

# SUMMARY OF CONCLUSIONS AND POLICIES

## Chapter 1: Science in the Economy

**The UK should be in a position to take full advantage of new technological opportunities. It should achieve this by promoting the exploitation of academic research, by having a scientifically-capable, well-trained workforce, and by sustaining a fiscal and regulatory culture that makes the UK an attractive place for innovators and entrepreneurs. Government funding should recognise that private industry can only invest heavily in the development of a product, service or process once it has been shown to be feasible.**

⇒ In order for science to feed the economy in a healthy way, four elements need to be in place:

- i) the science base needs to be vibrant, with a reciprocal transfer of knowledge between the science base and wealth-creating industries
- ii) industry needs to carry out its own development and research, to generate new products and processes
- iii) colleges and universities need to train scientists and engineers to the range of levels, as a skilled workforce for economically-active industry
- iv) the science base needs to maintain a wide pool of expertise, available to grasp opportunities or deal with problems as they arise.

⇒ Successful knowledge transfer schemes should be eligible for continued public funding to make them more sustainable in the long-term, not just repeatedly to start new projects.

⇒ Future measures must ensure that exploitation of research is not hampered by unfair fiscal rules.

⇒ In measuring the success of universities in generating wealth-creating activity, the Government should use more sophisticated measures than the blunt instruments of counting spin-outs or patents.

⇒ The UK Government should press hard for the European Union to introduce an efficient, low cost, patenting system that would enable companies to protect their ideas across the entire trading bloc.

⇒ The Government should commission a rigorous study of the perception that British business has shorter-term horizons than companies elsewhere, and if the perception is real, of the reasons such short-termism prevails.

⇒ In the Government's portfolio of finance for business research and development, the role of the

Research Councils should be expanded to include support for high-quality research and development in the private sector. To achieve this, it will be necessary to ensure that the Research Councils put in place mechanisms to assess a wide spectrum of industry-based proposals, rather than merely considering research in academic institutions and academic analogues.

⇒ The educational curriculum, including vocational elements, in schools, universities and colleges should be sufficiently flexible to suit the changing needs of the economy.

## Chapter 2: Science and Engineering as Cultural Activities

**Science should be recognised as an important part of our culture and heritage, and the cultural value of science should be recognised as a valid reason to carry out curiosity-driven research. The scientific community should be in a position to engage actively with other groups in order to maintain and enhance this important relationship. Opposition to particular scientific activities must be understood, and the scientific enterprise must demonstrate some recognition of its accountability to society.**

⇒ Science should be treated at least equally with sports, the arts and heritage in the distribution of National Lottery funds.

⇒ When considering the BBC's Charter, or the more general use of public money for public service broadcasting, the Government should give proper consideration to whether science and engineering are being adequately covered.

⇒ Better funding mechanisms are needed to allow scientists to spend time on communication with a wider audience.

⇒ Funds should consistently be allocated to the Research Councils so that they can directly fund projects in the public sphere, without cutting into budgets allotted for research activities.

⇒ The Department of Culture, Media and Sport should contribute to the ongoing support of science centres; longer-term funds should be made available for all centres.

### Chapter 3: Science & Engineering in Public Policy

**Public policy in the UK should be based on the best research, and a proper appreciation of the deficiencies in the available information. Good policy-making depends on a strong scientific culture within Government departments and other public bodies, and on the adequate funding of necessary research.**

⇒ All Departments of State that have not done so should immediately appoint Chief Scientific Advisers, chosen from outside the civil service.

⇒ All Departments of State should initiate an active programme of employing scientists and engineers in the civil service on secondments, to bring in fresh thinking and better understanding of the way that science can be used in policy-making and implementation. Short-term secondments are important, and there would also be considerable merit in developing a programme of medium-term or long-term posts for scientists within the civil service.

⇒ The Government should create a post of Cabinet Minister for Science and Engineering, responsible for a Ministry of Science with a remit to coordinate scientific and technological issues across Government.

⇒ Strict adherence to constitutional rules must not hinder the proper flow of information, and if necessary, new formal mechanisms must be put in place to ensure that ministers and officials of the devolved parts of the UK have access to the most reliable scientific information.

⇒ As a first step towards restoring adequate investment in the evidence base on which policy is built, the overall budget for research within Government departments should be increased by at least 20% in real terms over the course of the next Parliament.

⇒ The Science and Technology Committee of the House of Commons should be re-established as on a permanent basis, equivalent to the Select Committees that shadow departments of state.

⇒ In general, all scientific advice to Government should be published as soon as possible in a form that is widely accessible.

