

Save British Science is a voluntary organisation that campaigns for science and technology throughout UK society

We achieve this by:

- **meeting** with Ministers, advisers and officials
- regularly **submitting evidence** to Parliamentary and Government consultations
- having a reputation in the media as a **ready and reliable source of information and comment** on science policy
- **bringing together** leading figures in Government, Industry and the City to facilitate wealth creation from the science base
- hosting a series of **symposia and discussion meetings**
- keeping our members up-to-date with a quarterly **newsletter**
- publishing **reports and briefing documents** on all aspect of science policy

We focus on:

- the science and engineering research base
 - science education
 - science in the economy
 - science in society

Our work is supported by:

1,500 individuals
35 universities
25 scientific societies
25 private companies

SBS in Northern Ireland

SBS is committed to campaigning for science and technology in a devolved Northern Ireland

In the past two years, SBS and its representatives have:

- corresponded with the Secretary of State for Northern Ireland about the budget for university research
- interacted with officials responsible for setting and administering the Northern Ireland research budget
- given a seminar to scientists from both of Ulster's universities about campaigning for a strong science base in Northern Ireland
- met with Carmel Hanna MLA, Minister for Employment and Learning and Sir Reg Empey MLA, Minister for Enterprise
- attended the launch of Centre for Molecular Biosciences at the University of Ulster
- attended the Celebration of Queen's Science at Queen's University Belfast
- published a response to the Northern Ireland Executive's innovation strategy been quoted or had opinions published in the Northern Ireland press, including *The Belfast Times*, *The Coleraine Times*, and *The Irish Times*



Science Policies for the Northern Ireland Assembly

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Science Policies for the Northern Ireland Assembly Agenda for the Next Four Years

INTRODUCTION

Science touches every aspect of modern life. In various forms, including technology, medicine and engineering, scientific progress is a part of everyday life and it is the fundamental basis of a modern economy.

Because of its all-pervading influence on society, science now hits the headlines more often than ever before. At the same time, the rapidly-moving world of scientific discovery and technological change can alarm sections of the population, who feel that they need more information or better expert guidance if they are to make sensible and positive choices about science in a democratic society.

Because of this, the majority of non-scientific politicians can no longer afford to leave scientific and technological issues to a small group of experts.

Political debate must encompass discussions about how science and engineering advice can feed into effective policy-making, and how scientific innovation can stimulate the economy. Public policy must also understand how to fund and organise scientific research, and how to structure a scientific education.

This document is a contribution to such a debate from Save British Science (SBS), a voluntary organisation that campaigns for better funding of scientific research, and stronger policies relating to science.¹ SBS focuses its efforts both on the UK

government in London, and also on the devolved administrations in Belfast, Edinburgh and Cardiff.

In this document, we set out our thoughts about the state of science in Northern Ireland, and list those policies we believe are necessary for it to be strong and productive over the next four years.

One of the driving beliefs of SBS is that, in the UK's scientific culture and history, together with its current potential, there is something worth saving. The box below² gives a few examples of the contributions Northern Irish scientists have made to the UK's illustrious scientific heritage.

This document is divided into four interlinked themes:

- The science research base
- Science education
- Science and the economy
- Science in society

In these headings, the word 'science' is used as a shorthand to include the social and natural sciences, engineering, technology, medicine and mathematics. Page 12 sets out some specific policies that SBS believes create an agenda for Northern Ireland's Scientific Future up to 2007.

This document is a companion to SBS's *Science Policies for the Next Parliament*³, published before the UK General Election in 2001.

Historic Scientific Achievement in Northern Ireland

Thomas Andrews investigated the critical temperature of gases, and showed that ozone is a form of oxygen. His work on liquefaction of gases led to the development of refrigerators.

James Thomson, the brother of Lord Kelvin, became professor of Civil Engineering at Queen's College in 1857. His work in fluid dynamics helped to improve the industrial uses of the field.

