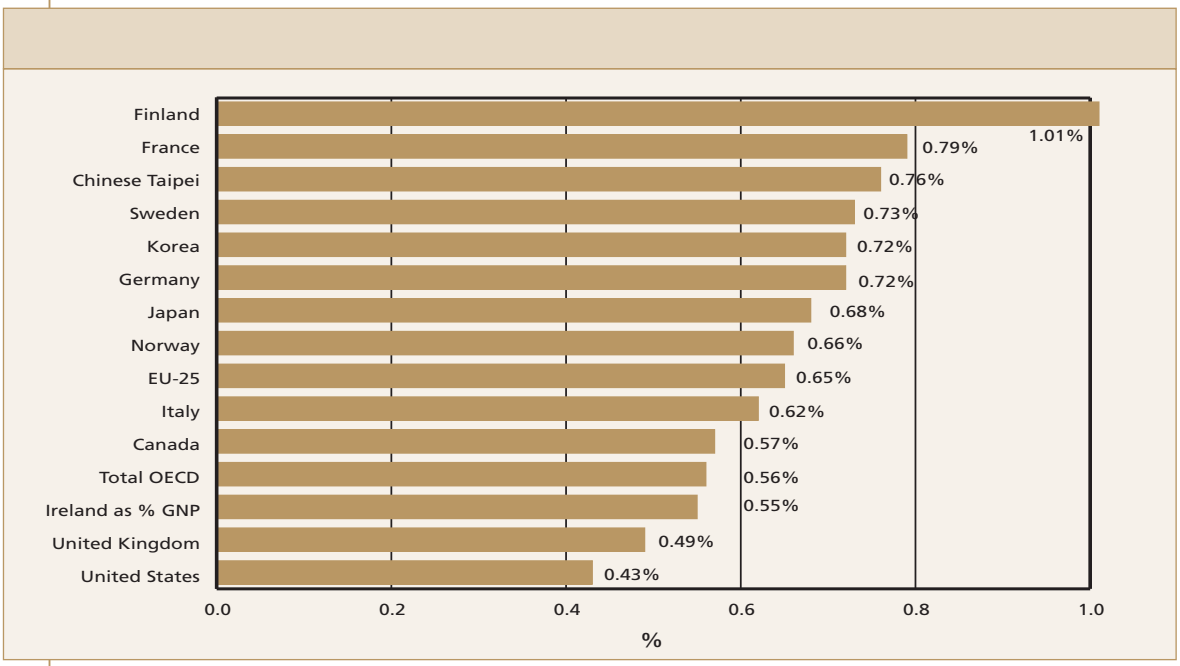
Table 4: *International comparisons of civil GBAORD (% GDP, 1996 and 2006)*

	Civil GBAORD/GDP	
Country	**1996**	**2006**
Finland	0.93%	1.01%
France	0.75%	0.79%
Chinese Taipei	not available	0.76%
Sweden	0.85%	0.73%
Korea	not available	0.72%
Germany	0.79%	0.72%
Japan	0.52%	0.68%
Norway	0.73%	0.66%
EU-25	0.64%	0.65%
Italy	0.55%	0.62%
Canada	0.51%	0.57%
OECD	0.50%	0.56%
Ireland as % GNP	0.36%	0.55%
United Kingdom	0.47%	0.49%
United States	0.40%	0.43%

Source: OECD, Main Science and Technology Indicators, June 2006 and Forfás Survey of State Expenditure on S&T activities, 2006

Ireland has no R&D defence budget - unlike the US and UK where the R&D defence budgets comprise 57% and 31% respectively of their total GBAORD. Civil GBAORD is the metric used for international comparisons with Ireland as it eliminates the defence portion.

