

**[A STRATEGIC FRAMEWORK FOR SCIENCE IN SCOTLAND - 2008]:**

**REPORT OF THE INTERNATIONAL WORKING GROUP**

**REPORT STRUCTURE**

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## Summary

Scotland is - and has been long recognised as – a science nation. Excellence in science, engineering and technology (SET) research and teaching are key factors in Scotland's current international and economic position - in terms of:

- recognition, reputation and influence
- provision of teaching, learning and qualifications (in schools, colleges and universities);
- research partnerships - at individual, institutional and strategic levels; and
- securing sustainable inward investment (particularly in research).

Scotland had over 36,000 international students in 2006/07, of which around 24,000 were from outwith the EU (15,000 were at postgraduate and 9,000 at undergraduate level). There has been a 50% increase in EU students in last 5 years and a 118% increase in students from outside the EU. Scotland's [International Lifelong Learning Strategy](#) was launched in March 2007. It aimed to position Scotland as a world-leader in international post-school education. It included supplementary aims concerned with, for example, attracting talent to Scotland and fostering international partnerships and strategic alliances.

Scotland has a high level of public investment in R&D, at 0.95% of GDP, compared with 0.6% for the UK as a whole and 0.7% for a comparator group of countries. Also, Scotland's scientific research base is ranked first in the world in terms of the rate our research papers are cited, relative to our GDP and second in the world behind only Switzerland. We are ahead of the USA in terms of impact (measured as the average number of citations per paper). The best performing research fields, in terms of impact, are clinical sciences (2nd in the world), health and related sciences (1st), and biological sciences (3rd). That said, a step change in the economic value derived from the Scottish science base and cultural change in both academia and business will be required to deliver sustainable economic growth and the other outcomes set out in the Government's Economic Strategy and [National Performance Framework](#).

The main - inter-related - challenges for Scotland's science base are:

- Global competition, and the need to maintain our national pre-eminence in SET teaching and research;
- Developing a SET workforce which is aligned to the needs of the science base in business and academia, by retaining or attracting scientific talent and expertise;
- Increasing business R&D and utilisation of the science base
- Attracting SET-related inward investment; and
- Improving the international marketing of Scotland's science, engineering and technology, and seeking broader and deeper international collaborations with new and existing partners.

There is a clear consensus that sustaining the global competitiveness of the science base in Scotland - in the face of anticipated changes such as the current scale and pace of SET capacity building in India and China, or other unforeseen factors - is the optimum way to build on that success and support sustainable economic growth if coupled with:

- the enhanced skills utilisation and open innovation which are the aims and outcomes of the Skills for Scotland and the Innovation Framework
- A range of interchange programmes which support the development of science and scientists in Scotland and sustainable strategic partnerships with the best in the world;

- more effective collaboration to foster and exploit future opportunities to attract inward investment in our science and research base in research institutions and companies; and support for increased international activity in the SME base; and
- a shared commitment to communication, raising awareness of Scotland's distinctive SET capacity and ambition.

## 1 – Introduction and Context

1. The Government’s Economic Strategy (GES) defined the Purpose<sup>1</sup> and confirmed plans to “develop a new science strategy for Scotland, outlining how science will underpin Scotland’s success as a nation through:

- developing knowledge exchange between academia and business;
- increasing the flow of overseas investment into Scotland’s R&D base; and
- developing the science base”.

2. The clear focus of the GES text has roots in earlier work by (the Office of) the Chief Scientific Adviser and others, notably:

- The “original” 2001 [science strategy](#) <sup>2</sup>(and the progress report published in 2006);
- The 2006 [consultation paper](#) about a prospective science and innovation strategy, and the 2007 [summary and distillation of the responses received](#);
- Parallel development of [innovation policy](#) and the growing consensus that science or technology-driven innovation, while vitally important, is a subset of innovative best practice.

3. The responses and subsequent stakeholder dialogue (combined with published Scottish, UK and international research and analysis) provide a substantive and valid body of evidence and ideas from which to craft a new strategic framework for science. As such, work on the early development of the strategic framework has been taken forward by three internal Scottish Government Working Groups (chaired by a nominee of either Scottish Enterprise or the Scottish Funding Council, to link policy development with implementation and delivery) required to take account of:

- The Purpose and the 5 strategic priorities<sup>3</sup> of the GES (and the National Performance Framework<sup>4</sup>);
- prior formal engagement with stakeholders in Scotland (updated in 2008 through informal ongoing dialogue with stakeholders);
- the aims and objectives of Skills for Scotland, the new International Framework;
- the interim report of the Joint Future Thinking Taskforce on Universities; and
- parallel development of innovation policy as envisaged by the Government’s Economic Strategy.

It is particularly important to recognise and understand the way in which these strategies and frameworks integrate to produce a complex but holistic system of support for higher and sustainable economic growth.

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<sup>1</sup> to focus the Government and public services on creating a more successful country, with opportunity for all of Scotland to flourish, through increasing sustainable economic growth

<sup>2</sup> An important objective of any strategy for science must be to maintain and enhance Scotland’s international reputation as a place where high quality scientific work is undertaken; as a place in which it is desirable to invest in scientific work; and as a place where it is desirable to do scientific research. This requires access to global scientific knowledge and expertise. Scientists in academia and research institutes have always worked as part of a global network – seeking out the best scientists in the world with whom to collaborate. This sharing of ideas and information and working together to influence science policy is key to the advancement of science. In addition to international collaboration we also need to be able to recruit, retain and professionally develop sufficient high quality scientists across a range of disciplines, as well as other staff required to support their work. Scotland is successful at attracting scientists with international reputations to work in its science base. Equally some of our scientists go to work in other countries. This is recognised as being a healthy part of the global scientific network, but our science base needs to continue to be attractive to other scientists and investors

<sup>3</sup> Learning, skills and well-being; Supportive Business Environment; Infrastructure development and place; Effective government; Equity

<sup>4</sup> Scottish Budget /Spending Review 2007, page 46.