Denis Parsons Burkitt was born in Enniskillen in 1911. While working as a surgeon in Uganda, he identified a type of cancer and its viral cause, and discovered some beneficial effects of eating fibre.

John Stewart Bell studied the nature of antiparticles in the 1950s, then worked at CERN on accelerator physics, and contributed to the foundations of quantum mechanics.

¹ For more information see our website <www.savebritishscience.org.uk>

² *Chambers Biographical Dictionary*, Chambers Harrop, 2002

³ *Science Policies for the Next Parliament: Agenda for the Next Five Years*, SBS 2001

THE RESEARCH BASE

The science and engineering research base is the foundation on which to build all the other aspects of national life. Although Northern Ireland is a small part of the UK, with just two universities, it has a broad and successful research base.

The Research Assessment Exercise

Table 1 shows the performance of Northern Ireland's universities in the Research Assessment Exercise of 2001. Out of 22 science and engineering subjects represented in Northern Ireland, there were nine in which Ulster's institutions performed better than those in the rest of the UK (shaded).

The overall picture is that Ulster's science is relatively strong. Although Northern Ireland has less than 2% of the UK's university institutions¹, using the RAE as a measure, Northern Irish researchers outperform their counterparts across the rest of the UK in 41% of the science subjects that are represented in the province. Subjects that were not represented in Northern Ireland's Assessment included veterinary medicine, physiology, earth sciences, statistics and applied mathematics.

Funding

However, as Table 2 shows, funding for research in Northern Ireland is too low, compared with the rest of the UK. Researchers in Northern Ireland are also less well funded than those in Republic of Ireland, by over 30%.²

The main manifestation of this underfunding is that universities in the UK, including those in Northern Ireland, have difficulty in appointing researchers

Subject	Northern Ireland	Rest of the UK
Mechanical, Aeronautical, Manufacturing Engineering	6.00	4.22
Other Studies & Professions Allied to Medicine	5.00	3.41
Electrical & Electronic Engineering	5.00	4.23
Community- Based Clinical Subjects	5.00	4.27
Civil Engineering	5.00	4.57
Nursing	4.00	3.12
Food Science & Technology	4.00	3.70
Agriculture	4.00	3.78
Computer Science	4.00	3.95
Metallurgy & Materials	4.00	4.31
Chemistry	4.00	4.32
Biological Sciences	4.00	4.37
Chemical Engineering	4.00	4.44
Physics	4.50	4.52
Pharmacy	4.00	4.73
Clinical Laboratory Sciences	4.00	4.88
Psychology	3.50	4.10
Environmental Sciences	3.00	3.27
Pure Mathematics	3.00	4.39
Hospital- Based Clinical Subjects	3.00	4.60
Clinical Dentistry	3.00	4.62
General Engineering	3.00	3.64

Table 1: Average scores in the 2001 Research Assessment Exercise in Northern Ireland and the rest of the UK.³ Shaded subjects are those for which Northern Ireland's researchers obtained higher average scores than their counterparts elsewhere. 3a and 3b ratings were both given 3 points, 5-Star ratings were given 6 points.

of the highest calibre. In a survey of the Deans of Science at UK universities, institutions in Ulster reported that it was becoming harder to find good post-graduate students and research staff, and that in some cases, posts had been left unfilled because, on the salaries that

¹ According to the website of UniversitiesUK, it has 121 member institutions, of which two have addresses in Northern Ireland.

² Data comparing the UK with the RoI from the OECD *Basic Science and Technology Indicators and Main Science and Technology Statistics*, with the UK data adjusted to give a Northern Ireland figure, using the proportions from Table 2.

³ 2001 Research Assessment Exercise: *The Outcome*, HEFCE, 2001.

universities could offer, it was not possible to recruit researchers of international quality.¹

Annual investment in £ per capita:	via the Higher Education Funding Councils	via the Research Councils
Scotland	39	41
England	23	33
Wales	24	15
Northern Ireland	20	6

Table 2: Investment in the Science & Engineering Research Base in the constituent parts of the UK in 2003²

The importance of collaboration

With just two universities, and no Research Council laboratories, the research base in Northern Ireland needs to be innovative, finding ways of collaborating with partners in other sectors, or in other parts of the world.

