

Council for Science and Technology: comments on the *science and innovation investment framework 2004-2014*

1. The Council for Science and Technology welcomes the government's clear recognition of the strategic importance of science and technology to our society in the *science and innovation investment framework 2004-2014*. The objectives of securing a sustainable science base while at the same time working to maximise the long-term social and economic benefits of scientific endeavour resonate strongly with us.
2. The investment framework is not an end in itself but a means of ensuring that we as a nation can build a research base across universities and business that: is of the highest international scientific standing; is sustainable; produces and can draw on a skilled and diverse workforce; operates with increased collaboration both within the university sector and between universities and industry; enables greater innovation by business; supports public policy development; and is supported by the public.
3. In this document we focus on a number of areas that we regard to be key issues for government and for the science base. We are keen to work with the government to develop solutions to these issues and would be interested to hear where government believes CST could add value to its own deliberations and where it has other mechanisms in place to address these issues.
4. Our comments fall under three main headings:
 - Nurturing a flexible and responsive science base
 - Building the relationship between science and society
 - Reaping economic and social benefits

NURTURING A FLEXIBLE AND RESPONSIVE SCIENCE BASE

5. We need a science base that has both the creativity to identify new and exciting scientific questions and the capacity to take advantage of the opportunities it creates. Government's allocation of public funding is the most direct route by which it can influence the behaviour of the science base.
6. The commitment to sustainability in the UK science base, matched with real increases in public funding, is welcome. Together with the ambitious target of increasing UK R&D investment as a proportion of national income from its current level of 1.9% to 2.5% over the next decade, this should have a very visible impact on our science base. The additional funding that the government is putting in to the science base is significant but, as the framework makes clear, achieving the target of 2.5% depends substantially on increased investment in R&D from the private sector. Stimulating this increase represents a huge challenge. Notwithstanding this challenge, we do not want to lose sight of the longer-term target of 3%, agreed by EU member states in Lisbon, March 2002.

Allocating public funding

The Research Assessment Exercise

7. The allocation of a block grant to university vice-chancellors presents them with the freedom to allocate resources flexibly across their institution according to their own strategic priorities. However, in practice, a major factor influencing vice-chancellors' decisions is the need to secure the maximum possible rating in the next round of the Research Assessment Exercise (RAE) and so secure the maximum possible grant next time round. Such decisions are influenced not only by the written

rules of the RAE but also by perceptions of how the system operates, which can restrict creativity and lead to unintended outcomes.

8. For example, we are concerned that there is a widespread belief that the RAE does not recognise interdisciplinary research on a par with research within disciplines. Given that some of the most exciting science is taking place at the boundaries of the traditional science disciplines, this is an important concern. We have discussed our concerns with the UK funding bodies and the Research Councils. We were reassured that they are aware of the potential barriers to interdisciplinary research and that they are actively looking to address them. But we are not confident that positive messages about the assessment of interdisciplinary research in the RAE are getting through to universities. We would like to see the funding bodies putting greater effort into communicating how the RAE can contribute to the nurturing of a flexible and responsive science base and embrace interdisciplinary research.

9. As well as providing a basis on which to distribute block grants to universities, the RAE has also, in the past, contributed to driving up the quality of research in UK universities. We have a real concern that it is no longer yielding dynamic change. Without such associated benefits, it is increasingly difficult to justify such a hugely bureaucratic, expensive and disruptive process.

10. We do believe that the government and the funding bodies are aware of the shortcomings of the RAE and are therefore disappointed that the decision has been taken to continue the system essentially unchanged in 2008. We acknowledge the steps that have been taken by the funding bodies to improve assessment of interdisciplinary research and to lighten the bureaucratic load but are not confident that this minor tweaking of the system will deliver a process that feels significantly different on the ground.

11. Given that this decision to go ahead with the 2008 RAE appears to be irrevocable, it is essential that the government and the funding bodies communicate clearer messages to the science community and to the RAE review panels over how the RAE is intended to contribute to the nurturing of a flexible and responsive science base. At the same time, to enable more radical change to be introduced for future assessments of research quality, urgent steps must be taken to develop alternative metrics.

Full Economic Costs

12. The introduction of Full Economic Costing (FEC) is intended to ensure a sustainable future for the UK science base, a sentiment that we wholly endorse. But we do not want to see FEC come to unintentionally restrict creativity in the way that the RAE has done. Now is the time to predict unintended consequences of the introduction of FEC and to plan mitigating steps; we acknowledge that this is an area that government has been considering.

