INNOVATION, UNIVERSITIES, SCIENCE & SKILLS COMMITTEE

ENGINEERING (ENGINEERING IN GOVERNMENT CASE STUDY)

Memoranda of Evidence

INDEX

Memorandum 1

Submission from the
Department for Innovation, Universities and Skills (DIUS)

Introductory Remarks

1. Engineering has a role across many areas of Government work, and will be critical to the success of a number of key challenges, such as mitigating climate change and security. Amongst other activities, Government engineers contribute to policy, provide capability to respond to emergencies, set standards, develop national and European legislation and provide an 'intelligent customer' function for buying-in advice from industry.

2. Many, if not all, of the big challenges faced by Government will demand creative, flexible, multidisciplinary multi-agency approaches to tackle them effectively. Engineering disciplines and engineering approaches will clearly continue to have a crucial contribution to make. However, in determining the best way forward, it is probably most helpful not to consider science and engineering in traditional terms – as separate disciplines with discrete boundaries – but rather as a continuum of knowledge that can be used and applied with other relevant evidence to address future challenges.

3. The Government Chief Scientific Adviser (GCSA), supported by the Government Office for Science (GO-Science), works closely with departments, departmental Chief Scientific Advisers (DCSAs) and Heads of Scientific and Engineering Profession (HoSEPs) and with independent advisory bodies, such as the Council for Science and Technology (CST), the Royal Society and the Royal Academy of Engineering (RAEng). The aim is to ensure that Government policy decisions and delivery are supported by robust evidence and stand up to the challenges of credibility, reliability and objectivity. Consequently decisions makers can be confident that advice also stands up to these challenges, that engineers in Government are supported, and that the public are aware (and are in turn confident) about the engineering advice supporting the Government's work.

The role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across Government and communicating issues relating to engineering in Government to the public

<u>The Government Chief Scientific Adviser and the Government Office for Science</u>

4. The Government Chief Scientific Adviser (GCSA), Professor John Beddington, is responsible for advising the Prime Minister and Government on key science, engineering and technology issues affecting policy and delivery challenges. This is achieved through meetings with and advice to the Prime Minister, Secretaries of State, key Ministers, Cabinet Committees and through participation in strategic emergency planning and emergency response. He pays particular attention to issues that traverse departmental boundaries, engages international policy makers (including Devolved Administrations on

non-devolved matters) and supports long-term strategic planning processes inside departments. The GCSA heads the Government Office for Science (GO-Science) and works in concert with the community of Departmental Chief Scientific Advisers (DCSAs)[1], the Director General of Science and Research in Department for Innovation, Universities and Skills (DIUS) and other heads of analytical professions. He also sets standards of good practice and quality assurance across Government and heads the Science and Engineering Profession in Government.

5. The issues on which the GCSA and GO-Science are involved cover many disciplines, from natural and physical sciences through engineering and technology to mathematics. For convenience, they are normally referred to collectively under the umbrella expression of 'science'. And, as far as advice into Government is concerned, science and engineering are treated as an integrated subject, where the analytical approaches from one discipline flow through to another in a continuum and within the context of the wider evidence base. A prime example of this is the new and increasingly important area of synthetic biology.

6. Moreover, from a policy or delivery perspective, even the traditionally separate engineering disciplines benefit from being considered from an integrated perspective, with most modern engineering challenges requiring a multidisciplinary engineering approach. Both plastic electronics and environmentally friendly buildings, for example, require input from many different engineering disciplines, as well as science and social research.

7. The roles and linkages that help embed scientific and engineering evidence into Government can be found across a wide range of policy documents and statements (see Annex 1).

8. The Select Committee on Science and Technology heard evidence from the former GCSA, Sir David King, to inform its Report on Scientific Advice, Risk and Evidence Based Policy Making and received copies of the GCSA's revised Guidelines on Scientific Analysis in Policy Making (2005), which encompassed engineering within the general term of 'science'.

Departmental Chief Scientific Advisers

9. Departmental Chief Scientific Advisers (DCSAs) have direct access to Ministers and their own Departmental Boards to bring to bear science and engineering advice in wider Departmental policies, finance, and strategy. For example, a recent intervention by the Department for Transport's (DfT's) DCSA is proving successful with a very large rail project in making evidence of achieving performance targets more robust and revealing previously unknown issues.

10. DCSAs also provide professional leadership for the science and engineering personnel in their departments and Agencies – though in some cases the role of departmental Head of Science and Engineering Profession (HoSEP) is performed by another person – as well as supporting the intelligent customer

[1] A significant proportion of these are engineers (see paragraph 11).

function in Departments for science and engineering advice. For example, the Ministry of Defence's (MoD's) DCSA is a member of the Defence Council and the Defence Board, and attends the Defence Ministerial Committee by invitation; Chairs the Investment Approvals Board and the Research and Development (R&D) Board and is the UK Principal for the 1958 UK-US Mutual Defence Agreement.