Figure 11: *International comparisons of civil GBAORD as a percentage of GDP*

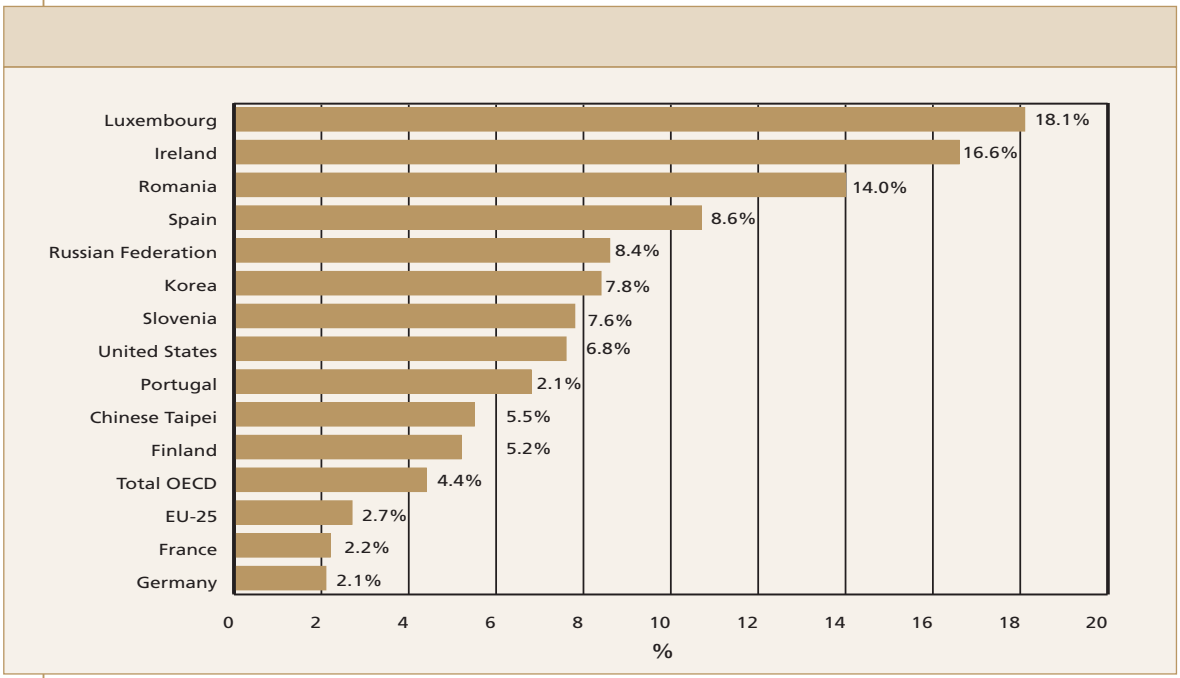


Source: OECD, Main Science and Technology Indicators, June 2006 and Forfás Survey of State Expenditure on S&T activities, 2006

2.5 Annual growth rates of civil GBAORD and international comparisons

Ireland, at 17%, ranks second out of 36 countries for the highest average annual growth rate (AAGR) of civil GBAORD from 2001 to 2006 % as illustrated in Figure 12 below.

Figure 12: *Average annual growth rate of civil GBAORD for selected countries (2001-2006)*



Source: OECD, Main Science and Technology Indicators, June 2006 and Forfás Survey of State Expenditure on S&T activities, 2006

Ireland ranks well ahead of the OECD, EU and US growth rates of 5%, 3% and 8 % respectively. (See Appendix Table 3 for more details).

3 Performance of R&D in the Public Sector

This chapter deals with performance of R&D in the Government sector (GoveRD). Most funding for State performed R&D comes from the government, although a small amount does come from private and other sources. It should be noted that GoveRD does not include the R&D performance in the higher education sector, which is calculated in the HERD performance survey.

3.1 Total expenditure on R&D performed in the Government sector

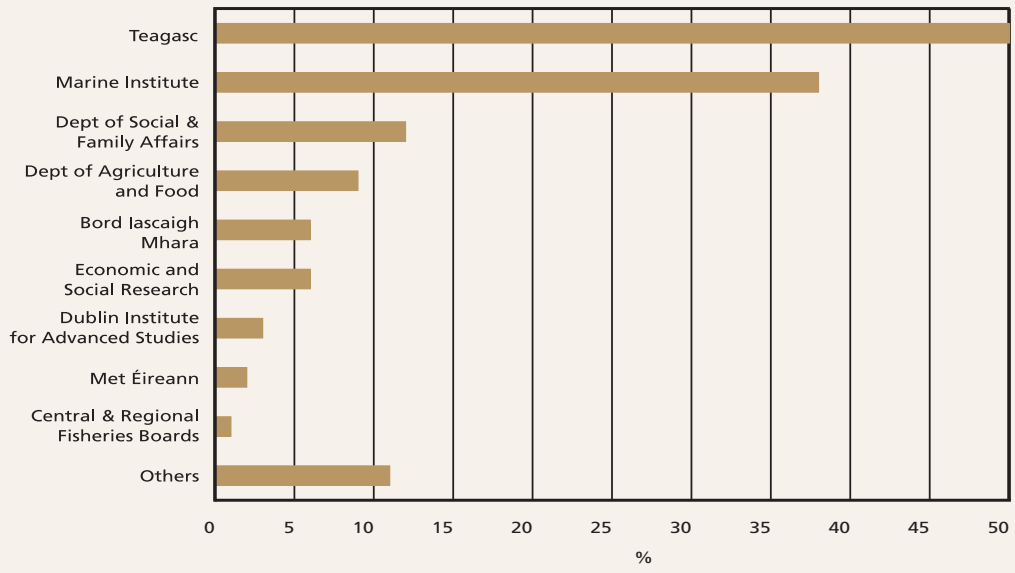
Total expenditure allocations for research performed in the government sector (GOVERD) amounts to €139 million in 2006. This represented a 9.4% increase in current prices compared to the previous year, and reversed the 8% drop in GoveRD between 2004 and 2005. In real terms R&D performed in the state sector increased by 5.3% in real terms between 2005 and 2006.

In relative terms GoveRD comes in at 0.09% of Gross National Product, somewhat below the EU and OECD averages. This reflects the smaller contribution of government spending proportionate to the overall economy compared to other economic models e.g Scandinavia. The recently released Strategy for Science, Technology and Innovation has also set ambitious spending targets for State sector performed research over the coming years.

Almost two-thirds of this is performed by Teagasc and the Marine Institute (Figure 13). Teagasc and the Marine Institute approximate spending of €50 million and €38 million on R&D in 2006. Additional and more detailed information on R&D and S&T spending programmes is contained in the attached CD-ROM appendix to this report.

Teagasc undertakes research relating to sustainable agriculture and rural development and food processing. The Marine Institute manage two research vessels, which form a crucial part of marine research for seabed, fisheries and environmental surveys and a wide range of research and monitoring tasks in the areas of marine environment and seafood safety.