4. Skills for Scotland is about a smarter Scotland with a globally competitive economy based on high value jobs, with progressive and innovative business leadership:

- Where people can work in teams, are creative and enterprising, motivated to contribute to Scotland's future and are confident that they can do so.
- Where people are entrepreneurial and innovative and small businesses are encouraged to grow by strong, coherent support for businesses of all sizes, and where migrant workers and overseas students play a valuable role in an expanded workforce and economy.
- Where employers improve productivity by investing in their own staff
- Where learning and training providers work as one system and thanks to wider use of technology and e-learning, barriers of geography and rurality have been reduced.

5. That will be delivered by:

#### Individual Development

- Developing a distinctively Scottish approach to skills acquisition, balancing the needs of employers and individuals, aligning employment and skills and placing the individual at the centre of learning and skills development.
- Developing a coherent funding support system for individuals of all ages and in all forms of education and training that encourages participation in learning and work.

#### Economic Pull

- Stimulating increased demand for skills from employers, both public and private.
- Improving the utilisation of skills in the workplace.
- Understanding current and projected demands for skills to help prepare for future skills needs.
- Challenging employers, learning providers, awarding bodies and others to use the Scottish Credit and Qualifications Framework (SCQF) as a tool to support learning, specifically to facilitate the recognition of learning and for enabling individuals to move smoothly through learning environments, getting credit for learning they have already achieved.

#### Cohesive Structures

- Simplifying structures to make it easier for people to access the learning, training and development they need, including formal and informal learning by merging a number of bodies into one, focussed on skills.
- Ensuring that *Curriculum for Excellence* provides vocational learning and the employability skills needed for the world of work and is the foundation for skills development throughout life.
- Achieving parity of esteem between academic and vocational learning, recognising that vocational learning is a valuable alternative to the academic pathway and important to all.
- Challenging our funding bodies to use their budgets to help achieve a step-change in skills development and use.
- Encouraging providers to see themselves as part of a continuum of provision – links in a chain – which helps individuals to see the relevance of learning to them, progress in their learning and make full and effective use of the skills they have acquired. Judging that system by how well it serves those who need the most support.

6. The International Framework is designed to place Scotland as a responsible nation and partner on the world stage. It aligns public sector international activities to the Government's purpose of increasing sustainable economic growth by:

- Creating the conditions for talented people to live, learn, visit, work and remain in Scotland - so that Scottish population growth matches EU average;

- Bringing a sharp economic growth focus to the promotion of Scotland abroad - so that the Scottish GDP growth rate matches the UK's by 2011; and
- Managing Scotland's reputation as a distinctive global identity, an independent minded and responsible nation at home and abroad and confident of its place in the world.

7. Those goals relate to Scotland's performance as a nation. Work under the Framework will focus and align the actions and policies of the Scottish Government and other public sector actors to maximise their role in contributing to that performance, including:

- The work of Scottish Development International in more than 20 offices overseas to promote international trade and inward investment;
- Fresh approaches to existing relationships with:
  - a revised more proactive approach to the EU and key EU priorities as set out in the Action Plan on European Engagement;
  - The US and North America are key trade and tourism markets - there will be a sharper more focused programme of events representing our interests in the US and Canada;
  - China as set out in a refreshed China Plan;
  - the Arc of Prosperity (Norway, Finland, Iceland, Ireland and Denmark); and
  - The Commonwealth in India, Pakistan, Canada, Australia and New Zealand, We will in particular look to further work we can do to strengthen links with India, recognising its tremendous potential research ability and capability that exists within this developing economy and the strong and growing educational links between Scotland and India.

8. Particularly relevant to SET is the commitment to continuing to position Scotland as a great place to live and work; take action to understand and remove the barriers to attracting high quality talent to Scotland and ensure that we are taking steps to retain the talent we have already attracted by improving the integration of new Scots into our society and ensuring that our young people understand what Scotland has to offer them. The Government's National Performance Framework includes an indicator to improve perceptions of Scotland's reputation. The main tool for measuring that is the Anholt Nation Brand Index, which measures perceptions of 35 different nations and their reputations using a panel of respondents from across the world. The initial data from this survey showed that, while respondents showed a strong awareness of Scotland's reputation in terms on tourism, people and culture, awareness and knowledge was much lower in relation to exports (which included awareness of Scotland's reputation for innovation in science and technology).

9. The interim report of Joint Future Thinking Taskforce on Universities "New Horizons - responding to the challenges of the 21<sup>st</sup> century" was published on 24 June 2008. It proposes major modernisation of the relationship between the Scottish Government, Scottish Funding Council (SFC) and Scotland's Universities and the way in which universities are funded, including:

- In return for the substantial public funding they receive, universities must clearly demonstrate that Government funded activities are aligned with the Government's purpose of delivering sustainable economic growth for the benefit of all;
- a new funding system for universities, including a more flexible General Fund for mainstream activity and a Horizon Fund to provide new opportunities and incentives which support delivery of the Government's priorities and also each university's own mission and strengths;

- All universities should undertake research as well as teaching with rejection of the ‘teaching only’ universities proposed in England and
- SFC regulation should be significantly relaxed to give universities greater autonomy. This will free up the council to work on implementing key strategic initiatives in partnership with universities and Government, such as improving the links between Scottish business and Scottish higher education.

10. The Horizons report is outcome-driven, setting out ambitions for a university sector:

- which is widely recognised within and outwith Scotland as shaping, preserving and developing our country, our economy, our culture and our society with the result that the substantial Government investment in universities is widely understood;
- which is nationally and internationally competitive, is regarded as ‘world class’;
- which is an attractive and welcoming place for students outwith Scotland to come and study; which actively supports a changing learner demographic and assists learners to access university and progress through the education system, returning throughout their lives to upskill, re-skill or develop new skills for life and work;
- which develops entrepreneurial capacity and makes a significant contribution to graduate employability;
- where learning, teaching *and* research continue to be the cornerstone of university activity and are increasingly carried out as collaborative activity across these boundaries;
- which willingly engages with the micro, small and medium sized business base of Scotland, playing a key role in increasing demand side ‘pull’ for new knowledge created in universities and delivering knowledge into the Scottish economy which creates additional wealth;
- which produces ‘curiosity driven’ research that advances the frontiers of knowledge (for global benefit) which may contribute directly to Scotland’s people, economy, society or culture; and
- which works actively with employers to ensure the skills of graduates can be utilised to best effect in the workplace and where employers are engaged in the development of the curriculum, influencing its content and participating in its delivery.