13. We support the principle of FEC as applied at the institutional level: universities need to ensure that, across their full portfolio of activities, they are operating on a sustainable basis. Application at the institutional level rather than at an individual project level is an important contribution to ensuring that perverse effects are minimised. We believe that this is what the government intends but it is not well understood across the higher education sector: continued communication is essential.

14. The government is frank about the need for other funders of research to share its vision for a sustainable research base. The explicit recognition of the important role charities play in UK research is welcome. We commend the government for the win-win funding strategy presented in the framework, which sees the creation of a new funding stream from government to support charity research funding.

15. Notwithstanding these welcome developments, there is a risk that researchers will be less likely to approach sources that do not pay FEC for project funding. For example, while the Research Councils are committed to moving towards FEC, other funders, including charities, the EU and industry (particularly SMEs), are likely to be reluctant or unable to increase the price they pay. Researchers may therefore instead turn increasingly to Research Councils' already overstretched budgets or, in the case of industry, feel unable to put forward competitively priced proposals. Flexibility at an institutional level is essential to recognise that universities receive funding from a diverse range of sources. This flexibility needs to be clearly communicated by government and understood by universities and researchers.

European framework funding

16. The UK is currently successful at securing funding through the EU framework programmes and this is likely to extend to the European Research Centre with the welcome agreement that excellence will be the only criterion to be used in allocating funding. We fully support the government's plans to argue for EU programmes to pay a higher proportion of the total cost of research projects. However, given the difference between funding systems in the UK and other countries in Europe, the chances of success appear low.

17. It would be extremely unfortunate if applications from the UK for EU funding fell with the introduction of FEC. In parallel with monitoring the UK's success in securing EU framework funding, we suggest that government should start to explore the feasibility of providing a fund to support EU grants similar to that developed for supporting projects funded by the medical research charities.

18. We believe that these issues require careful consideration and that the government should consider their implications for the operation of the dual support system.

Supplying a skilled workforce

19. Our university research departments rely heavily on young scientists, primarily graduate students and post-doctoral trainees in the age range of 22-35 years. For many of these people there will be little opportunity for career progression as research scientists. This arises for a number of reasons, but includes the pyramidal structure of the academia and limited opportunities available in industry. The mismatch between the aspiration of these young researchers and the opportunities available to them creates bad publicity for scientific careers. We suggest that government explore further how supply and demand could be brought together and would be keen to work with government in finding ways to tackle these issues.

20. In parallel, we ask whether the UK is training an appropriate quantity and quality of BSc, MSc, PhD and postdoctoral students to be effective in scientific research, industry, teaching and in more general non-science roles. One question is whether the academic research endeavour would be better served by having fewer but higher quality and better resourced research scientists. The current emphasis on quantity, reflected in the indicators that the government plans to use for measuring the progress of the framework, distorts the issue.

21. It is encouraging that the framework, quite properly, takes the issue of the supply of SET skills so seriously. However, it has relatively little to say about the demand side, to which supply is closely coupled. We would like to see greater attention given to ways in which the demand for and awareness of the benefits of R&D can be stimulated in industry. This would create a greater demand for scientists and engineers, making these more attractive career options for young people while at the same time building a stronger business R&D base.

22. The framework discusses the structural interdependence of teaching and research funding in universities, such that falling rates of student applications have led to the closure of active physics and chemistry departments. Vice-chancellors have to make these difficult decisions based on the best interests of their institution. At the same time, government should have a role in ensuring that, at a national level, we maintain appropriate teaching provision and an excellent research base across disciplines.

23. The framework offers two solutions to the issue: to require universities to give 12 months notice before closing a department; and for HEFCE to provide additional funding to departments under threat where closure would hinder student access to disciplines that are important to national and regional economic development. We do not want to see HEFCE establish an overly bureaucratic process that interferes with universities' independence. At the same time, we recognise that HEFCE has a legitimate role in overseeing the health of disciplines at a national level and would support intervention that aligns with the usual principle of supporting excellence.

BUILDING THE RELATIONSHIP BETWEEN SCIENCE AND SOCIETY

Engaging with the public

24. The public acceptability of new technologies will be crucial to the realisation of economic benefit from the investment framework. We concur strongly with the framework in the need for greater public engagement and dialogue in science-based policy and think that the suggested approaches are a good way forward. We cautiously support the move away from the current responsive mode of funding for public engagement programmes and are keen to help government think about how the practicalities might be worked through.