For example, the Northern Ireland Bioscience and Technology Institute involves Queen's University Belfast in a collaboration with partners in the USA and Singapore, and is the first centre of its kind anywhere on the island of Ireland. Sophisticated research laboratories and facilities for commercialising results combine to form an important part of the research base in Ulster.

The Northern Ireland Knowledge Engineering Laboratory is a research and technology transfer organisation hosted in the University of Ulster. Technology transfer projects include spoken language technologies, knowledge based systems, telecommunications, data mining and electronic commerce.

In its National Development Plan for 2000-2006, the Government of the Republic of Ireland gave a commitment to promotion and co-operation across the border, on all aspects of the education system, including

universities and their research role.³ This offers another opportunity for Northern Ireland to forge productive research links.

Future funding

To ensure that Northern Ireland's research base can continue to take advantage of such opportunities, it needs to have secure and substantial levels of funding. It was therefore disturbing when, in 2002, the draft budget for Northern Ireland included no increase at all in funding for university research.

An active campaign by the universities, SBS and other interested parties convinced the authorities that this decision must be reversed, but in future it will be necessary for the Government of Northern Ireland to take a much more positive attitude towards investing in the scientific future of Ulster.

¹ *The recruitment and retention of researchers in UK universities*, SBS, 2000 [SBS 00/20]

² Calculated from *The Forward Look 2001: Government-funded science, engineering & technology*, Office of Science & Technology, 2001; Hansard [House of Commons] 12 June 2000, column 465W; figures assume that the distribution of Research Council investment is the same as it was in 1999, although the total has risen.

³ *National Development Plan 2000-2006*, Department of Finance, Government of the Republic of Ireland, 1999

SCIENCE EDUCATION

Northern Ireland takes education seriously. Well over 70% of its young people stay in full time education post-16, and around 36% gain two or more A-levels.¹ If that record is to prove a firm base from which to build a vibrant economy in the twenty first century, then achievement in science and mathematics must be at the heart of the education system.

Achievement in schools

An international study of scientific literacy among 15-year olds found no statistically significant difference between children in Northern Ireland, England and the Republic of Ireland. Three countries performed significantly better than Northern Ireland - Japan, Korea and Finland - while 15 nations achieved significantly lower scores, including Norway, Belgium, Germany and Italy.

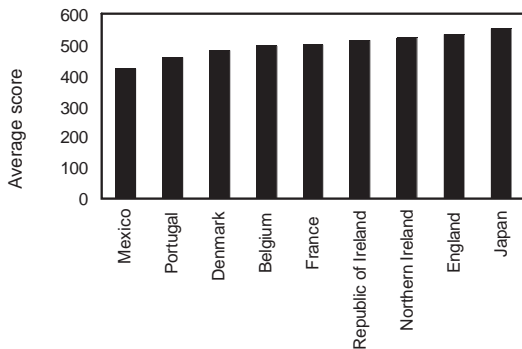


Figure 1: Results of a study of scientific literacy in 15-year olds for a sample of countries.²

In tests of mathematical ability, 15-year olds in Northern Ireland had almost identical scores to those in England, but performed significantly better than those

in the Republic of Ireland. Only Japan and Korea performed significantly better than Northern Ireland, while 14 nations, including Spain, the USA and Italy, achieved significantly lower scores.