11. Many issues are best tackled using a collaborative approach to generating a robust evidence base. Departmental Chief Scientific Advisers (DCSAs) work together under the leadership of the GCSA to support each other and to address and provide cross-cutting advice. The principal mechanisms for dealing with issues relating to science, engineering and technology are the Chief Scientific Advisers Committee (CSAC) and the Core Issues Group (CIG) of Chief Scientific Advisers. Representation on the committees includes both science and engineering – with four of the nine members of CIG having a background in engineering and three being Fellows of the Royal Academy of Engineering (FREng)[2].

Communicating issues relating to engineering in Government to the public

12. The GCSA and DCSAs communicate in specialist high-level fora and, as appropriate to the general public through mass media.

13. The Freedom of Information Act presumes openness and transparency in the publication of expert advice by departments. One of the ways in which the GCSA tests the effectiveness of this in relation to science and engineering is through his rolling programme of departmental Science Reviews, which look at (amongst other things) the publication, dissemination and debate of findings and results.

14. A key aspect of using engineering evidence and advice well in Government involves understanding, managing and communicating risk effectively. This is too often over-simplified, and scientific and engineering advisers, policy makers and those involved in engaging the citizen and the media need to be fully sensitive to the complexities involved, as well as ensuring that they have the best possible evidence base. The establishment of the Risk and Regulation Advisory Council in January 2008 was a key step forward in that respect, with the aim of a major change in policy-making culture in Government. The Better Regulation Commission's report *Public Risk – the Next Frontier for Better Regulation*[3] highlights the progress made in mature analysis, discussion and planning inside and outside Government of the management of risk, but it rightly points out that there is much further still to go.

15. On 18 July, DIUS launched a three-month public consultation on developing a new *Science and Society strategy* to realise the vision of a society that is excited by science (in its broadest sense), values its importance to our social and economic wellbeing, feels confident in its use, and supports a well-qualified,

[2] Professor Michael Kelly, Professor Mark Welland and Professor Sir Gordon Conway.

[3] *Public Risk – the Next Frontier for Better Regulation*, Better Regulation Commission, January 2008: http://archive.cabinetoffice.gov.uk/brc/upload/assets/www.brc.gov.uk/public_risk_report_070108.pdf.

representative workforce. The participation of the engineering community was recognised as being essential to this process. Working closely with the main engineering institutions, the Royal Academy of Engineering (RAEng) is co-ordinating the UK engineering profession's response, which will help ensure that the resulting strategy reflects engineering appropriately and takes full account of the needs of the UK's engineering community.

Promoting Engineering

16. Last year, the Engineering and Technology Board and the RAEng jointly published the findings of the first national survey of public attitudes and perceptions towards engineering and engineers. The report revealed fundamental misconceptions of engineering among young people that could worsen the UK's shortfall in engineers, if it affects their future career choices.

17. To improve the perception of engineering, a large number of campaigns, projects and initiatives exist, particularly aimed young people. To provide coherence to these activities (some of which are discussed below), the engineering community has agreed to work together under the banner of the RAEng's Shape the Future campaign to improve the promotion, delivery and information systems that will provide better co-ordinated support for engineering and technology in schools and colleges.

STEMNET

18. DIUS is investing £19 million (2008-2011) in STEMNET – the Science, Technology, Engineering and Mathematics Network, which aims to ensure that more young people in the UK make a choice to enter careers related to these subjects, and that future generations are properly informed about the science and technology that surrounds them.

Science and Engineering Ambassadors (SEAs)

19. An important strand of the Government's STEM policy is the successful and expanding Science and Engineering Ambassadors (SEAs) programme. Over 20,000 ambassadors – two thirds of whom are engineers – are acting as role models in schools, inspiring young people to study STEM subjects and pursue related careers.

Engagement with Engineering Development Trust GO4SET[4]

20. In 2007, the Engineering Skills Director of MoD's Defence Equipment and Support (DE&S) sponsored ten schools in the Bath/Bristol area as part of the South West scheme. Engineering staff volunteered as mentors to promote careers in science, engineering and technology to young people through participation in a competitive project. Other staff provided interactive demonstrations of engineering principles, sustainable development and physics during school visits to Abbey Wood.

[4] An initiative involving students, engineers and companies in projects to stimulate the interest of young people in Science, Engineering and Technology (http://www.go4set.org.uk/).

Engineers of the 21st Century Programme

21. Complementing the activities run under the Shape the Future framework, the Government is involved with various other initiatives to encourage young people. For example, the Department for Environment, Food and Rural Affairs (Defra) supports the Engineers of the 21st Century programme run by Forum for the Future[5]. The programme has been running for nine years and, within the programme, projects have been carried out looking at Higher Education for Engineers and the delivery of sustainable buildings and future challenges for the built environment. Defra also supported the establishment of the Chair of Sustainable Engineering at Cambridge.

The use of engineering advice in Government policy making and project delivery, including examples of policy decisions or project delivery that have been or will be taken with or without engineering advice

22. Engineering plays a significant part in policy and delivery across many areas of Government work, and will be critical to the success of a number of key challenges, such as mitigating climate change and security. A small sample of the wide-ranging use of engineering being made by Government is provided below.

Keeping Hostile Vehicles at Bay

23. Experts, including civil and structural engineers and materials scientists, at the Centre for the Protection of National Infrastructure (CPNI) are at the forefront of developing effective (and aesthetically-sensitive) countermeasures, in the form of protective security barrier systems, which can keep Vehicle Borne Improvised Explosive Devices at safer distances from critical assets.