25. The emphasis in the framework on increasing industry's investment in R&D makes the need for careful public engagement based on best practice all the more important. The public trusts scientists working in academia more than those working in industry, although this could be at risk with the increasing engagement between academia and industry. Entering into dialogue with the public about how new science and technologies could benefit society and about areas of potential concern before applications are developed (co-called 'upstream' engagement) may help government, industry and scientists to make decisions that gain greater public acceptance. In particular, thought should be given to how public engagement can feed into the new Technology Strategy Board.

26. We suggest that there are four issues that should be given particular priority and are already working with government to explore and address them:

- Horizon scanning for public concern. We agree that, in parallel with OST's developing processes of foresight designed to identify new technological potential, there should be a process designed to anticipate emergent areas of public concern, not only about new technologies, but also about economic and social processes where there is perceived risk of harm.

- Appropriate processes of public engagement and dialogue. The framework rightly stresses the importance of developing processes of dialogue where science based issues of public concern can be addressed. The nature of these processes needs to be adapted to the nature of the issue and of the likely public response; work should be done to describe good practice.
- Relating dialogue to decision making. Dialogue alone is not enough. A process of dialogue that appears to be ignored in the process of ultimate policy formation will rapidly lose credibility and cease to engage the public. Clearly, government decision-making is informed and influenced by a wide range of factors, but there is a need to acknowledge the role of dialogue and to explore ways of feeding back to participants and the public how their aspirations and concerns have been considered.
- Costs and benefits of public dialogue. Government may want explore whether it is possible to quantify the benefits and costs of engaging in public dialogue.

Enthusiasing young people

27. It is widely agreed that we need young people to be given a strong foundation in science so that: they can be confident in taking decisions in their own lives that are based on scientific understanding; are aware of the role of science in shaping our culture; and, last but not least, continue to study science and aspire to science-based careers.

28. We welcome the emphasis in the framework on the need to ensure a strong supply of science teachers: excellence and enthusiasm in teaching produces excellent and enthusiastic students. The framework also identifies the key role that wider partners can play in enhancing science education, but does not issue the clarion call to the science and engineering community that is needed if more young people are to be enthused by science at school.

29. It is promising that HEFCE will work to increase science links to schools and colleges by 'supporting' universities in their outreach activities. It is key to the success of the framework that scientists are better enabled to engage in outreach activities, whether with schoolchildren or in dialogue. For this to happen, they need to be rewarded and valued for this kind of work, and it has to be meaningful for their career progression, rather than being seen as a distraction. However, looking to 'increase links' is not enough. The quality of the interaction and the impact need to be assessed and improved.

30. We welcome the plans to establish a high-level cross-government strategy group to bring coherence to the many education initiatives across the system. We encourage the group to look thoroughly at existing schemes, and in particular at their effectiveness, to help drive up the quality of provision. We also suggest that the remit and membership of this group should explicitly cover the UK as a whole; the issue of the supply of scientists is not limited to England.

REAPING ECONOMIC AND SOCIAL BENEFITS

31. The framework rightly emphasises the need to extract maximum advantage from past investments in the science base to bring us economic, social and environmental benefits today, including the creation of high quality and sustainable jobs.

32. However first and foremost, the framework represents a welcome and appropriate commitment to the long term view of the benefits from science and technology. The social and economic benefits that we are reaping today arise from

research carried out in past decades. We cannot, therefore, expect to see major benefits from today's investments in the science base for many years to come. We commend the government for investing for the future and resisting the pressure to sacrifice the long term for short term returns.

33. A long term perspective, however, requires the government to find ways to measure progress towards the long term aims. This should include assessment of the intermediate process changes explicit or implicit in the framework.

Identifying priorities

34. To use its resources most effectively the government must make its strategic investment choices in what is an inherently uncertain environment. We feel that there is a need for government to have an open and transparent approach to identifying priorities, which clearly demonstrates the use of a rational and objective methodology. In addition, there must be flexibility in the system so that the government can redirect resources in response to an analysis of progress. We welcome the establishment of the Technology Strategy Board to advise the government on setting priorities as a first step in the right direction.

35. We are concerned that the evidence and analysis presented in the framework places rather more emphasis on the technology producing sectors than those sectors that are technology users, such as the high-value-added service sector. Productivity growth in sectors such as retail, wholesale and financial services have, because of their weight in the economy combined with their productivity gains, driven much of the US productivity improvements in the past decade. They have the potential to do so in the UK too. The factors determining access to new technology in the service sector and to its implementation are important areas for policy to address. The same is true for the factors that affect the level of R&D activity in the sectors themselves and their access to the science base and technology suppliers.