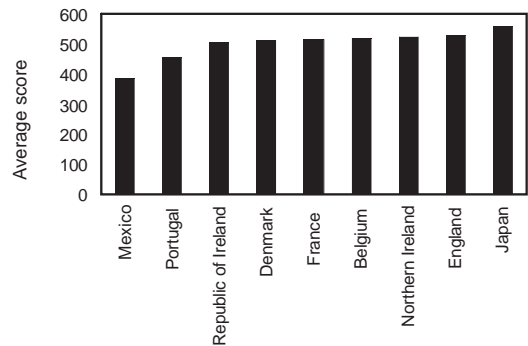


Figure 2: Results of a study of mathematical literacy in 15-year olds for a sample of countries.³

In GCSE examinations, Northern Ireland's pupils appear to outperform their English counterparts. 66% of those taking GCSE exams in Northern Ireland in 2002 achieved at least a grade C in either mathematics or at least one science subject, or both.⁴ In England, the figure was 54%.⁵

Secondary school science teachers

There are increasing difficulties in recruiting sufficient well-qualified science teachers. Science and mathematics teachers are in higher demand in Ulster than those in other subjects.⁶ This is relatively recent change, and was not observed a few years ago.⁷ This trend mirrors the situation in England, where a shortage of qualified teachers has become the most serious threat to education in science and mathematics.

¹ Northern Ireland Educational Statistics 1998-2001, Department of Education / Department for Employment and Learning, 2002

² Student Achievement in Northern Ireland, Results of the PISA Study, OECD, 2002

³ as above

⁴ <www.ccea.org.uk/exam_stats/Stat_Book.pdf>

⁵ GCSE/GNVQ Examination Results of Young People in England, 2001/02 (Early Statistics), Office for National Statistics, 2002

⁶ Three Years Later: A follow-up survey of teachers who qualified in 1995, Northern Ireland Department of Education, 2000

⁷ A follow-up survey of teachers who qualified in 1991 and 1992, Northern Ireland Department of Education, 1997 [RB2/97]

Recent proposals on the future of education in Northern Ireland have recognised the need to support opportunities for the continuing professional development of teachers.¹ One major difficulty for science teachers is that research advances so rapidly that knowledge quickly becomes out-of-date. The opportunity for teachers regularly to update their personal experience of a subject is crucial to a healthy education system. Ideally, teachers should be given regular sabbatical periods, to engage in activities that would reinvigorate their knowledge and enthusiasm.

Vocational Education

Vocational education and training form an important part of an education system that prepares people for work in the knowledge economy. In 2000, industry was expressing concerns that a serious skills shortage was developing in Ulster, in some specific areas of engineering.

Working with industry and the Qualifications and Curriculum authority, Further Education colleges in Northern Ireland have developed a programme to provide the necessary training in these areas to fill the skills vacuum. Two institutes are now providing the relevant education and training, and have been awarded the status of "Engineering Centres of Excellence" in recognition of their work in their field.²

Continuing to expand this type of tailored education provision will give Northern Ireland the potential to build the kind of highly skilled workforce that will be essential for the economy to succeed in the coming years.

Higher Education

Figure 3 shows how the number of applications to study two major areas of science have changed in Northern Ireland and in England over the past few years.

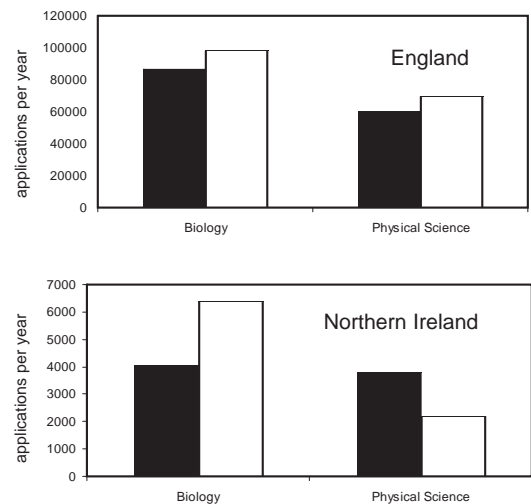


Figure 3: Numbers of applications to study science subjects at universities in Northern Ireland and England in 1997 (black) and 2000 (white)³.