Figure 13: *Major R&D performers in the State sector, 2006*

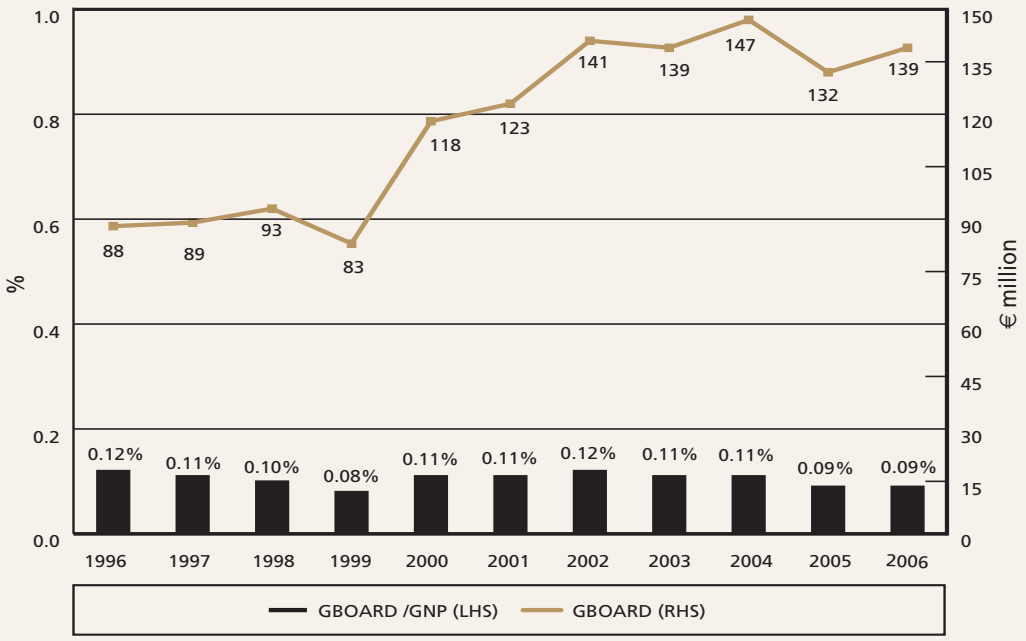


Source: Forfás Survey of State Expenditure on S&T activities, 2006

3.2 Performance of R&D in the Government sector as a % of GNP

Figure 14 shows the trend in GOVERD for Ireland in constant terms over the last decade. The trend increased steadily until 2004 (€147 million) and then fell to €132 million in 2005. This was due to a cessation of R&D programmes for Media Lab Europe, and lower R&D spending in 2005 over the 2004 outturn by the Office of Public Works, the ESRI, Sustainable Energy Ireland, the Department of Health and Children and COFORD.

Figure 14: *GOVERD as a percentage of GNP and GOVERD trend, 1996-2006*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

An increase of €12 million is anticipated for 2006 bringing it back on par with the 2003 level of €139 million for R&D performed in the Government sector.

This is due to increases in spending on R&D programmes of:

- €1.7 million - Bord Iascaigh Mhara for the Supporting Measures for Sea Fisheries Development programme
- €2.3 million and €1.6 million - Marine Institute for the Ocean Science Services programme and NDP support for R&D programmes respectively
- €7.3 million - The Dept. of Social and Family Affairs for various R&D programmes

A survey of R&D performed in Irish hospitals was also undertaken by Forfás for the first time in 2006. Data was available on funding of health research from GBAORD, but no data on expenditure for R&D performed in hospitals thereby creating a gap in the national R&D statistics. Preliminary results show that in excess of €22 million is spent on in-house R&D in hospitals in Ireland.

More significantly though there has been a drop in GOVERD as a percentage of GNP to 0.09% from 0.12% in 2002. Although GOVERD accounts for only 8% of total Gross Expenditure on Research and Development (GERD) the decrease has implications for the achievement of the National Action Plan GERD target of 2.5% by 2010.

A target of 0.8% of GNP by 2010 was set for the public sector (HERD and GOVERD) from a base of 0.4% in 2001. HERD as a percentage of GNP increased to 0.4% in 2004 from 0.27% in 2001 compensating for the fall in GOVERD over the period. HERD increases are expected to continue with substantial investments from SFI, the HEA and extra funding from the Science Strategy.

Table 5 provides an international comparison of GOVERD as a percentage of GNP for 1996 and 2006. Ireland ranked 31st out of 31 countries benchmarked for this indicator in 2001 and 2006. (See Appendix 3, Table 3 for more details).

Table 5: *GOVERD as a share of GDP*, 2001 and 2006 (or latest available data)*

	2001	2006
Chinese Taipei	0.51	0.60
France	0.36	0.36
Korea	0.32	0.34
Finland	0.35	0.33
Germany	0.34	0.33
United States	0.31	0.33
Japan	0.29	0.30
Total OECD	0.27	0.28
China	0.28	0.28
Norway	0.29	0.25
EU-25	0.24	0.24
Canada	0.22	0.19
United Kingdom	0.18	0.18
Italy	0.20	0.17
Spain	0.15	0.17
Belgium	0.13	0.14
Sweden	0.12	0.14
Ireland	0.11	0.10

** GNP for Ireland*
Source: Forfás Survey of State Expenditure on S&T activities, 2006

3.3 Types of Research

Research can be broken down into 3 categories – basic, applied and experimental. The OECD Frascati definitions are:

Basic Research: Experimental or theoretical work undertaken primarily to acquire new knowledge, without any particular application or use in view.

Applied Research: Original investigation undertaken in order to acquire new knowledge, primarily directed towards a specific practical aim or objective.

Experimental Development: Systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

Expenditure on intramural R&D is broken out into the different types of research in Table 6. Applied research accounts for 82% of research performed in the Government sector.

Table 6: *GOVERD by type of research, 2006*

Type of Research	2006	% of total
Basic	10	7%
Applied	114	82%
Experimental	16	11%
Total in-house research	**139**	**100%**

Source: Forfás Survey of State Expenditure on S&T activities, 2006

3.4 Field of Science

Table 7 breaks out the research expenditure further into field of science and type of research. Almost half of the research performed in the Government sector is in the field of agriculture (Teagasc and Dept. of Agriculture). One-third is classified as natural sciences encompassing research performed by the Marine Institute. Almost one-fifth is social and economic research carried out by ESRI and the The Dept. of Social and Family Affairs.