24. Traditionally, protective security barriers, such as bollards, planters and gates, have required deep and/or wide structural foundations which have large cost and time implications for excavations and the relocation of underground utilities. CPNI has been working with industry and specialist advisors (such as the Transport Research Laboratory and MIRA Ltd) to push the boundaries of science and engineering to better understand the dynamic loadings on various types of barrier during vehicle impacts, to identify the thresholds of success/failure and to identify new materials and alternative construction methods that can better cope with both vehicle impact and explosion. This work has allowed systems to be engineered with far less extensive foundations and is already paying dividends on site – for example with the use of bollard systems requiring only 112 mm (4.5 inches) of excavation. Pioneering structural measures are currently being sited within the iconic Whitehall streetscape, that are not only sympathetic with the environment but provide significant improvements to the area, such as better use of public space and improving the visitor experience by widening footways.

[5] The Engineers of the 21st Century (E21C) Programme started from the perceived need to accelerate change in the engineering profession to enable it to respond fully and positively to the challenge of sustainable development (http://www.forumforthefuture.org/node/1369).

Buncefield

25. The explosion at Buncefield had major implications for the fuel storage sector both in the UK and overseas. Initially, following the incident, many of the Health and Safety Executive's (HSE's) engineers were deployed to investigate and understand what had gone wrong. Later, the Buncefield Standards Task Group was formed consisting of representatives from HSE and industry, with the aim of translating the lessons from Buncefield into effective and practical guidance that industry would implement as rapidly as possible. In the longer-term, HSE's research programmes will deliver further intelligence to develop standards in the industry.

Major Public Events

26. A key component of the planning process for major public events is an understanding of the threat posed by improvised explosive devices and the potential effects should one be used. This advice is provided by explosion protection engineers – for example, the Explosion Consequence Analysis or Structural Vulnerability Assessment reports compiled by the Home Office's Scientific Development Branch on the locations proposed for major political party conferences and other high profile events.

European Community Whole Vehicle Type Approval

27. The European Community Whole Vehicle Type Approval (ECWVTA) is a major project that will result in the application of common construction standards to road vehicles[6]. Currently construction standards only apply to cars, but this project will extend application to lorries, vans, buses, coaches and trailers. The activities associated with ECWVTA involve all areas of engineering in Government. This includes technical research, establishing performance criteria for Directives, and then implementation in the UK of these standards (by multiple agencies). The work has been underway for five years, and will be implemented in the UK on 29 April 2009.

Nimrod

28. Ensuring that military aircraft are and remain airworthy is a responsibility that can be met only through the expert competence of the MoD's engineers. Military aircraft are operated often at the limit of their performance and in extreme, adverse environments. MoD engineers, working closely with Industry engineers, define the complex design standards used in the procurement, certify military aircraft acquired as airworthy and sustain their usage in service through maintenance and modification. When Nimrod XV230 was lost over Afghanistan in 2006, MoD engineers were instrumental in determining the immediate remedial work needed to restore airworthiness and return the aircraft to service in support of ground operations. They worked closely with industry and the scientific community to understand the complex engineering issues identified by the accident and to define changes to military airworthiness policy, regulation and guidance.

[6] These are standards designed to improved road safety.

Fire Fighting

29. The development of fire core temperature monitoring has developed from science through engineering and should deliver an effective workable product which will improve the safety of emergency workers when they are fighting fires.

30. In addition, the new Incident Recording System and the Fire Service Emergency Cover for the Fire Service are two examples of software engineering that is near completion, leading to reduced data burdens on local authorities and an improved evidence base for both local and national policy.

Salcey Aerial Walkway

31. The Royal Forest of Salcey is an ancient woodland offering a rare and varied wildlife habitat. Civil engineers in the Forestry Commission played a major part in the development of the Salcey Forest – including constructing a unique, 300 metre long tree top walkway to take visitors of all ages and abilities from the forest floor to the upper canopy. The project won the Environment category of the British Construction Industry Awards in 2006 and, since the project's completion, visitor numbers have increased from under 100,000 to over 250,000 a year.

Severn Bridge Cable Corrosion

32. This major suspension bridge is suffering a significant corrosion of the supporting cables. Engineers from the Highways Agency are working with other client authorities who have similar problems around the world and with specialist engineering consultants, weighing-up the evidence and risks and interpreting design standards so that cost-effective decisions can be taken whilst ensuring safety is not compromised. This has led to a management strategy for the Severn Bridge with little or no impact on road users.

Adaptation and mitigation of climate change

33. Looking over the next 10-20 years, one of the biggest challenges facing society is climate change. Engineers at Defra are working on adaptation measures (such as making the Thames more flood resilient) and mitigation (developing energy efficient technologies and increasing renewable energy) to respond to this challenge.

Thames Estuary 2100 Flood Risk Management Strategy

34. In flood and coastal erosion risk management, Defra engineers collaborate with the flood and coastal erosion risk management operating authorities (the Environment Agency, local authorities and internal drainage boards) and practitioners and are at the forefront of policy development and the consideration of strategic solutions. Direct involvement is mainly through review of major projects that fall outside the delegated authority of the operating authorities.