Encouragingly, Ulster has seen a very substantial rise in interest in the biological sciences, with demand outpacing that in England. As the biosciences become more important and open up new and exciting opportunities for research, and for economic growth, this trend has the potential to prove very positive for Northern Ireland.

But in other areas of science, notably the physical sciences, interest has fallen in Ulster while rising modestly elsewhere. The interdisciplinary nature of much modern science means that no country can afford to neglect particular subjects. Greater effort will be needed to reinvigorate the students' interest in the physical sciences in Northern Ireland.

In Northern Ireland's universities, 24 science departments have been assessed for the quality of their teaching. The average score was 21.88 out of a possible maximum of 24. This compares favourably with the average score across the UK of 21.26 points.⁴ University education remains one of Northern Ireland's strengths.

¹ *Education for the 21st Century - Post Primary Review Body*, Northern Ireland Department of Education, 2001

² *Centres of Excellence: Working together for Engineering*, QCA.

³ *Annual Statistical Tables*, UCAS.

⁴ All of the scores for departmental subject reviews are available in an accessible form via <www.guardian.co.uk/education>

SCIENCE IN THE ECONOMY

In the twenty-first century, the "knowledge economy" has become a reality. Successful nations in the coming decades will be those that invest heavily in scientific and engineering research, and those which put in place effective mechanisms for capitalizing on new knowledge.

Private sector investment in Research and Development

Of the Northern Irish companies listed on the London Stock Exchange¹ only one invests enough in research to be included in the R&D Scoreboard². This means that although Northern Ireland has approximately 2-3% of the UK's population, it has only 0.3% of the UK's most research-intensive companies.

Given that the European Union has recently announced an intention that its economies should invest 3.0% of GDP in research and development, to catch up with the USA (which invests 2.7% of its GDP) and Japan (which invests 3% of its GDP), the current figure of 0.5% for business in Northern Ireland seems extremely low.³

Over the longer-term, Northern Ireland must be much more ambitious in its aims if it is to compete with other small European countries. Ulster's industry currently invests a smaller proportion of its profits in research than the industries of the Irish Republic, Denmark or Norway.⁴

The performance of the science-based economy

The only company based in Northern

Ireland that performs enough research to be included in the R&D Scoreboard is Galen Holdings. Between 1999 and 2003, it outperformed the FTSE 100-Share Index by a considerable margin. A £100 investment made in the FTSE on 1 January 1999 would have been worth £63.50 on 1 January 2003, indicating that the overall economy had not been performing well. But an investment of £100 in Galen would have been worth £74.07 by the beginning of 2003.⁵ This mirrors the situation in the wider economy, where companies that perform substantial amounts of research and development typically have greater success than firms that do not.⁶

Northern Ireland needs more companies that carry out significant amounts of research and development. In April 2003, Andor Technology announced that was expanding its operations in Belfast, and specifically mentioned an increase in research and development as a major part of its strategy. If this is a sign that Ulster's knowledge economy is set to develop strongly, ministers and other politicians must grasp the opportunity.

Links between business and universities

Throughout the UK, there has been a huge cultural change in the way in which universities engage with the world of business and industry.

Northern Ireland's universities have been particularly effective at seizing the new opportunities that have been created. For example, the university institutions in Northern Ireland have 27 Teaching

¹ <www.londonstockexchange.com/landmark/ireland/trigger_ireland.asp>

² *R&D Scoreboard 2002*, Department of Trade & Industry, 2002

³ *More Research For Europe: Towards 3% of GDP*, European Commission, 2002 [COM(2002) 499 final]

⁴ *Statistics on Science & Technology in Europe, 2000 Edition*, European Commission, 2000

⁵ Data from <www.ft.com>

⁶ *The 2002 R&D Scoreboard: Commentary & Analysis*, Department of Trade & Industry (2002)

Company Scheme Awards each, where graduates are employed to work in companies on research or technology transfer projects, in collaboration with the universities. This compares with averages about 5 or 6 such awards per university in England, Scotland and Wales.¹

In 2001, Northern Ireland's universities produced an average of 9.5 new spin-out companies. This is a much higher rate of formation than in Scotland, which produced 2.6 such companies per university, or England and Wales, which produced fewer than two companies per university.²

These interactions between Ulster's universities and its business community offer a major opportunity for the economy of Northern Ireland to thrive in the coming years.