Table 7: *Field of science classified by type of research, 2006*

	2006 (€m)			
Fields of Science	**Basic**	**Applied**	**Experimental**	**Total**
Natural sciences	4	40	3	**47**
Engineering sciences	0	1	0	**1**
Agricultural sciences	3	54	8	**65**
Medical sciences	0	1	0	**1**
Social science and humanities	1	18	4	**23**
Total	**10**	**114**	**16**	**139**

Source: Forfás Survey of State Expenditure on S&T activities, 2006

4 Personnel engaged in R&D

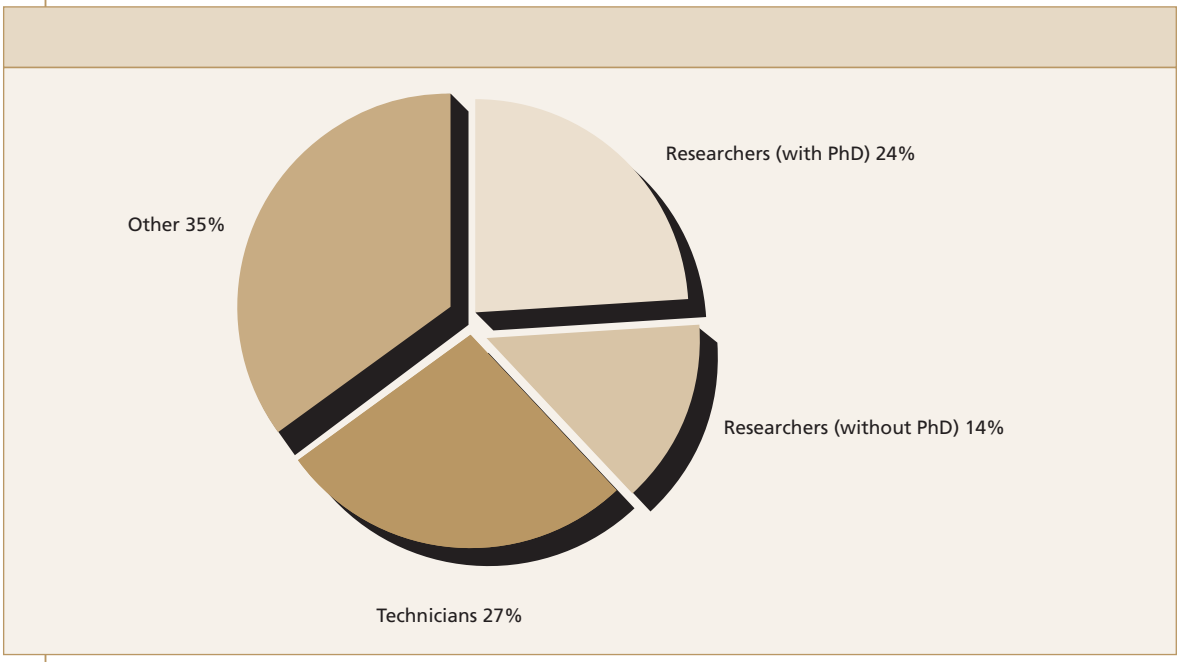
This chapter focuses on the human resources involved in R&D activities performed in the Government sector. Questionnaires were sent to 41 Government departments and organisations requesting details on gender, occupation, and PhD status for all R&D personnel. The total headcount was requested and an estimate of time spent purely on research or full–time equivalents (FTEs)[10].

4.1 Total research personnel in the Government sector

In 2006, 1262 R&D personnel are employed in the Government sector. In terms of full time equivalents 1147 people are employed. The occupations of R&D personnel are categorised as follows:

1. Researchers with PhDs
2. Researchers without PhDs
3. Technicians
4. Support Staff.

Figure 15: *Total R&D personnel by occupation in FTEs, 2006*

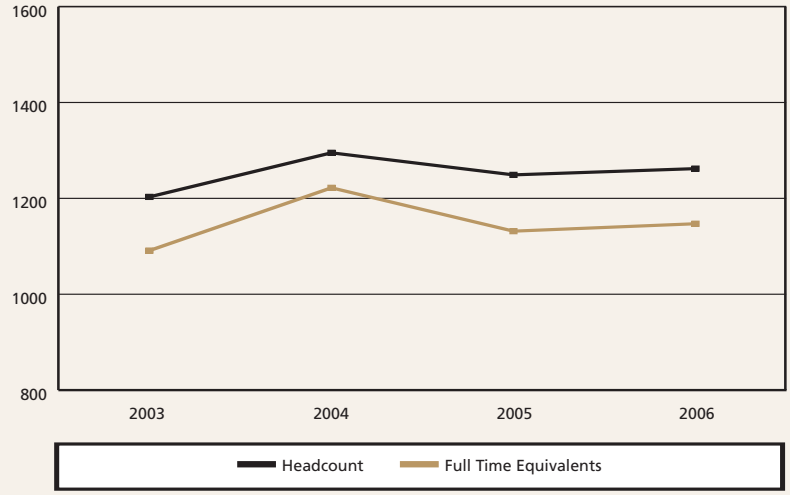


Source: Forfás Survey of State Expenditure on S&T activities, 2006

About two-thirds of total R&D personnel in the government sector are support staff and technicians. Researchers in full-time equivalents hold a 38% share of total R&D personnel in 2006 as shown in Figure 15. Almost two-thirds of Government sector researchers have a PhD.