35. For example, the Thames Estuary 2100[7] project is a joint initiative between the Anglian, Southern and Thames regions of the Environment Agency, which aims to determine the level of flood protection needed for London and the Thames Estuary for the next 100 years. Defra engineers represented the department alongside Environment Agency staff on the Quality Review Panel, which provides ongoing review of the development of the strategy, in advance of the formal submission to the department and HM Treasury for agreement.

Development of energy efficiency technologies and renewable energy projects

36. Currently underway is a Severn Tidal Power Feasibility Study to assess the potential for tapping the tidal power of the Severn Estuary, which has the second greatest tidal range in the world. The tidal range in the Severn has the potential to provide around 5% of the UK's electricity needs. This represents a major opportunity for the UK to mitigate the effects of climate change and to meet our proposed EU target to source 15% of all our energy[8] from renewable sources by 2020 and the Government's own Renewables Obligation for 20% of our electricity supply to come from renewable sources by then[9]. It is expected that a short list of preferred proposals will be announced by the Department for Business, Enterprise and Regulatory Reform (BERR) at the end of this year.

Energy Research Partnership

37. The GCSA is a member of the joint public-private Energy Research Partnership (ERP), which provides enhanced leadership and coherence to the total UK investments in energy research and innovation. An early initiative of the Partnership was to support the establishment of the ETI (see below). Other work by ERP has included developing a vision for the UK's future energy research, development, demonstration and deployment (RDD&D) funding landscape, as well as inputting to the development of a new Environmental Transformation Fund, providing support for the demonstration and early stage deployment of low carbon technologies, and assisting the development of a new renewables energy strategy, published by the Government for consultation in June 2008.

Energy Technologies Institute

38. The Energy Technologies Institute (ETI) brings together some of the world's biggest energy and engineering companies – BP, Caterpillar, EDF Energy, E.ON UK, Rolls-Royce and Shell – in a 50:50 partnership with Government. Detailed calls for proposals in offshore wind (in collaboration with Carbon Trust), wave and tidal stream energy were made on 17 December 2007. ETI announced its third technology programme – on distributed energy – in April 2008. More programmes will follow in due course. ETI expects to announce the outcome of its first two calls for proposals (in the areas of Offshore Wind and

[7] Formerly 'Planning for Flood Risk Management in the Thames Estuary'.

[8] Electricity, heat and transport.

[9] In 2007, 5% of the UK's electricity supply came from renewable sources.

Marine energy) in Autumn 2008. The GCSA attends ETI Board meetings, and the Chairman of the Board has a very strong background in engineering[10].

How Government identifies the need for engineering advice and how Government sources engineering advice

39. A variety of routes exist whereby the need for engineering advice is identified. These include: when an engineering or policy solution is required to solve a particular issue (for instance, to protect occupants in vehicles should a crash occur), the provision of independent advice from academia or advisory bodies (such as the Council for Science and Technology), the result of a literature review or consultant's report, or through futures work.

40. The route chosen will be determined on a case-by-case basis depending on the task in hand and the internal resources available – which vary widely between Departments.

41. If expertise does not exist in-house, it can be bought in from external consultants, or developed internally where long-term requirements have been identified. Where external engineering advice is needed, this may be sourced either through the operating agencies (such as the Health and Safety Laboratory for HSE or the Environment Agency in the case of Defra) or by employing specialist consultants directly.

Royal Academy of Engineering and the Engineering Institutions

42. The RAEng is a major source of authoritative, impartial advice for Government on issues with an engineering dimension. As the UK's national academy for engineering, it provides overall leadership for the UK's engineering profession – along with the Engineering Institutions. The Academy's membership of 1375 Fellows brings together the UK's most eminent engineers from all disciplines.

43. The Government engages with the RAEng and the engineering institutions on a variety of issues, such as sustainable energy and climate change, health and wellbeing, food security and counter-terrorism. At the invitation of the GCSA, the RAEng has also recently become a member of the Global Science & Innovation Forum (GSIF), a vehicle for cross-Government exchanges of information and ideas to improve co-ordination of UK effort in international science and innovation collaboration, providing strategic guidance and systematic horizon scanning for new and emerging issues.

44. As part of its independent advisory role, the RAEng provides advice on the membership of Government committees to help ensure that policy debate is informed by the best engineering expertise. This includes formally nominating one member of the Home Office's Science Advisory Committee.

[10] Sir Robert Margetts CBE FREng FIChemE is a Governor and Fellow of Imperial College of Science, Technology & Medicine and a Fellow of the Royal Academy of Engineering and Institution of Chemical Engineers.

45. Departments work directly with individual engineering institutions. These arrangements are often reciprocal; DfT, for instance, is represented on the Institution of Engineering and Technology Sector Panel.

46. Whilst there is already much interaction between Government and the engineering community, there is scope to do more. The GCSA is working closely with the RAEng and the leading engineering institutions to develop the role and accessibility of the engineering community for Government departments and organisations seeking engineering advice and opinion. He has initiated regular meetings with Chief Executives of the RAEng and Engineering Institutions' and has addressed the RAEng and engineering institutions at several of their events, for example the RAEng Council dinner in April 2008, where he outlined his priorities and plans for GO-Science.