11. The Innovation Framework, while not yet finalised, is expected to be structured by three key principles:

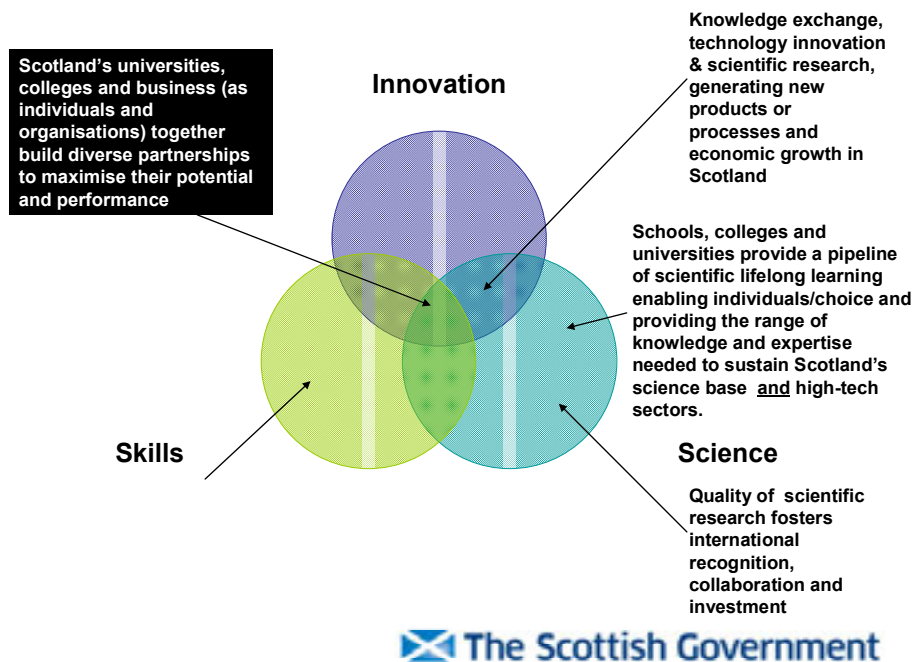
- Current emphasis on science and technology-based innovation and R&D is necessary but not sufficient
- An effective innovation policy should adopt a systemic view of Scotland’s innovation ecosystem – understanding how the parts work together
- An effective innovation policy depends on an effective skills and human resources strategy.

12. As such it will address issues around:

- System Alignment – making sure that all the major players are working towards the same outcomes and that the various roles fit together, with no obvious duplications or gaps
- Skills – following on from the Skills for Scotland strategy, identifying the types and mix of skills that will be needed to enhance Scotland’s innovative capacity, e.g. collaboration, team working, management skills
- Science Push versus Demand Pull – making sure that our support for innovation is more balanced to reflect the clear weakness in the area of demand pull and the issue of absorptive capacity of the industry base versus the perceived strength of our science base.

Use of intermediaries such as lawyers, bank managers, accountants to communicate message to industry

- Manufacturing/Services – there is a clear understanding that public sector support is biased towards manufacturing, and the framework will examine the importance of the services sector to the Scottish economy and, in any case, the quality of support for manufacturing; and
- Public Sector – the role of the public sector play in fostering innovation; through example, by being innovative itself; through use of procurement to encourage innovation



13. This report captures the work of the International Group, which focused on

- Enhancing international connections; and in particular
- increasing the flow of overseas investment into Scotland's R&D base.

14. It provides:

- A brief baseline description of current or planned activity and the impact this is expected to have on sustainable economic growth (see also Paper 1 and 3 for statistical data and reference materials reviewed as part of this process);
- An assessment of the key strategic issues still to be addressed;
- Options for changes or incentives required to better support the Purpose; and
- Conclusions and recommendations.

15. This report will - with corresponding reports from the other two Groups be used to inform advice to Ministers and the development and drafting of the strategic framework for science in Scotland.

16. Finally it is important to emphasise that this report is about science, engineering and technology (SET). The term “science” should always be viewed in that broader context and with regard to the definition used in the original consultation document:

We do not intend to limit the term “science” in future strategy to a particular set of disciplines or areas of the economy. “Science” should therefore be taken to include all activity in the pursuit of systematic knowledge which benefits, or is likely to benefit, the economy or society in some way.

## 2 – Where we are now

17. The recently published [International Framework](#) makes clear that Scottish Government's international engagement is driven by the Government Economic Strategy and the need to place Scotland as a responsible nation and partner on the world stage. It confirms that international activities will contribute to the Government's purpose of increasing sustainable economic growth by:

- Creating the conditions for talented people to live, learn, visit, work and remain in Scotland;
- Bringing a sharp economic growth focus to the promotion of Scotland abroad - so that the Scottish GDP growth rate matches the UK's by 2011; and
- Managing Scotland's reputation as a distinctive global identity, an independent minded and responsible nation at home and abroad and confident of its place in the world.

18. Science, engineering and technology in Scotland contributes substantively to all three by dint of the quality of research undertaken in the Scottish science base, the flow of students and researchers to Scotland and the related draw for foreign direct investment (FDI) by companies wishing to access highly skilled staff or research communities. In addition 70% Scottish exports are dependent on science and engineering.

19. The [International Lifelong Learning Strategy](#) was launched in March 2007. It aimed to position Scotland as a world-leader in international post-school education. It included supplementary aims concerned with, for example, attracting talent to Scotland and fostering international partnerships and strategic alliances.