10 To convert the data to FTE from HC, a time use co-efficient is applied. For example, if a person spends half their time on R&D activities and half of their time on other non-R&D activities, then they are counted as 0.5 FTE

Figure 16: *Total R&D personnel in terms of headcount and FTEs, 2003 – 2006*



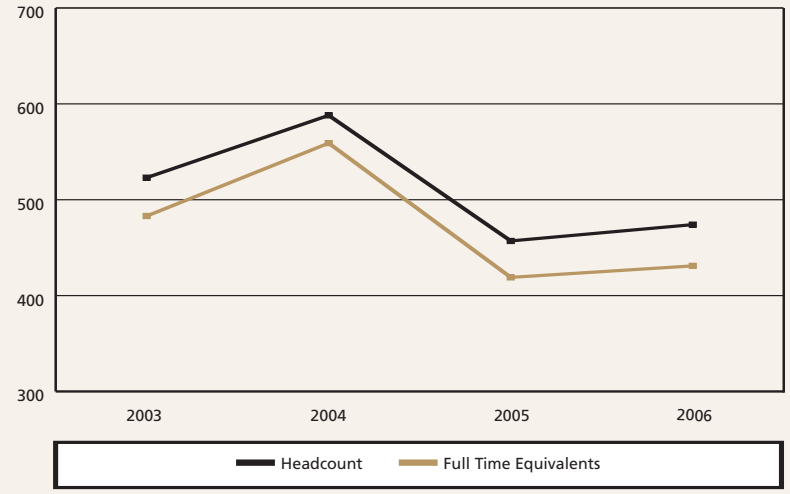
Sourc Forfás Survey of State Expenditure on S&T activities, 2006

Figure 16 illustrates the trend in R&D personnel employed over the last four years. In 2004 there were 1295 personnel employed in terms of headcount and this fell to 1249 in 2005. Media Lab Europe went into liquidation in January 2005 and had employed 76 researchers which accounts for the drop in terms of headcount and full-time equivalents in 2005. This correlates with a reduction in GOVERD over the last few years, as salaries would constitute a significant share of total R&D expenditure. The chart also shows that R&D personnel are spending more than 90% of their time on R&D related activities.

4.2 Researchers in the Government sector

Figure 17 shows the number of researchers employed in the Government sector declined from 588 in 2003 to 457 in 2005 due to the closure of Media Lab Europe, with an anticipated increase to 474 in 2006. Researchers employed in the government sector are consistently spending more than 90% of their time on research.

Figure 17: *Total Researchers, 2003 - 2006, HC and FTEs*

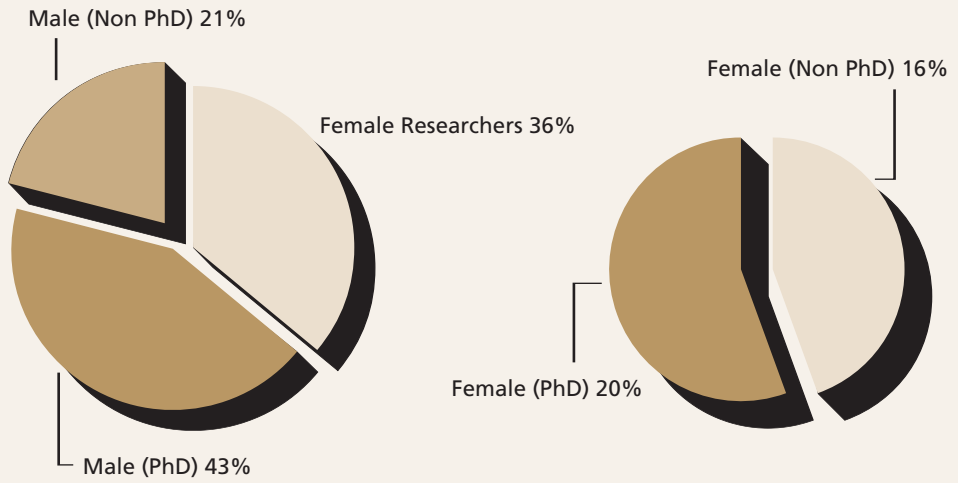


Source: Forfás Survey of State Expenditure on S&T activities, 2006

4.3 Researchers categorised by gender and field of science

An estimated 474 FTE researchers will be employed in the Government sector in 2006. The ratio of male to female researchers is 2:1. Figure 18 illustrates their gender and qualification make up.

Figure 18: *Researchers by gender and qualification, 2006*

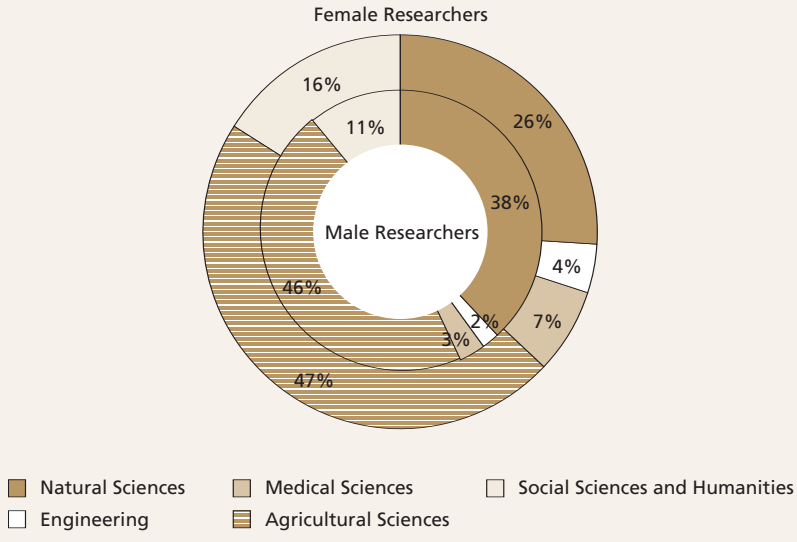


Source: Forfás Survey of State Expenditure on S&T activities, 2006

Female researchers make up 36% of total researchers in the government sector. Ireland is positioned 17th out of 30 countries for this indicator (see Appendix 3, Table 4 for more detail)

Almost two-thirds of Government sector researchers have a PhD. Two-thirds of male and over half of female researchers have a PhD.