Northern Ireland's scientific workforce

Figure 4 shows that Northern Ireland has the lowest proportion of the workforce working in science of any part of the UK. These figures include not just people actively engaged in research, but those who use science and engineering as the professional basis for their work. To reach English levels, Northern Ireland would need to create at least an extra 10,000 scientific jobs.

Directly comparable figures are not available for the Republic of Ireland, but it certainly has a greater proportion of its workforce actively engaged in research. To reach the level of research-active workforce enjoyed in the South, Northern Ireland requires an extra 1,500 jobs for people whose employment meets the international definition of "research personnel".³

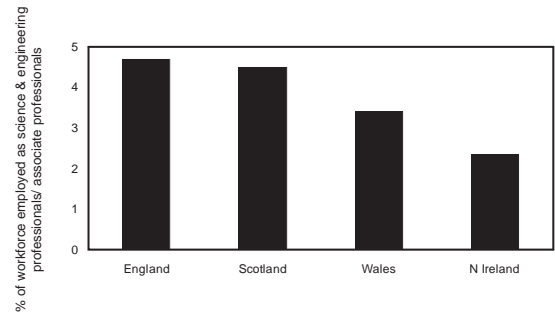


Figure 4: Percentage of the workforce employed as science or engineering professionals or associate professionals in the constituent parts of the UK.⁴

¹ *Higher Education-Business Interaction Survey*, HEFCE, 2001 [HEFCE 01/68]

² *Higher Education - Business Interaction Survey 2000-2001*, HEFCE, 2003 [HEFCE03/11]

³ *Main Science & Technology Indicators and Basic Science & Technology Statistics*, OECD

⁴ 1991 Census of the UK

SCIENCE IN SOCIETY

The place of science in a wider society involves two significant elements. First, it is important to understand what non-scientists think and feel about science and scientists. Second, it is crucial to put in place policies that facilitate the provision of high quality expert scientific advice to Government.

Ulster's attitudes to science

There is little if any direct evidence that specifically addresses what the people of Northern Ireland think and feel about science and about scientists. However, the fact that there are seven public science centres in Ulster suggests that there is an appetite among the general population to be engaged in discussion about science.

"Whowhatwhenwherewhy" is a new interactive discovery centre in Belfast, which aims to give people an experience of "unravelling some of the mysteries of science, technology and engineering"¹. Opened as part of "Science Year", a measure of its popularity is that 275,000 people visited it in 2002.² At the same time, even though Armagh Observatory itself was closed for restoration, its outreach programme continued to engage local people, reaching some 6000 during the year.³

Investment in policy-oriented research

Figure 3 shows the level of investment in scientific research to answer questions of Government policy, for English Departments of the UK Government in Westminster, for the Northern Ireland Executive (and the Northern Ireland Office) and for the Welsh Executive.

While investment in Northern Ireland has

risen modestly in real terms, English investment has risen slightly more, and Welsh investment very much more.

If Northern Ireland is to maintain a healthy base of its own publicly-funded research, aimed at informing public policy, it will need a very substantial increase in this budget. To invest at the same level as England now does, the Northern Ireland Executive would need to fund an extra £30 million of policy-oriented research every year.