20. It provides good data on student and staff numbers and their economic contribution. students who come to Scotland to study, and about the economic contribution they make. Scotland had over 36,000 international students in 2006/07, of which around 24,000 were from outwith the EU (15,000 were at postgraduate and 9,000 at undergraduate level). There has been a 50% increase in EU students in last 5 years and a 118% increase in students from outside the EU. In terms of staff, Universities Scotland (US) estimate that approximately 20% of the teaching staff in Scottish universities is from outside the UK. One of the most obvious benefits these students and staff bring is an economic one – Universities Scotland estimate that an average overseas student taking a four year degree course invests up to £50,000.

21. . In May 2008 a new £1.5 million fund to support the development of Scotland's ILL strategy was launched. The funding - £500,000 a year over three years - is intended to promote collaborative working to:

- enhance Scotland's profile in key international markets; increase college and university engagement in international education;
- support post-graduate employment of international students; and
- improve the quality of the international student experience; and
- increase opportunities for students and academics to gain overseas experience.

22. The UK is the largest recipient of FDI in Europe, and the 2nd largest globally (after the USA). Although “services” dominates FDI between developed countries, in 2006 there was a ‘significant increase’ in FDI in R&D intensive industries, especially in the pharmaceutical and auto industries. Of the £313m worth of inward investment in Scotland recorded by SDI in 2006/07, £95m came from the Americas, £179m from Europe, the Middle

East and Africa (EMEA), and £39m from Asia-Pacific, and creating or safeguarding 7,507 jobs. An SDI analysis of FDI prospects by key sectors is set out below:

<b>Lifesciences</b>	Analysis	Global market, some international reputation, growth in exports and FDI
	Response	Target inward investment potential and support export capability
<b>Energy</b>	Analysis	European hub with international reputation. Growth in exports and FDI success
	Response	Internationalisation support of growth companies especially in O&G and Power gen
<b>Food &amp; Drink</b>	Analysis	Strong export sector especially whisky and fish. Majority of sector relies on UK markets.
	Response	Exploit premium growth markets internationally and build profile of Scotland as visitor destination of high quality F&D
<b>Tourism</b>	Analysis	Good growth in visitor numbers. Global profile in certain products and destinations.
	Response	Product and destination development targetting international visitors and benchmarking internationally. FDI focus on attracting complimentary assets to key destinations
<b>Financial Services</b>	Analysis	Global market with increasing competition. One of Europe's leading financial districts, 2nd in UK. Largest FDI sector in Scotland
	Response	Enhance Scotland's image as centre of financial services expertise. Continue to attract high value jobs to the sector. Support growth companies to internationalise
<b>Electronic Markets</b>	Analysis	Significant FDI and export. Global reputation in small niche areas
	Response	Support international business development and FDI including convergence areas.

23. The Group also reviewed material setting out the science strategies of a host of other nations (see in particular Paper 2 which describes the relevant policies of the Arc of Prosperity countries), and recognised that a major consequence of globalisation is that scientific research and knowledge production is increasingly distributed across the world. The share of the EU in worldwide R&D expenditure has declined from 29% in 1995 to 25% in 2005. The shares of the US and Japan have also declined over the same period. Gains are mainly found in China, South Korea and other emerging Asian countries. For example, China's R&D expenditure has been growing at close to 20% a year since 1999 with plans for it to rise to 2.5% of GDP by 2020. In Korea current R&D spend is close to 3%. India plans to raise its R&D spend from around 0.8% of GDP in 1996 to 2% by 2012.<sup>5</sup> Governments around the world have recognised the key role that scientific research plays in successful economies and are developing strategies designed to increase their research intensity and in particular the intensity of business R&D.

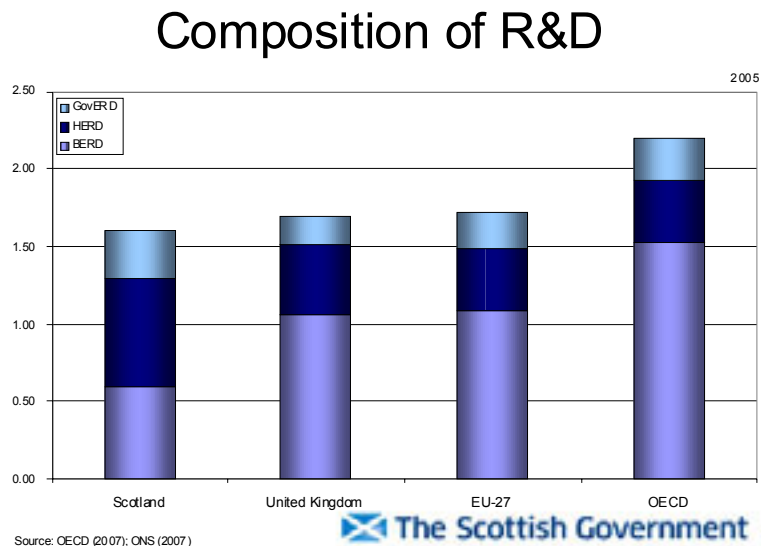
24. The OECD report "[The Sources of Economic Growth in the OECD Countries](#)" states "indicators of the "intensity" of R&D within each country support previous evidence, suggesting a significant effect of R&D activity on the growth process. Furthermore, regressions including separate variables for business-performed R&D and that performed by other institutions (mainly public research institutes) suggest that it is the former that drives the positive association between total R&D intensity and output growth."

25. "The future of Science and Technology in Europe - setting the Lisbon agenda on track" (2007) describes the policies and progress of countries including Denmark, Ireland, and Norway towards the EU goal of increasing research expenditure to 3% of GDP. It records a lack of visible progress between 2002 and 2005 and suggests that "this is largely

<sup>5</sup> Atlas of Ideas - How Asian Innovation can benefit us all - DEMOS Report 17, January 2007.

due to the fact that business research expenditure depends on the structure of industry, which evolves slowly”.