Figure 19: *Researchers classified by gender and field of science (FTE), 2006*



Source: Forfás Survey of State Expenditure on S&T activities, 2006

Figure 19 shows the main areas of Government sector research with a gender breakdown, Table 8 provides more detail. Teagasc and the Marine Institute perform 80% of Government sector research, explaining the bias towards agricultural and natural sciences.

Almost half of male and female researchers perform agricultural research (Teagasc and the Department of Agriculture and Food). The next greatest share for both sexes is natural sciences (Marine Institute), followed by social sciences. A greater share of males than females perform research in the natural sciences; 38% compared with 26% respectively. 16% of female researchers undertake social and economic research compared with 11% of males.

Table 8: *Total researchers classified by gender and field of science*

Field of Science	Male	% of total	Female	% of total
Mathematics and computer sciences	1	0%	1	1%
Physical sciences	36	13%	12	8%
Earth and related environmental sciences	63	23%	27	17%
Biological sciences	5	2%	0	0%
Electrical engineering, electronics	4	1%	1	1%
Other engineering sciences	3	1%	5	3%
Agriculture, forestry, fisheries and allied sciences	127	46%	73	47%
Health sciences	8	3%	11	7%
Economics	26	10%	22	15%
Other social sciences	2	1%	2	1%
History	1	0%	0	0%
	276	**100%**	**154**	**100%**

Source: Forfás Survey of State Expenditure on S&T activities, 2006

Appendix 1

Methodology

Methodology

The information given in this document relates to 41 institutions in receipt of monies from the exchequer for the performance or support of scientific, technological and related activities in every field and is based on the information supplied by these institutions. In general, institutions and information relating to them are listed separately. In a few cases an institution is listed with its parent department or organisation but identified separately. Where practicable the programmes of the various institutions have been separated and categorised in accordance with international practice into relevant scientific and technological activities ie:

- Research and development (R&D)
- Technical services
- Training, education and information
- Technology transfer and
- Other S&T activities.

However, in many instances, especially in institutions with few staff, institutions operate several programmes jointly, sharing resources in an administratively appropriate unit. In these circumstances the programmes, as described here, do not represent truly independent programmes. Consequently, the data should be interpreted with caution if expansions or contractions are being considered.

Expenditure data for specific programmes refer to the 2005 outturn costs of programmes and to the expected costs in 2006. The outturn costs are mainly funded by matching grant-in-aid or voted monies. Where programmes are funded in other ways these monies are noted separately. In these instances the expenditure (cost) data shown includes both exchequer and other income contributions.

Expenditures are based on unaudited figures, except in a few cases where they are identical with a Vote by the Oireachtas. For convenience, general overheads, where shown, are distributed in proportion to programme expenditures. Programmes are attributed to the institution most directly involved, that is to those actually operating them, but not necessarily funding them. An example of the latter is the Department of Enterprise, Trade and Employment, which funds, but does not operate or manage any programmes. Only their own administrative costs are attributed to the funding institutions in such cases.

Numbers of staff involved on individual S&T programmes are shown only where a reasonable subdivision is possible. Where institutions are involved in funding a large number of external R&D (or similar) personnel, data on these external personnel are not given.

Apportionment problems arise in the third level sector, mainly from the monies distributed by the Higher Education Authority and the Department of Education and Science to the institutes of technology. In the case of the HEA, total funds are first apportioned between S&T faculties and non-S&T faculties in the colleges (expenditure on non-S&T faculties is not included in this document). The extent and cost of the R&D work undertaken in colleges and funded out of the HEA's general block grant, is determined indirectly from surveys of academic staff in colleges. These surveys are carried out by Forfás on a multi-annual basis and the corresponding cost data are, of necessity, based on historical estimates. The HEA funding of academic departments was isolated from administration and support services within colleges.

Government Departments and agencies included in the 2006 Science Budget

The Science Budget records expenditure on science and technology in the government sector. This includes

- government departments
- associated government agencies
- government offices

Table 1 below lists the 41 government departments, agencies and offices included in the 2005/2006 science budget.

Table 1: *Government departments/agencies funding S&T activities, 2006*

Departments/Offices	Associated Agencies
Dept. of Agriculture & Food	Teagasc
Dept of Arts, Sport and Tourism	
Dept of Transport	National Roads Authority
Dept. of Communications, Marine & Natural Resources	Bord Iascaigh Mhara Central & Regional Fisheries Boards COFORD Marine Institute Sustainable Energy Ireland
Dept. of Community, Rural & Gaeltacht Affairs	Údarás na Gaeltachta
Dept. of Education and Science	Dublin Institute for Advanced Studies HEA Irish Research Council for Humanities and Social Sciences Irish Research Council for Science, Engineering and Technology
Dept. of Enterprise, Trade & Employment	Enterprise Ireland FÁS Forfás IDA Ireland InterTrade Ireland National Microelectronics Application Centre Science Foundation Ireland Shannon Development
Dept. of Finance	Economic & Social Research Institute
Dept. of Health and Children	Food Safety Authority Health Research Board Postgraduate Medical & Dental Board
Dept. of Social and Family Affairs	
Dept. of the Environment, Heritage & Local Government	Environmental Protection Agency Met Éireann Radiological Protection Institute of Ireland
Dept. of the Taoiseach	National Economic & Social Council
OFFICES	Central Bank Central Statistics Office Office of Public Works Ordnance Survey Ireland State Laboratory

Source: Forfás Survey of State Expenditure on S&T activities, 2006

Appendix 2

Questionnaire

Questionnaire

STATE EXPENDITURE ON SCIENCE AND TECHNOLOGY INCLUDING RESEARCH AND DEVELOPMENT, 2005/2006

The Science and Technology and Research and Development Budget provide details of the allocations/outturns made by the Government to science and technology activities. The preparation of the Science Budget is a legal requirement under Section 9(1) of the 1993 Industrial Development Act which also requires, that, following consideration by the government, it be laid before the Houses of the Oireachtas.