Scientific Advisory Committees and Councils

47. Government departments also seek specialist expert advice through Scientific Advisory Committees and Councils. Some of these bodies either have engineers in their formal membership or co-opt engineering experts to meet particular issues. For example, engineering expertise is provided within membership of Defra's Committee on Radioactive Waste Management (which currently has three more engineers than are formally required) and also on the Royal Commission on Environmental Pollution. Defra's Scientific Advisory Council includes two engineers. MoD's Defence Scientific Advisory Council requires that eight of its members have engineering expertise. Similarly, engineering advice is also contained within the Home Office's Science Advisory Committee and several of its specialist advisory committees[11].

The Council for Science and Technology

48. The Council for Science and Technology (CST) is the Prime Minister's top-level independent advisory body on strategic science and technology policy issues. The 17 members of the Council are all respected senior figures drawn from across science, engineering and technology – six of these 17 are engineers[12].

49. The CST's report *Strategic Decision Making for Technology Policy Making* (November 2007) had a strong engineering focus in terms of the key technology areas where it considered that a greater focus by Government could accelerate the real returns for the UK within a five-year timeframe. These included carbon capture and storage, disaster mitigation technologies, low carbon distribution networks for electricity generation, medical devices, and a detailed case study

[11] For example, there are presently three serving members on the Home Office Scientific Advisory Committee who are engineers and two engineers serving on the Biometrics Assurance Group.

[12] Professors Wendy Hall and Michael Sterling and Dr Sue Ion and Dr Phil Ruffles are all former Vice-Presidents of the Royal Academy of Engineering – Dr Ruffles is also a past member of the Nominations Committee and Professor Sterling a former Chair of its Membership Committee, as well as past President of the Institution of Engineering and Technology. Professor Michael Sterling, Dr Hermann Hauser and Dr Raj Rajagopal are all Fellows of the Royal Academy of Engineering, with Dr Rajagopal also being a Fellow of the Institution of Electrical Engineers and a Fellow of the Institution of Mechanical Engineers. Additionally, Professor Hall is a Fellow of the Institution of Engineering and Technology and a Fellow and past President of the British Computer Society.

on plastic electronics which recommended a comprehensive value-chain analysis of the plastic electronics sector, a strategic role for Government in bringing the key players together to facilitate interaction between users of the technology and the science base, and an assessment of the training needs for the workforce.

Research Base

50. To support their work and share thinking on developing policy with key stakeholders, departments maintain close links with the research base through the individual Research Councils, the TSB (see paragraph 83), and on energy issues through the GCSA's involvement with ERP and ETI (see paragraphs 35 and 36). The GCSA has also initiated three meetings a year to bring together the Chief Executives of the Research Councils and DCSAs so that issues of common interest can be explored. The first meeting was held on 7 July 2008, where the main topic on the agenda was the cross-council Living with Environmental Change (LWEC) programme.

51. A number of departments maintain close links with the Research Councils. The Home Office maintains close links with the Engineering and Physical Sciences Research Council (EPSRC) and, at strategic level their DCSA meets with EPSRC's Chief Executive annually. Additionally, two DCSA are closely involved with EPSRC – MoD's DCSA (Mark Welland) is a Council member and DfT and BERR's DCSA (Brian Collins) is member of the Technical Opportunities Panel.

52. The Research Councils are also represented on a number of important advisory bodies and departmental Scientific Advisory Councils and Committees. Dr Sue Ion (an EPSRC Council member) is a member of the CST, Professor Christopher Snowden (another EPSRC Council member) is a member of the Defence Scientific Advisory Committee and the UK Committee for National and International Hydrology, is chaired by Professor Alan Jenkins from the Natural Environment Research Council (NERC).

Other sources of advice

53. The list above is not an exhaustive one, and novel and new associations are continually being made to solve particular problems. One example is provided by the Home Office's recent work with the Smith Institute in order to bring together expertise to help model and understand the process of 'entanglement' (net-like barriers in the water), which might be used by law enforcement agencies to stop suspect vessels relatively safely, by fouling up their propulsion units. Whilst this was conceived as a mathematical approach, it is one that has been used to understand better an engineering problem.

Longer term planning

54. Longer term planning of departmental policies and resources are supported by the Horizon Scannning Centre (HSC) within GO-Science alongside other departmental long-term policy planning resources. Collectively, these resources identify enablers and inhibitors in emerging areas of science and technology

that are most likely to inform future departmental policies from only a few years hence up to 30 years or more.

55. One of the key principles of horizon scanning is to look broadly. The HSC is part of the GO-Science Foresight Programme. The HSC seeks and uses evidence from multiple disciplines in all its work, and engineers have made significant contributions to a number of HSC projects and activities. Examples include a project on the defence implications of synthetic biological engineering (see Annex 2); and another on Emerging Technologies to inform the Comprehensive Spending Review 2007, which identified and described for HM Treasury a set of eight 'clusters' of key areas of science and technology that, over the period of approximately 2015-2020, have the potential (either as enhancers or disruptors) to: transform the delivery of public services; challenge society; and/or affect wealth creation.