26. Scotland scientific research base invested the equivalent of 1.61 per cent of GDP in R&D, which below the UK level (1.76 per cent) and also below the EU and OECD averages. Although we are only lagging slightly behind the R&D expenditure of the UK and EU, the composition of Scottish R&D expenditure is distinctive. Compared to the UK, EU25 and OECD averages, Scotland is ahead in terms of government R&D and far ahead in terms of HE R&D expenditure. On the other hand, a relatively small proportion of Scotland’s R&D is carried out by businesses.



27. Government support for scientific research in Scotland’s **universities** is set in the context of a UK-wide dual support system:

- a research quality assessment system, shared by the four UK funding bodies which informs individual funding bodies’ Quality Research (QR) grant allocations for infrastructure towards university facilities and academic staff;
- a UK-wide Research Councils system which provides project funding for research staff and specific pieces of equipment and apparatus, to which UK HEIs and RC-owned research institutes bid competitively; and,
- the umbrella organisation, RCUK, which provides coordination across the UK and mechanisms for engagement with the funding agencies of other European States and the EC.

28. Scotland’s science base as a whole has achieved a high proportion of the UK investment in SET. This is particularly evident in the proportion of UK funding achieved from the UK Research Councils, where in every year over the past 8 years to 2005-06 the proportion has been 11 or 12%, compared with a population share of just under 9%. This amounted to £222m in 2006-07, compared with the SFC’s £176m<sup>6</sup> Main Quality Research Grant (which funds the infrastructure which underpins those competitive UK allocations).

29. Scotland also achieves high levels of research funding from UK charities and other UK funders of research. For instance, the Wellcome Trust spends around 15-20% of its research funding in Scotland – around £35m in 2006. Other leading research charities include Cancer Research UK (£14m in 2006) and the British Heart Foundation (£5m in 2006), and in total the Association of Medical Research Charities estimate that their members spent around £61m in Scotland in 2006, 14% of the UK total.

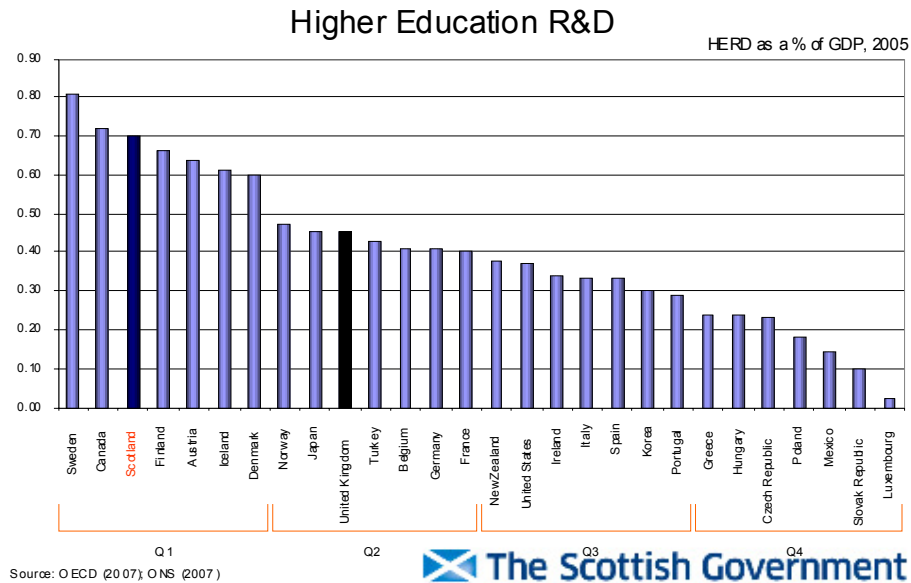
<sup>6</sup> £197m for academic year 2008-09.

30. Much of this success is the result of the dual support system which ensures that the science base infrastructure remains competitive with the UK's. However, there is also evidence that the quality of SET in Scotland is highly competitive in world terms notably the recent Evidence report which indicates that Scotland is first in the world in terms of citations per GDP and second in terms of the impact of our science.

31. The 2001 Research Assessment Exercise (RAE) signalled that Scotland had inadequate critical mass and scope for further collaborations. In deciding what to do in support of the research base it was concluded that the English proposal of research concentration in specific HEIs was not a solution for Scotland. Instead, it was concluded that the model should support excellence wherever it is – led by the highest quality leadership. The policy options would be to restructure (support or redeploy); build upon strengths, with rationalisations; and nurture sustainable areas. Out of this thinking has come the Strategic Research Development Grant (SRDG) and related subsequent funding innovations. SRDG is a mechanism of strategic investment used to accelerate significant strategic investments in research infrastructure. The SRDG aims to bring together existing research strengths to further improve capability and quality, and to build capacity in areas of strategic importance to Scotland. These are often partnerships between SFC and other funders. The Scottish School of Primary Care might be regarded as an early pilot. It brought together the expertise of all four departments of academic general practice/primary care to create a more effective critical mass better able to develop and support capacity and capability in this important field of healthcare. That said, a distinctive feature of Scottish research structure in the past four years has been the enthusiasm of the HEI sector for large scale collaborations – sharing of sovereignty over an area – referred to as ‘research pooling’. To date, pools have been created in Physics, Chemistry, Geoscience, Economics, Engineering, Biological Science and Brain Imaging with a total SFC investment exceeding £100 million and a total investment over all partners exceeding £300 million. New investments, such as that for Informatics and Computer Science, will bring the total number of ‘pools’ and similar pan-Scottish collaborations up to fifteen, involving more than 50 per cent of the Scottish research base. Proposals are still coming forward, e.g. for Marine Sciences. These structures offer further opportunities for cultural, policy and economic development. The Research Assessment Exercise (RAE) 2008 will report in December and the Scottish Funding Council will use it to inform funding decisions from 2009-10 until further notice<sup>7</sup>.

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<sup>7</sup> A new UK-wide mechanism to assess research quality, the Research Excellence Framework, is currently being developed by all four UK funding bodies. The Scottish Funding Council has, as yet, taken no decision as to whether it will participate in the REF or whether it will use the output of participation in any future funding method. Decisions will be subject to the outcome of the Joint Future Thinking Taskforce on Universities.