This is a request for details of the resources allocated to science and technology and research and development in your organisation in 2006, together with details of the equivalent 2005 outturns.

Expenditure Allocated to Scientific & Technological Activities 2006

Agency Name:

Section1: Science & Technology - Total Expenditure (incl. government and non-government funding) (€'000)								
	Total Research & Development (Insert details in Section 2 below)	Total Technical Services (€'000)	Total Training, Education & Information (€'000)	Total Technology Transfer (€'000)	Total of Other S&T Activities (€'000)	Total Current Expenditure (€'000)	Total Capital Expenditure (€'000)	Gross S&T Expenditure (current+ capital) (€'000)
	Current Capital Expend Expend	Current Capital Expend Expend	Current Capital Expend Expend	Current Capital Expend Expend	Current Capital Expend Expend			
Total S&T Programmes (€'000)						0	0	0

Section 2: Research and Development - Detailed Expenditure (€'000)

Government funded expenditure on R&D ONLY				Sources of non-government funded expenditure on R&D ONLY					Region in which R&D programme was performed
R&D programmes - performed in-house:	Current expenditure (€'000)	Capital expenditure (€'000)	Total (€'000)	Irish Industry (€'000)	Foreign Industry (€'000)	Private individuals (€'000)	EU Public Funding (€'000)	Total (€'000)	Code
			0					0	
	0	0	0	0	0	0	0	0	
R&D programmes - performed elsewhere (state organisation)	Current expenditure (€'000)	Capital expenditure (€'000)	Total (€'000)	Irish Industry (€'000)	Foreign Industry (€'000)	Private individuals (€'000)	EU Public Funding (€'000)	Total (€'000)	
			0					0	
	0	0	0	0	0	0	0	0	

Expenditure Allocated to Scientific & Technological Activities 2006

Agency Name:

Section 3: Type of Research & Development activity undertaken in-house

Please indicate the percentage breakdown of total in-house R&D expenditure in terms of the following categories as defined below

Basic Research	%
Applied Research	%
Experimental Development	%
	100%

Section 4: Science and Technology funding RECEIVED from other government departments or other agencies

Please note that this section is only applicable if S&T funding has been received from other government departments or other agencies.

Details of funding received from other government departments or other agencies

Programme Name	Name of government department or agency funding was received from	Amount of funding (€'000)

Expenditure Allocated to Scientific & Technological Activities 2006

Agency Name:

Section 5: In-house Personnel devoted to Research & Development within your organisation (Headcount and Full Time Equivalents *)

Please note that this section refers only to Personnel involved in R&D within your organisation. Any other personnel need not be recorded here.

	Research Scientists & Engineers				Technicians		Other Staff		Total	
	With PhD		Without PhD							
R&D personnel only (Headcount) by programme	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
									0	0
									0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

	Research Scientists & Engineers				Technicians		Other Staff		Total	
	With PhD		Without PhD							
R&D personnel only (Full Time Equivalents) by programme	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
									0	0
									0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

***Full Time Equivalents (FTE):** One FTE may be thought of as one person-year. Thus, a person who normally spends 60% of his or her time on R&D and the rest on other activities should be considered as 0.6 FTE. Similarly if a full-time R&D worker was employed at an R&D unit for only six months this would result in a FTE of 0.5.

Appendix 3

Detailed Tables/Acronyms/Definitions

Detailed Tables

Table 2: *Average annual growth rates in civil GBAORD 2001-2006*

Country	AAGR	Rank
Australia	2.9%	27
Austria	4.1%	20
Belgium	3.1%	26
Canada	3.4%	24
Czech Republic	6.2%	13
Denmark	3.3%	25
Finland	5.2%	18
France	2.2%	29
Germany	2.1%	30
Greece	5.7%	15
Iceland	6.3%	12
Ireland	16.6%	2
Italy	0.8%	33
Japan	3.6%	23
Korea	8.4%	6
Luxembourg	18.1%	1
Mexico	0.0%	34
Netherlands	1.9%	31
New Zealand	1.6%	32
Norway	4.1%	21
Poland	-1.0%	36
Portugal	6.8%	10
Slovak Republic	5.6%	16
Spain	10.7%	4
Sweden	6.1%	14
Switzerland	6.7%	11
United Kingdom	3.9%	22
United States	7.6%	9
Total OECD	4.4%	19
EU-25	2.7%	28
Argentina	7.7%	8
Israel	-0.7%	35
Romania	14.0%	3
Russian Federation	8.6%	5
Slovenia	7.8%	7
Chinese Taipei	5.5%	17

Source : OECD, Main Science and Technology Indicators, June 2006.