56. The Foresight Programme aims to strengthen strategic policy making by embedding a futures approach across Government. The Programme also runs major projects which look in greater detail into particular scientific areas of interest which can help decision-makers to get a better understanding of and find new ways to tackle major societal challenges, such as the project on Flooding and Coastal Defence. This groundbreaking study drew heavily on leading experts from the UK's engineering and science communities. The project report, Future Flooding, provided a cornerstone for local and national policy, such as Making Space for Water, the Government's 20-year strategy for managing long-term flood risk in England. The report has also attracted considerable international interest. For example, a major Foresight-style 'flagship' project on flood-risk management is underway in Taihu, China, which is supported by Chinese government departments and is being led jointly by Chinese and UK engineers and scientists.

57. Another Foresight report ‘Intelligent Infrastructure Futures’ explored the scope for engineering the future environment so that over the next 50 years efficient and sustainable movement of people and goods can be achieved by the introduction of common systems. Importantly the study stimulated close working between Government and both the research and business communities in moving towards the development of robust technology solutions to these challenges.

58. Obesity is another key challenge for Government, and the Foresight report, 'Tackling Obesities: future choices' demonstrated how external determinants such as the built environment will have a crucial role to play in combating the future threat of obesity. In particular, it is essential that the space in which we live and work will be developed and engineered to maximise its 'walkability' and 'cyclability' and to encourage and promote other forms of physical activity and recreation.

Succession planning

59. Over the medium- and longer-term, departments need to consider their need for specialist advice and ensure that the range and deployment of engineering advice they have remains in line with their evolving business needs. A number of departments have identified issues surrounding the age profile of their specialist expertise and are considering how they should recruit, manage and foster expertise to ensure their engineers continue to be able to work effectively and with authority.

60. Some departments, such as Defra, have created science and engineering 'career homes', one of the functions of which is to evaluate departments' capacity and capability in relation to expertise.

61. Again, the GCSA's programme of Science Reviews looks at departmental capacity and capability with respect to science and engineering expertise.

The status of engineering and engineers within the civil service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service

The role and status of engineers with the civil service

62. Government engineers may be leading experts in their chosen fields working in specialist posts, or have general engineering backgrounds that can be applied to address more wide-ranging policy or delivery needs.

63. There are estimated to be around 18,000 scientists and engineers in the civil service – about 3.7% of the total number of civil servants[13]. The majority of engineering specialists are based in MoD.

64. Members of the profession play a part in a wide variety of issues across Government, from those with an obvious engineering angle such as better traffic management to those that may be less obvious such as reducing Healthcare Associated Infection. Their expertise spans the wide range of occupational settings they work in, including mechanical, electrical, chemical, civil and structural, highways, military, nuclear and water engineering. Some are highly specialised, such as those dealing with explosives, non-ionising radiation and biological agents and nuclear propulsion.

65. Engineers contribute to a broad range of work throughout Government departments, agencies and laboratories, including:
    - Interpreting science and engineering evidence to support policy and delivery;
    - Providing capability to respond to emergencies;
    - Providing the role of intelligent customer capability for departments so that they can commission and use science most effectively;

[13] There are currently 490,000 civil servants. Source: Civil Service statistics, updated on 16 July 2008 (http://www.civilservice.gov.uk/about/statistics).

- Undertaking essential work which cannot be or is not done outside Government, for example for reasons of national security;
- Standards setting/benchmarking;
- Policy making;
- Supporting risk management and improving public confidence;
- Meeting ongoing commitments in the Government's role as a regulator; and
- Conducting research in laboratories.

66. As well as the specialist expertise they bring, Government engineers are valued for their generic problem-solving skills and their ability to produce practical solutions to problems and drive delivery through project management skills. A high proportion of engineers joining the new Science and Engineering Community of Interest (see below) identified project management as one of their key skill areas.

Head of Scientific and Engineering Profession

67. GO-Science supports the GCSA in his role as Head of Scientific and Engineering Profession (HoSEP), where he seeks to give leadership and greater visibility to the role of scientists in support of overall Government policy. This role complements that of Departmental HoSEPs and corresponding heads of profession for other analytical disciplines.

68. A number of departments have reported the need to make better and timelier use of science and engineering in business planning and policy development, and to improve career options for specialists. Recognising this need, the GCSA has substantially developed and revitalised the HoSEP function since beginning his tenure in January 2008 – setting a number of key deliverables to be achieved during his first 12-18 months in office, including:
    - Holding the first annual conference for the science and engineering community to give members a chance the share knowledge, voice their concerns and create a sense of belonging;
    - Creating a Professional Skills for Government (PSG) framework for scientists and engineers below Grade 7 and refreshing the existing framework for Grade 7 and above (see below); and
    - Exploring other measures with outside organisations aimed at furthering people's careers and improving knowledge transfer, such as Pairing and Fellowship schemes.