36. We applaud the government's approach in driving innovation and R&D throughout the economy. At the same time, it is important to focus limited resources in areas of greatest opportunity. The Technology Strategy Board has a key role to play in this process and we will be seeking opportunities to work with them.

37. We were concerned that the important role of corporate venturing has not been addressed. The UK could usefully draw on examples from the US and elsewhere where corporate venturing plays a significant role in the overall provision of finance for innovative activity both in terms of exit routes for start-ups and early stage investments that boost to the R&D activities of hi-tech start-ups and SMEs.

Making science work for the regions

38. The Regional Development Agencies and their equivalents in the devolved administrations have a key role to play in facilitating knowledge transfer between the science base and industry to benefit their regions. The new Science and Industry Councils are a welcome development and will have an important role to play; we look forward to developing a relationship with them.

39. The global nature of innovation-intensive markets means that there is a propensity for successful innovative start-ups to expand internationally and or migrate regionally or nationally. This is an important challenge for RDAs wishing to capture the value added in their regional economies. But there will be areas of technology where only a national approach will suffice and where regional decision-making risks leading to duplication of activity. The framework will therefore require co-ordination among regional, national and international policies. Moreover while

there are strong economic and regional development arguments for technology transfer to be stimulated at the regional level, we emphasise that research priorities must continue to be identified on a UK-wide basis if we are to continue to pursue excellence.

Using science across government

40. We welcome the inclusion of a cross government focus in the framework; it is essential that the 'public good' benefits of research and development are not lost in the optimism around the economic gains that can be realised. We warmly welcome the role given to the Government's Chief Scientific Adviser in assessing departmental science and innovation strategies, which will be crucial in ensuring that all departments are playing their part in, for example, paying the full economic costs of research and encouraging industry to carry out more R&D.

41. It is interesting to see some detail on the activities of five government departments, although the criteria for the inclusion of these over others that also invest significantly in research, such as the Department for Trade and Industry and the Department for Transport, are not clear. We hope that it does not mean that these other departments have not thought through their strategies and priorities for research. We consider the omission of the Department for Education and Skills as particularly unfortunate as research carried out by that department should have a major role to play in informing the government's policies on strengthening the science skills base.

42. Two of the three government departments that are signatories to the science and innovation framework are undergoing major reorganisation in response to the Gershon and Lyons reviews: DTI and DfES. In developing their new strategic priorities, we hope to see both departments reflecting the enormous importance given through the framework to science, innovation and the underlying skills needs.

43. In the framework's 'vision for UK science' the government sets out an ambition for the UK to make a 'significant contribution to sustainable development and stabilisation of a world in which issues of poverty, education, water provision, population growth and global warming are tackled'. We endorse this aspiration. The description of the Department for International Development's activities given in the framework focuses almost exclusively on health issues. Responding to the threats from diseases such as HIV/AIDS, malaria and TB presents an enormous and critical challenge but should not lead to the exclusion of other science and technology issues. The Commission for Africa clearly presents an excellent opportunity to work in partnership with poor countries to consider the contribution that science and technology can make to development. We hope that DfID's new research funding framework will see the UK help strengthen capacity and encourage innovation in areas such as engineering, energy access, ICT and agricultural science, as well as health.

OVERVIEW

44. The government's vision for science and technology is bold, and the science and innovation investment framework sets out a sensible way forward. We are not alone in applauding the government for these developments, which demonstrates that the government has listened and responded to concerns and aspirations from across the science base. We hope that this open approach will continue and look forward to working with government in identifying ways to tackle key strategic issues so that the government's vision can be realised.

45. To enable us to provide the government with sound advice, we are developing relationships with key partners such as the Research Councils, Funding Bodies, RDAs and Learned Societies among others. We are already exploring how:

- government could make better use of public dialogue to contribute to greater public confidence in science, and government's use of science
- CST can work with the Technology Strategy Board to support government in selecting priority technology sectors
- personal information stored in databases can be used most wisely for the benefit of society
- research, development, technology and skills need to be managed if they are to contribute to a secure, low-carbon energy future

46. CST stands ready to advise government on tackling key challenges and issues. We welcome dialogue with government on where advice from the CST would be most valuable and would be interested to hear if the government would like us to follow up issues we have highlighted in this paper.