The benefits of such research could be significant. Serious criticisms have been attached to the UK Government, and to the Welsh and Scottish authorities regarding their treatment of scientific research on infectious diseases in agricultural livestock. Northern Ireland has already seen that when dealing with

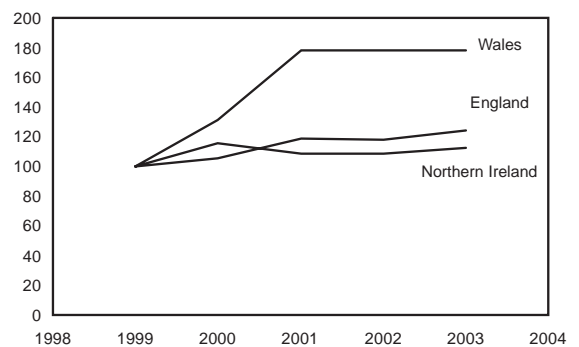


Figure 3. Government investment in policy-oriented research in the civil departments, per annum, in real terms [at 1999 prices] per capita, for England, Wales and Northern Ireland, scaled so that the 1999 figures are all 100.⁴ The English figures presumably include a tiny proportion of expenditure in Wales and Northern Ireland, because the devolution settlement reserved some powers in Westminster.

¹ <www.w5online.co.uk>

² Information from ECSITE-UK

³ as above

⁴ *The Forward Look 2001: Government-funded science, engineering and technology*, OST/DTI (2001)

diseases in farm animals, there are considerable benefits in not being forced to have the same policies and restrictions as other parts of the UK. To maintain a healthy research base may well help deliver greater benefits in the future.

Political interest

Figure 4 shows the number of official written and oral questions about science policy asked in Parliament and in the devolved legislatures. No doubt the apparent lack of interest in the Northern Ireland Assembly is accounted for by the fact that MLAs are busy dealing with Northern Ireland's unique political problems. But a healthy future for Ulster depends on the kind of economy that can only be delivered by taking science seriously. If Northern Ireland is to prosper, local politicians must begin to take a greater interest in science.

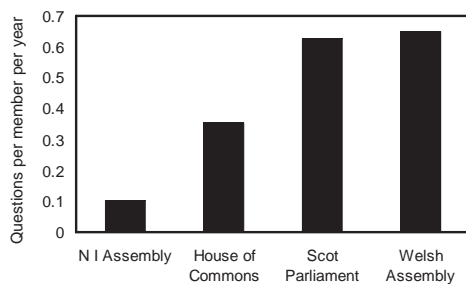


Figure 4: The number of written and oral questions about science policy asked by Assembly members and Members of Parliament, as an average per member over 2002.¹

¹ DeHavilland Information Systems, InfoPool; these figures refer to questions about science policy, and do not include all questions about scientific issues.

NORTHERN IRELAND'S SCIENTIFIC FUTURE

- *Research in Northern Ireland has improved in recent years, but it is in danger of suffering the effects of underfunding. Higher Education requires a substantial injection of cash to fund research.*
- *Part of the funding problem is that researchers are badly paid, and Ulster's institutions cannot compete on the world stage for the best talent. Salaries at Northern Ireland's universities need to rise substantially.*
- *A better baseline of funding for research will allow Northern Ireland's institutions to compete more effectively for grants from Research Councils and other funding bodies.*
- *The biggest problem facing science education in schools is the difficulty of recruiting enthusiastic and able teachers in science and mathematics. Teaching must be made a more attractive career for bright young scientists.*
- *The Government of Northern Ireland should commission a study of the supply, recruitment and retention of science and mathematics teachers in Ulster.*
- *If the Ulster economy is to thrive, the Assembly must do more to attract science-based businesses, and to encourage existing firms to carry out more research and development to give them an edge in a globally competitive market.*
- *Fundamental research, funded for scientific excellence rather than for obvious industrial relevance, is delivering real economic benefits in Northern Ireland, and funding mechanisms must ensure that it continues to receive high levels of funding.*
- *Investment in research to answer people's concerns about difficult political issues is low, and Northern Ireland should increase its per capita investment in this area.*
- *The Department of Education should insist that whatever replaces the Research Assessment Exercise, the rules are designed to reward rather than discourage researchers from interacting with a wider public.*