69. Whilst a few departments have a clearly identified science and engineering community, a fundamental obstacle to progressing the HoSEP agenda has been the lack of comprehensive data on scientists and engineers across Government. To address this, the GCSA has created a cross-Government community of interest of scientists and engineers. To date, 1316 people[14] have joined the community of interest, of which 703 have identified that science and/or engineering is essential to their post. Whilst not directly comparable,

[14] Data up to and including 21 August 2008.

these numbers equate favourably with the other analytic professions, whose total membership is as follows[15]:

- Government Economic Service (GES) – 1472;
- Government Statistical Service (GSS) – 1382;
- Government Social Research (GSR) – around1000; and
- Government Operational Research Service (GORS) – 371.

Skills

70. A cross-government skills strategy agreed by all Permanent Secretaries, *Building Professional Skills for Government*, was published in April 2008. The objective of the three-year strategy is to raise standards and enhance individual performance, improve organisational capability and ultimately improve the quality of public services. The GCSA and departmental HoSEPs (along with all other Heads of Professions across Government) have a central role in ensuring the skills strategy is a success.

71. The implementation of the skills strategy will make a real difference to the individuals within the profession, giving them better chances of identifying and developing the skills that will enable them to succeed in their chosen careers.

Career prospects of specialist engineers in the civil service

72. It is important that engineers within the civil service are valued for their expertise and that they are well informed about the attractive career and development opportunities that are open to them. To a large extent this is managed within individual departments, and a number of departments and Government research institutes have formal arrangements to support their staff in continuous professional development.

73. One issue which arises in creating attractive career structures for engineers is how to retain and reward those working as 'deep specialists'. Due to the needs of particular post or engineers' focus on their area of professional expertise, some deep specialists may not have the opportunity (or the desire) to obtain the broader skills needed to qualify for promotion to the Senior Civil Service. The MoD has made arrangements to reward and recognise such specialists; the GCSA has drawn departments' attention to this initiative through the HoSEP network, which will continue to pursue the area of reward and recognition.

74. It is also important that professional engineering work carried out within Government is not isolated from that being carried out outside, whether in academia, business or elsewhere. Departments provide encouragement and support for:

- secondments into and out of the civil service;
- support for the acquisition of relevant qualifications; and
- the provision of time and resource to attend conferences and work with their counterparts outside.

[15] Membership data provided by GES, GSR and GSS on 22 August, and GORS on 27 August 2008. Actual numbers in post may be lower than this due to study leave, associate membership, etc.; for example, the total number of GES in post is 1115 compared to a total membership of 1472.

75. For example, to provide variety to careers as well as giving experience required for specific posts, engineers in MoD may undertake secondments to international posts in NATO, UK embassies abroad, joint project offices, academic posts and other Government departments. In addition, the new DE&S Specialist Fellowship Scheme for engineers aims to reward and recognise the small number of civilian experts who are required by MoD to develop and maintain their world class specialist status.

76. Defra is in discussion with both Forum for the Future and the EPSRC about the possibility of Engineering Fellowships, placing either young private sector engineers or engineering research post-docs in Defra policy teams for 3-6 month projects.

77. Government engineering specialists are highly competent, many holding academic qualifications underpinned by membership of relevant professional bodies. This is a necessity when, for example their views are subject to robust formal challenges (e.g. as expert witnesses in legal proceedings or as Government representatives in a wide range of formal and informal meetings with experts from industry and other national and international bodies).

78. A number of departments and Agencies across Government, such as the Home Office and Environment Agency, encourage their engineers to gain chartered status through the appropriate institution. In addition, Chartered Engineer is a requirement of certain posts in the MoD, and has been adopted as the benchmark for professional engineering posts in DE&S.

Graduate Entry to the Civil Service

Science and Engineering Fast Stream

79. Graduates entering the civil service through the Science and Engineering Fast Stream (SEFS) do not enter specialist science or engineering posts. Rather, they undertake the same policy delivery, operational delivery and corporate delivery roles as other Fast Streamers in order to equip them for future senior management positions, the only difference being that they go into departments where their scientific or engineering knowledge will be useful to them.

80. The three departments which recruit from the SEFS (MoD, DIUS and BERR) report that entrants from the SEFS are in high demand by managers because of the skills and experience they bring to the departments' work, particularly on issues relating to science, engineering and technology, but also across the broader spectrum of their work (such as procurement or project delivery).

81. In addition to the entrants they take from SEFS these departments also recruit from the other parts of the Graduate Fast Stream. Many of those recruited will have taken science and engineering degrees but chose not to join through the SEFS.

Other Schemes

82. Some departments and their agencies run their own graduate recruitment schemes. MoD recruits civilian engineers through the Defence Engineering and Science Group (DESG) Graduate Scheme, and the Vehicle and Operator Services Agency (VOSA) runs a Graduate Mechanical Engineer Training Scheme that has been designed in such a way that it meets the Institution of Mechanical Engineer's Monitored Professional Development Scheme criteria – enabling graduates to become Chartered at the end of it.

The role and effectiveness of professional engineers and the engineering community in promoting engineering and providing engineering advice to Government and the civil service

83. As previously noted, there is a growing enthusiasm on the part of the RAEng, supported by the leading Engineering Institutions, to work more collaboratively than ever before and with Government to help tackle the big challenges it faces and, at the same time, better promote the UK engineering profession. Regular meetings with the GCSA, Ministers and senior officials help ensure that the engineering community has high-level input to policy making in a wide range of areas.