Table 3: *International comparisons of GOVERD as a percentage of GDP, 1996 and 2006*

Country	2001	Rank	2006	Rank
Belgium	0.13	28	0.14	28
Canada	0.22	20	0.19	20
Czech Republic	0.29	8	0.27	12
Denmark	0.28	11	0.17	23
Finland	0.35	4	0.33	4
France	0.36	3	0.36	2
Germany	0.34	5	0.33	4
Hungary	0.24	17	0.26	13
Ireland	0.11	31	0.09	31
Italy	0.20	21	0.17	23
Japan	0.29	8	0.30	7
Korea	0.32	6	0.34	3
Luxembourg	0.15	25	0.19	20
Netherlands	0.25	16	0.26	13
Norway	0.23	19	0.25	15
Poland	0.20	21	0.23	18
Slovak Republic	0.15	25	0.16	27
Spain	0.15	25	0.17	23
Sweden	0.12	29	0.14	28
United Kingdom	0.18	23	0.18	22
United States	0.31	7	0.33	4
Total OECD	0.27	14	0.28	10
EU-25	0.24	17	0.24	16
Argentina	0.17	24	0.17	23
China	0.28	11	0.28	10
Israel	0.26	15	0.21	19
Romania	0.11	30	0.13	30
Russian Federation	0.29	8	0.29	8
Singapore	0.28	11	0.24	16
Slovenia	0.38	2	0.29	8
Chinese Taipei	0.51	1	0.60	1

Table 4: *Women researchers (rses) as a percentage of total researchers in the Government sector (headcount), 2006**

Country	Female rses as a % of total rses	Rank
Argentina	47.3	3
Belgium	30.1	22
Chinese Taipei	17.9	28
Czech Republic	35.0	18
Denmark	35.5	16
Finland	40.2	10
France	32.0	21
Germany	27.1	26
Greece	38.9	11
Hungary	38.6	13
Iceland	42.1	7
Ireland	35.4	17
Italy	38.7	12
Japan	12.2	29
Korea	11.6	30
Luxembourg	28.5	25
Mexico	29.9	23
Netherlands	29.2	24
Norway	35.6	15
Poland	41.1	8
Portugal	57.9	1
Romania	49.2	2
Russian Federation	45.8	4
Singapore	33.6	19
Slovak Republic	42.7	6
Slovenia	41.1	9
Spain	45.5	5
Sweden	36.4	14
Switzerland	25.5	27
United Kingdom	32.2	20

* or latest available year

Acronyms

AAGR	Average Annual Growth Rate
BERD	Business expenditure on R&D
BIM	Bord Iascaigh Mhara - The Irish Sea Fisheries Board
CRFB	Central and Regional Fisheries Boards
COFORD	National Council for Forest Research and Development
CSF	Community Support Framework
CSO	Central Statistics Office
DIAS	Dublin Institute for Advanced Studies
EPA	Environmental Protection Agency
ESRI	Economic and Social Research Institute
EU	European Union
FÁS	Foras Áiseanna Saothair – National Training and Employment Authority
FSAI	Food Safety Authority Ireland
FTE	Full Time Equivalent
GBAORD	Government Budget Appropriations and Outlays on R&D
GERD	Gross Expenditure on R&D
GOVERD	Government Expenditure on Intramural R&D
HEA	Higher Education Authority
HERD	Higher Education Expenditure on R&D
HC	Headcount
HRB	Health Research Board
IDA	Industrial Development Agency
IRCHSS	Irish Research Council for the Humanities and Social Sciences
IRCSET	Irish Research Council for Science, Engineering and Technology
MLE	Media Laboratory Europe
NMAC	National Microelectronics Applications Centre
NESC	National Economic and Social Council
NMRC	National Microelectronics Research Centre
NRA	National Roads Authority
NSAI	National Standards Authority of Ireland
OPW	Office of Public Works
OSI	Ordnance Survey Ireland
OST	Office of Science and Technology - Department of Enterprise, Trade and Employment
PGMDB	Postgraduate Medical and Dental Board
R&D	Research and Development
RSE	Researcher
RPII	Radiological Protection Institute of Ireland
S&T	Science and Technology
SEI	Sustainable Energy Ireland
SFI	Science Foundation Ireland
SSH	Social Sciences and Humanities

Definitions

For the purpose of this survey science and technology comprises the five categories below:

1. **Research and development:**

- **Research:** Original, experimental or theoretical investigations undertaken to acquire new knowledge, with or without a particular application or use in view.
- **Development:** Systematic work drawing on existing knowledge gained from research and/or practical experience, that is directed to producing new products, processes, systems, services, varieties and breeds and to improving substantially already existing ones. Data collection conducted solely or primarily as part of the research and development (R&D) process included under "research" or "development" as appropriate.

2. **Technical services:**

Specialised support services of a scientific or technical nature generally provided by centralised laboratories or facilities and can be of a routine or non-routine nature. Essentially they comprise the technical back-up, analytical, diagnostic and data collection/processing services.

3. **Training, education and information:**

- **Training and education:** Education and training of third level or equivalent students in science and technology disciplines.
- **Information:** Provision of information via **formalised scientific and technical information and documentation (STID) services** includes all expenditure (manpower and materials) involved in acquiring, controlling or transmitting information to users with the involvement of staff whose primary function is in formalised STID services e.g. provision of S&T information, advice, liaison, specialist advice, information analysis, libraries, publications and documentation services, translations, technical seminars and conferences. Provision of information **via non-formalised STID services** includes expenditure on providing know how and expertise by members of staff who, while not specifically engaged in formalised STID services, provide specialist advice, liaison, consultancy or other general information services.

4. **Technology transfer:**

Activities which are directed solely or primarily towards the transfer and adoption of new technology, generally in enterprises. The horizontal transfer of technology, primarily from abroad, but also from colleges to enterprises is included here.

5. **Other S&T activities:**

Activities which cannot be conveniently grouped under the above headings can be included here e.g. grants to international organisations, policy planning units etc.

Other Definitions:

1. **Public funds =** Exchequer + EU funds
2. **GBAORD =** Government Budget Appropriations or Outlays on R&D (Public funds + funds for the Social Sciences and Humanities)

Appendix 4: Government departments and agencies' programmes

(CD ROM attached)

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