32. **Business** investment in SET is best approximated by Business Expenditure in Research and Development (BERD). The value of business enterprise research and development (BERD) undertaken in Scotland in 2006 was £579 million, 4% of the UK total and 0.56% of GDP. Expenditure decreased from £586 million in the previous year (a 4% decrease in real terms), mainly due to a decrease in expenditure on services R&D. This follows a large increase in overall expenditure in 2005. Almost two thirds of Scottish BERD supported just three product groups: ‘pharmaceuticals’ (42%), ‘precision instruments’ (19%), and ‘machinery and equipment’ (9%). Scottish business R&D provided employment for 7,325 people in 2006, most of which is made of up scientists and engineers. The majority of Scottish BERD is funded from businesses own funds.

33. Business participation in collaborative EU research programmes is also low relative to other European nations, despite the fact that the funding covers significant elements of the cost of participation (and the risk of participation are further lowered where business collaborate but do not lead) and provide a range of potential benefits:

- sharing the cost and risk of product, process or service development;
- developing existing or emerging fields and markets;
- nurturing business relationships and encourage pan-European networking; and
- accessing leading-edge technology and share expertise.

34. . In addition, the [Scottish Proposal Assistance Fund](#) which is available through SE and HIE provides assistance to businesses, in the form of a discretionary grant. This helps business develop quality project proposals for submission to the *Cooperation, People and Capacities* programmes of the European Commission's Seventh Framework Programme for Research and Technological Development

35. GES highlights how the low level of BERD drags down the overall level of gross expenditure on Research and Development (GERD) as a proportion of GDP:

*“While the rate of expenditure on R&D in Higher Education is in the top quartile of OECD economies and government R&D spend is above the average EU 25 and OECD rates, business expenditure on R&D in Scotland is less than half the UK rate. Scotland's business R&D statistics, however, do not take into account all of the innovative activity undertaken in the Financial Services sector. Moreover, R&D statistics provide only a partial view of Scotland's performance on innovation as the focus is on 'technical R&D' rather than a wider concept of innovative activity that would include process and service design innovation. Scotland ranks in the second quartile of EU members in the Community Innovation Survey, which reported that the majority of Scottish firms (56 per cent) were engaged in some form of innovation activity during 2002-2004, broadly in line with the UK average.”*

36. It should be remembered that BERD incorporates a significant level of spend in ‘Development’ as distinct from ‘Research’ so it is likely to overstate the level of business driven science.

37. The report, "[Metrics for the Scottish Research Base](#)" shows that investment in our research base has produced very positive results in terms of quality and impact. It confirms Scotland's world-leading position on the overall rate of citation, and our almost world-leading position of the impact of our research. The report provides information on the performance of Scotland's research base relative to that of the 26 comparator countries which are responsible for around 95 per cent of the world's top research. It contains information on research carried out in universities, research institutes, the NHS and by industry. It assesses Scotland's performance relative to the UK, G7, EU25 and similar sized EU economies such as Belgium, Denmark, and Finland, and confirms that:

- We are first in the world in terms of the rate our research papers are cited, relative to our GDP. Scotland captures 1% of world citations.
- We are ranked second in the world behind only Switzerland and ahead of the USA in terms of impact of the research we produce. Impact is measured as the average number of citations per paper, and this has been increasing progressively over the last ten years.
- Our best performing research fields, in terms of impact, are clinical sciences (2nd in the world), health and related sciences (1st), and biological sciences (3rd). Other strongly performing subjects are physical sciences and mathematics.

### 3 - Looking Ahead - Key Challenges

38. The Working Group accessed a range of futures or foresight material in order to ensure that as far as is possible policy analysis is robust and looks beyond immediate challenges. The main themes taken into account by the group were:

- The impact of demographic change in Scotland and the complex interaction of migration, age and employment factors; coupled with increasing competition for highly qualified and increasingly mobile individuals with knowledge and skills and global capital;
- Globalisation, and a recognition of the scale of investment in SET in across the world, with science and engineering being identified by most countries as a key factor in economic success; and
- The value which society invests in SET may increase in direct proportion to growth in popular perception of the threats posed by for example climate change and depletion of and competition for resources such as energy and food.

39. That said, as indicated earlier, the 2006 consultation and responses provided the Working Group with a range of long term perspectives and issues, including in particular:

- Promoting science and research links with important economies particularly in the Far East, USA and Europe
- Further development of mechanisms to attract and retain world class researchers, early career scientists and PhD students - from research fellowship schemes to investment strategy needed to be developed both for infrastructure and personal reward structures for science and scientists
- Responding to increasing competition from emerging economies such as India and China - the aim for the future should be to make Scotland a global centre for technologically-advanced and knowledge-intensive FDI;
- Most leading OECD countries undertake R&D tax incentives;
- Encouraging young researchers to spend some time abroad and then return to Scotland - for example through more international scholarships, exchange programmes and awards could be created for researcher to undertake sabbaticals in important existing or future science based economies
- The role of Scotland's Colleges as a gateway to the Higher Education system for international students and through exchange programmes e.g. Colleges are involved in both provision of, and advice on, technical education at Higher Education level in China, the Middle East and Africa
- Attracting more UKRC funding for PhD positions;
- In order to be attractive to international researchers, Scotland could host even more international scientific conferences;
- Continued investment in Universities and Research Centres to attract, reward, and retain world-class research staff within world-class infrastructure
- The problems experienced by companies and businesses engaging in EU Framework programmes;
- The sustainability of the international student market given the growth in English-language provision; and
- The role and expertise of SDI and the difficulty of supporting international staff who may not be expert in the context of a particular sector or scientific discipline.