### Chapter 4: Other effects of Science & Engineering on our Quality of Life

**Science and Engineering developments with the potential to improve our quality of life should be strongly supported even where they promise no economic growth and are not important for public poli-**

**cy. Medical breakthroughs that promise little or no economic return and technologies to ameliorate the effects of environmental pollution are just as important as scientific progress that promises significant and rapid wealth creation.**

⇒ The budgets of important scientific institutions like the British Library should be maintained and enhanced, both because of the economic value they create, but also because their activities improve the quality of people's lives in a variety of ways.

### Chapter 5: The Science & Engineering Research Base

**Excellence should be at the heart of the ethos of the UK's science and engineering research base, both in terms of what is being achieved, and in terms of potential excellence. Risk-taking and high quality research should be promoted and rewarded. The science base should include curiosity-driven investigations across a broad range of disciplines.**

⇒ To maintain a competitive science base in the coming years, the government should aim to invest in science and engineering research at a rate above the average of comparable industrialised countries. To achieve this, it will need to continue to increase funding at approximately the same rate as happened between 1998 and 2005.

⇒ As Research Councils move towards paying the full economic costs of research projects, either (a) the other leg of dual support funding for research must be maintained and enhanced in some form to regenerate the capacity of university researchers to carry out the most adventurous research, or (b) some other robust mechanism must be invented to ensure adequate funding for pilot projects, preparatory work and high-risk research.

⇒ In the short term, adequate levels of funding should be restored at least to departments rated 4 in the last Research Assessment Exercise.

⇒ In the medium term, funding decisions should be based not only on the preservation of what is already excellent but with due regard to the need to invest in potential excellence.

⇒ The British Government should make the payment of full costs by European grants a priority in the negotiations for future EU funding of science.

⇒ A central objective of policy for the science base should be to sustain high success rates for high-quality responsive-mode grant applications. Under the current system, it should not fall below 40%.

⇒ To prevent serious damage to the long-term potential of the science base, the government should remove the strings, conditions and additional direction that has come in recent years.

⇒ Most public funding for university science should be awarded on the basis of research potential and quality, and should not require the universities to raise large sums of matching funds.

⇒ A more sensible balance between research and teaching needs to be restored to the university system.

⇒ The funding for salaries should be sufficient to allow universities to achieve a more sophisticated system of rewards and benefits for academic staff, rewarding contributions to teaching, administration and research.

⇒ The Government should provide an additional £250 million annually through the Higher Education Funding Council, specifically to address the salary element of the problems of recruiting and retaining the best researchers.

⇒ The Government should make modest funds available for experimental systems of providing access to scientific publications, such as the institutional repositories proposed by the House of Commons Science & Technology Committee.

## Chapter 6: Scientific Education

**The UK's policies in science education should aim to enthuse all young people about the wonders of science and engineering, and should permit people at all levels to study science for its own sake. They should attempt to prepare the majority who will not be scientists for active participation in a society that is increasingly driven by science and technology. The educational system should also allow the detailed scientific training of those who require technical education at various levels.**

⇒ Science must remain part of the curriculum throughout compulsory education.

⇒ The UK should be spending at least as much of its national wealth on education as the average among European countries.

⇒ There needs to be a greater clarity in the roles that exam boards, Local Authorities, the Qualifications and Curriculum Authority (QCA) and individual schools have to play in making the transition from primary into secondary school more effi-

cient.

⇒ The DfES needs to ensure that practical research is carried out that will enable the early identification of problems and ensure the most effective policy solutions can be put in place.

⇒ The Qualifications and Curriculum Authority needs to liaise more effectively with higher education institutions in order to address the issue of the interface between school and university science courses.

⇒ There is a need for improved coordination between the science and mathematics on the part of the Qualifications and Curriculum Authority.

⇒ The school curriculum must recognise that Science Studies form a vastly different discipline from Science, and should therefore not be considered a suitable substitute for the core science requirement.

⇒ It would be advantageous for aspects of science to be studied throughout the curriculum; a free-standing course in 'science for citizenship' is not necessarily the most appropriate way to include this.

⇒ Primary school teachers' maths and science training should go well beyond the requirements of the curriculum they are expected to deliver.

⇒ Clearly, there is a need for appropriate support and materials to be provided to primary school teachers, to build their confidence in engaging children with the basic concepts of trial and error and of deduction from observation.

⇒ A National Science Strategy is needed in education, similar to the national numeracy strategy, to boost current standards throughout primary schools

⇒ Continuing professional development for primary teachers must include some element of science and mathematics subject specific training.

⇒ Schools and their departments should be routinely allowed to carry funds over from one year to the next in order to make more significant purchases of equipment.