40. These issues - and more - were captured by the Working Group in an early and very comprehensive SWOT analysis (which complements the interests and work of the other two working groups) was used as a checklist and reference guide as progress was made to final conclusions and recommendations -see Annex 2. However the Working Group subsequently prioritised the following set of inter-related challenges for Scotland's science base:

- Global competition, and the need to maintain our national pre-eminence in SET teaching and research; the threats and opportunities posed by emerging SET driven economies;
- Developing a science workforce which is aligned to the needs of the science base, by continuing to invest in basic research based primarily on excellence and by retaining or attracting scientific talent and expertise;
- Increasing business R&D and utilisation of the science base, and attracting inward investment; and
- Improving the international marketing of science in Scotland, and integrating SET messages more prominently into the international "branding" of Scotland.

41. Finally, it is important to record that the Working Group was given two very valuable presentations from Interface and the Sector Skills Council for Science, Engineering & Manufacturing Technologies (SEMTA) about, respectively, building knowledge exchange links and the potential for a new international dimension, and science skills which are important for many science-based companies operating in Scotland and related plans to develop a new **science skills forum**. The latter may more properly fall to the Science Base Group to approve or pursue, but the Working Group saw real merit in bringing together all delivery stakeholders at regular intervals when new "science" labour market forecast information becomes available in order to ensure an appropriate degree of co-ordination, communication and understanding, and ultimately an increased expectation that the supply and demand for science skills might generally be more likely to be in balance.

#### 4 - Next First Steps

42. The Working Group believes that the key to science supporting our international profile and FDI growth is to sustain the science base and the current prioritisation of research excellence.

43. Scotland is - and has been long recognised as – a science nation. That needs to be sustained. As such, the Working Group’s consideration of options were firmly rooted in a recognition that excellence in scientific research and teaching are key factors in Scotland’s current international and economic position - in terms of: recognition, reputation and influence; provision of teaching, learning and qualifications (in schools, colleges and universities); research partnerships - at individual, institutional and strategic levels; and securing sustainable inward investment (particularly in research). Many countries around the world are investing heavily in SET in order to create the type of national science base Scotland already has. Business R& D may as the OECD report suggests be the optimum driver of sustainable economic growth, but it is important to recognise the importance of SET R&D currently undertaken in institutions in Scotland as being a key factor in attracting and retaining the presence of global technology companies in Scotland. The Working Group recognised and accepted the importance of building on the existing strength of Scotland’s science base to improve business investment in R&D and ensuring that actions to increase business R&D over time do not jeopardise the scale and quality of investment or R&D already in place.

44. It is also worth highlighting that this type of evolutionary approach seemed wholly consistent with the context of established financial allocations for Scottish Government up to 2010-11 and a recognition that these issues would be revisited in the next and subsequent Spending Reviews. It is also a product of the Working Group’s view of what the new science framework should not do under any circumstances, which would be to undermine in any way the existing quality, impact and international standing of Scotland’s science base. The key to science supporting our international profile and FDI growth is to sustain the science base and the current prioritisation of research excellence, together with the range of options set out below.

45. Of course, the extent to which science and technology can immediately underpin higher global competitiveness will vary across Scotland’s key sectors and there is therefore a need to consider, develop and take forward a sectorally focused approach in relation to implementation of relevant proposals. That will be particularly valid where opportunities are interdisciplinary or trans-disciplinary. Research pooling as funded by the SFC may provide a useful platform for exploiting these opportunities - as indeed would collaboration with sector advisory boards and other business stakeholders best placed to identify and help address sectoral differences.

46. The GES states that “our people are our greatest economic asset. A skilled and educated workforce is essential to building our comparative advantage and on the delivery of sustainable growth. Investment by all individuals and by the state in early years, school, further and higher education has a proven impact on the employability and productivity of individuals and, in turn, business growth.” As such, the Working Group favours a range of actions to promote the development of the SET workforce of the future:

- An integrated range of Scottish Saltire Scholarship/Interchange programmes which support the development of science and scientists in Scotland and sustainable strategic partnerships with the best in the world - effectively drawing together and building on a range of existing initiatives - for example Chevening Scholars and the new range of bursaries and PHD s targeting improved links with China, India and the USA - to create critical mass and brand profile; this could be a key part of the goal set out in the International Framework of managing Scotland’s reputation as a distinctive global identity; the pace and scale of growth would be dependent on the availability (if any) of new or redeployed funding); [Delivery partners - OCSA/HELs/SFC/International]
- Subject to resource availability postgraduate research studentships and Knowledge Transfer PhD studentships - at an assumed approximate average costs of £10,000-£16,000 per student per year<sup>8</sup>. Students would supervised by institutions in two countries: Scotland and, for example, China, India, Pakistan, Brazil or African countries. Expected benefits would include attracting talent to Scotland and offering a high quality experience, fostering international partnerships and other strategic alliances and leading development, capacity building and sustainability projects [Delivery lead - SFC].

47. The Government Economic Strategy signalled the importance of building “on the new more focused structure of the Scottish Government by reducing duplication, bureaucracy and overlap across the public sector in pursuit of greater efficiency, effectiveness and speed of delivery”. As such, the Working Group favours a range of options designed to ensure and enhance Government support for SET-driven sustainable economic growth:

- more effective collaboration to foster and **exploit future opportunities to attract inward investment** in our science and research base in research institutions and companies:
  - SDI target and grow inward investment linked to new world-class research centres identified in RAE 2008;[ Delivery partners - SDI – with support from SE/SFC/HIE/]
  - Support non-technical SDI staff based outside Scotland through Global Scot network, linked to greater SDI/OCSA collaboration and joint exploration of the scope for an SDI-support function in research pools [Delivery partners - SDI/SE/SFC/OCSA];
  - Science stagaire – promoting increased - preferably two-way - interchanges with EU (and others) - involving policy-makers, scientists, trade organisations and key sector bodies [Delivery partners - OCSA/HELs/International]
  - International Interface - development of role of pilot to resource consistent participation in SDI proposition preparation particularly in providing support to non-technical staff based in other countries; this recognises that the impact of Interface is substantive, but small-scale and constrained by resource/capacity. Expansion may involve either more direct articulation with SDI in support of FDI options or increase support for marketing/new business [Delivery partners - SDI/SFC/SE/HIE].
- Sectoral R&D advocates - to promote business engagement with R&D and in particular EU collaborative programmes; this would necessarily also involve work to raise awareness and uptake of the Scottish Proposal Assistance Fund [Delivery partners - SE/HIE]

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<sup>8</sup> Actual cost is dependent on a) the ability of the partnering country to contribute towards costs and b) the fee level for international institutions receiving Scottish students.

- As acknowledged in the International Framework, Scotland's reputation as a nation renowned for innovation in science and technology can play an important part in how Scotland is perceived by those considering Scotland as place to live, learn, visit, do business and invest, which in turn will impact on economic growth. Scotland's image could be enhanced in a more coherent and consistent way by an accessible hierarchy of core messages and utilisation by individuals representing Scotland anywhere in the world. The Scottish Government and partners should work together to measure attitudes and perceptions, and capitalise on such opportunities to enhance and strengthen Scotland's SET reputation. [Delivery partners - International Projects/ SDI/ OCSA]

48. The Working Group welcomes complementary proposals emerging from the Science Base Working Group and endorses in principle the Knowledge Exchange Group proposal that investment in strategic KE activity should be increased in order to promote sustainable economic growth generally and in business R&D and business-led collaboration with the science. The Working Group does not however endorse the suggestion that such increased funding could come from a redistribution from the SFC Main Quality Research Grant, believing that any such reduction would be incompatible with "delivering an evolving base of international quality and reputation, and one that is ready to seize opportunities as the scientific and economic agenda shifts against a backdrop of strongly increasing global competition in science". We need to maintain and develop the competitiveness of the Scottish science research base, in order to attract investment and gain maximum economic and social benefit. The case for additional investment is strong and compelling, and conversely the adverse impact of any real terms reduction would be significant.

49. The Working Group also endorsed calls from the other Groups for appropriately co-ordinated joint activity involving SFC, SE and HIE focused on outcomes.

## Annex 1 – SWOT Analysis

<p><u>Strengths</u>          Research base          Scottish education          Pooling          Scottish HEIs are much more internationalised than our companies          There are some very innovative and lively SMEs.          English is generally the language of science.          Cost effective to locate in Scotland          Good quality of life          Diversity - applies to HEIs niches, international engagement, geography          But compact - centres of population, concentration of unis, clusters.          SG more accessible          Historical links eg US homecoming, EU, UK          Green energy (infrastructure) - potential          Use Scotland as a base for Europe - legacy of industries eg. Defence          Highly skilled skills base          Part of the UK - plays into all SWOT dynamics.          70% of Scottish exports are stem dependent.</p>	<p><u>Weaknesses</u>          Migration          Demographics          High percentage of SMEs          Low interaction SMEs with universities          Low local BERD – links with HEIs          BERD predominantly international          GDP low relative to skills base          More modest, lack of ambition          Transport issues and silo mentality Edinburgh/Glasgow          Are we flattering ourselves relative to competitors?          Low entrepreneurship          Good KT from HEIs but not to large scale.          HEI structure - competition for students but collaboration on research – enough “Scotland plc” behavior?          Language skills.          Outward mobility          Are we doing enough to target EU funding?          Part of UK/not part of UK – does lack of self governance affect graduate retention rates?</p>
<p><u>Opportunities</u>          Exploit ethnic base          Contribute more (policy/funding) to Europe, ERA etc          What support can we provide SMEs to grow?          Entrepreneurship is an opportunity. Explain how easy it is. eg. Iceland.          Ireland R&amp;D advocates – More proactive than Interface.          Vouchers for SMEs to access HEIs research.          Rapid response – Capacity to Change funding structures - Government/institutions with funding and scientifically informed staff) to really big investment opportunities          Making science more overt within branding.          HEIs refocus on commercialisation side?          Pooling - international pooling? CoEs          SDI - each account managed company will be encouraged to take up full range of services.          Greater outward focus - companies, students, support.          Networks of small companies getting together to bid for big projects.          Emerging economies - trade and HE links - China, India.          SCQF well regarded – selling our education sector.          Africa as a trade not just charity opportunity for Scotland eg. Malawi.          USPs - Green power, environmental science, agriculture (collections, heritage – food, biodiversity), health and life sciences.(drug discovery, clinical trials, stem cells) Rural skills/ICT, hi tech but within the communities inc distance learning          Part of UK/devolution model is interesting for externals.          International expansion - teaching, research, influencing aspirations          Constitutional reform          Knowledge legacy          Skilled people          Available land/facilities</p>	<p><u>Threats</u>          Not being able to grow the economy – SME complacency or resistance.          Lost opportunities eg. in emerging markets - our competitors beat us          VC (esp US) funding decrease will have large negative effect in Scotland - need to diversify our FDI base          Reduction in public funding - Westminster          Brain drain?          Ageing population          Is pooling sustainable? Evaluation this year.          Further EU expansion in membership negatively affects Scotland          Inward investment – mobility          Mismatch – policy/investment          Government seeing science funding as a priority          Less people studying science.          Having unsustainable short term partnerships eg international students as cash cow – what happens when China has capacity to train its students?          RSA - UK/EU - boundary changes          Being silent - not selling Scotland enough.          Investors may withdraw if full independence but others may come in.          UK competition.</p>

## **Annex 2 - Group Membership**

Chairman - Professor Tariq Durrani (SFC)  
Vice-Chair - Mike Shiel, SDI  
Joe Brown, BGI-SSP  
Hazel Gibson, OCSA  
Tracey Houston, HELS-HEFR  
Ann McVie, HELS - International Students  
Murray McVicar, SFC  
Oonagh Loughran, SE  
Calum Davidson, HIE  
Daniel Klienberg, DGE-International  
Alison Spaul, DGH-CSO  
Liam Kelly, DGEnv-SPC  
Dermot Rhatigan, DGE-EDS  
Anthony Moulds - Analytical Services  
Lynn Graham - Analytical Services