⇒ A national scheme for sharing equipment donations may help to deliver an improved standard of education to all students.

⇒ The Scottish system of limiting all classes with a practical element to 20 pupils should be adopted throughout the UK.

⇒ To enable as many children as possible to benefit

from the practical experience of field trips, regulations must be put in place to support teachers in taking students out of school rather than leaving them open to significant risk of litigation on the rare occasions when accidents occur.

⇒ Enhanced efforts are required to ensure the best advantage is taken of science facilities in specialist science colleges.

⇒ Every student at Key Stage 4 should have the opportunity to be taught by specialist teachers trained in physics, biology and chemistry.

⇒ Clearer guidelines are needed on how to make the most of scientists and science students who visit schools in a way that will be constructive for science learning.

⇒ As part of the development of science ambassador schemes, research should be undertaken by the DfES to investigate the effective learning involved in being taught by a subject specialist.

⇒ A post-16 educational system should be set in place to ensure that students who specialise mainly in the arts and humanities are encouraged to develop interests in the sciences.

⇒ A broad baccalaureate-style post-16 curriculum would serve the interests of the nation and of individual students better than the current system.

⇒ Mathematics should be studied by everyone engaged in the broadened curriculum for post-16 education, with different modules appropriate to different students depending on factors such as the balance of other subjects they are studying.

⇒ The Government needs to do far more to ensure that careers advisers are well informed of the job market and the opportunities available to young people. A new service or information portal should be developed aimed at informing careers advisers.

⇒ The maximum potential earnings for classroom science teachers need to be increased in order to attract more graduates into the profession.

⇒ As a medium term-solution, more courses are needed to enable those with limited subject knowledge to train as science and mathematics teachers.

⇒ There is a need for more effective research to inform strategies for increasing the quality and quantity of teachers recruited.

⇒ School teachers should be allowed sabbatical periods in which to update their subject knowledge by

carrying out a project with a company, university or other institution.

⇒ Similarly, there should be more opportunities for scientists in universities and industry, particularly those carrying out research for their doctorate, to gain some experience of teaching in schools.

⇒ Time and money must be made available for teachers to undergo continuing training, as well as to pay for the direct costs of the courses themselves.

⇒ Vocational courses must be properly valued in their own right, and should not include irrelevant academic content.

⇒ It is essential that vocational courses are properly linked with employers both at the design stage and in their delivery.

⇒ The UK's system of further education needs a detailed and serious examination, without political interference, leading to credible and ambitious reform. The mechanism most likely to achieve this would be a Royal Commission.

⇒ An increased scientific content could help to raise the standard of vocational courses in their own right, without the inclusion of spurious academic content.

⇒ All scientific HE courses should include some component of science communication skills.

⇒ Universities must retain the freedom to choose students who will be best placed to benefit from courses.

⇒ Universities and regulatory authorities must work together to develop an undergraduate system capable of giving credit for any achievements made, including those that are below the level required to obtain a bachelor's degree.

⇒ National responsibility needs to be taken by the government in ensuring the availability of higher education provision in a range of disciplines throughout UK.

⇒ In the short-term, the Higher Education Funding Council should restore the ratio of two-to-one between funding for science students and arts students; in the longer-term public investment should be based on the real costs of high-quality teaching.

⇒ Fees charged to students in the sciences must be at least as low as for other disciplines. Government support is needed to account for the higher costs of running courses in practical work and other time-intensive aspects of higher education.

# NOTES & REFERENCES

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### Abbreviations used in the references

ALI - Adult Learning Inspectorate

CAF - Charities Aid Foundation

CST - Council for Science & Technology

DCMS - Department of Culture, Media & Sport

DELNI - Department of Employment & Learning, Northern Ireland

DETR - Department of Environment, Transport & the Regions

DfES - Department for Education & Science

DTI - Department of Trade & Industry

GTTR - Graduate Teacher Training Registry

HEFCE - Higher Education Funding Council for England

HEFCW - Higher Education Funding Council for Wales

HESA - Higher Education Statistics Agency

IOP - Institute of Physics

MAFF - Ministry of Agriculture, Fisheries & Food

NRDC - National Research & Development Centre for Adult Literacy

NUT - National Union of Teachers

OFSTED - Office for Standards in Education

OECD - Organisation of Economic Cooperation & Development

OST - Office of Science & Technology

QCA - Qualifications & Curriculum Authority

RCUK - Research Councils UK

RSC - Royal Society of Chemistry

SHEFC - Scottish Higher Education Funding Council

SBS - Save British Science

TTA - Teacher Training Agency

UCAS - Universities & Colleges Admissions Service