<u>The National Measurement System</u>

84. The National Measurement System (NMS), sponsored by DIUS, maintains and develops the UK's measurement infrastructure delivering world-class measurement science and technology and providing traceable and increasingly accurate standards of measurement. It has a mission to enhance UK innovation and industrial enterprise, facilitate trade and improve the quality of life in the UK. The NMS supports innovation by enabling the benefits of new products and processes to be measured and, specifically, by stimulating new product development in the instrument sector. It also raises productivity through improved process and quality control. Measurement also underpins a wide range of public goods, including consumer protection, forensic science, environmental controls, medical treatment and food safety regulation, as well as the technical standards that ensure barrier-free trade.

85. The NMS is organised into 12 programmes. One of these 'Engineering and Flow Metrology' addresses dimensional, mass and flow measurements. Other programmes such as 'Materials and Thermal Metrology' and 'Physical Metrology' also contain a significant element of work relevant to engineering. Since measurement plays such a fundamental part in our lives, it is important that the accuracy of the measurement is fit for purpose. In order to ensure that the NMS serves the needs of users throughout the economy work programmes are guided and prioritised by expert advisory groups. These groups are comprised of scientists and engineers recruited from universities, industrial companies developing or making use of the technologies concerned or regulatory bodies, where this is appropriate.

Technology Strategy Board

86. The DIUS funded Technology Strategy Board (TSB) is a business-led, business focused body that plays an important leadership role across all sectors of the UK economy – with a particular focus on stimulating innovation in those areas which offer the greatest scope for boosting UK growth and productivity. The Chief Executive and four members of the 12 strong TSB Governing Board are engineers.

87. To help to focus their work TSB have identified a number of Key Application Areas – broad fields where technological innovation has a major role to play and which represent major societal challenges or are associated with the challenge of maintaining a world-leading position. A number of these have a strong engineering component, for example: Environmental sustainability, Energy generation & supply and, the Built environment. TSB have also defined several Key Technology Areas which allow them to focus initiatives and interventions on core technologies that are critical to the UK's success. These include: High value-added manufacturing processes; Advanced materials; Nanotechnology; and Photonics & electrical systems – all of which have strong engineering dimensions.

88. TSB Innovation Platforms (IPs) pull together policy, business, Government procurement and research perspectives and resources to generate innovative solutions. The first two IPs, Intelligent Transport Systems & Services, and Network Security, involved the TSB working with DfT and the Home Office respectively to address these two important underlying challenges facing modern society. Three more IPs have now been announced – Low Carbon Vehicles, Assisted Living and Low Impact Buildings – each again addressing a specific societal challenge requiring considerable engineering input.

89. TSB also operate Knowledge Transfer Networks – single over-arching national networks in specific fields of technology or business application which bring together people from businesses, universities, research, finance and technology organisations to stimulate innovation through knowledge transfer. Many the KTNs have a significant engineering component, for example Aerospace & Defence, Cyber Security, and Intelligent Transport Systems.

UK Trade & Investment

90. UK Trade & Investment (UKTI) is the Government organisation that helps UK based companies succeed in international markets and assists overseas companies to bring high quality investment to the UK's economy. UKTI's Sectors Group focuses on strategic and political Government assistance to UK business in pursuit of overseas opportunities on those sectors and activities where it can best add value.

91. UKTI's sector teams takes advice on developing and implementing international trade and inward investment marketing strategies from business advisory groups, including the Advanced Engineering Sector Advisory Board (AdESAB), who are also actively engaged in international marketing campaigns. Members of the AdESAB are drawn from advanced engineering businesses and are

actively involved in the sector, providing insight into the challenges and opportunities facing large, medium and small enterprises and the different sub-sectors of advanced engineering.

International examples of how engineers and engineering advice are embedded in Government

92. As illustrated by the examples below, countries source and manage engineering advice into government in very different ways.

United States

93. Like the UK, engineering policy is generally considered as part of the science policy agenda in the United States (US). Engineers are spread far and wide within the US Government, and are probably one of the best-represented disciplines. Many agencies and programs in the US share engineering policymaking and oversight responsibilities. The split is such that there is no true primary engineering agency, nor is there an agency that holds primacy in funding engineering research.

94. The major agencies and departments employing and funding engineers and engineering research are the Department of Defense, the Department of Energy, the Army Corps of Engineers, the National Science Foundation, the National Institute of Standards and Technology, the National Aeronautics and Space Administration, the National Institutes of Health, the Environmental Protection Agency, and the National Oceanic and Atmospheric Administration.

95. Beyond these agencies are several other groups with significant say in engineering policy.

France

96. France has a network of civil service schools – including a number of engineering schools[16] – which provide initial training to future civil servants before and so that they are given a post in the civil service. Training mainly consists of practical knowledge, professional skills and work methods necessary for the future working environment.

Germany

97. Germany has no equivalent of the GCSA. Instead, government seeks scientific and engineering advice from academies, research organisations, appointed advisory bodies, and professional and trade associations. For its 2007 G8 and EU Presidencies, the German federal government appointed a top German climate scientist and a top energy industry representative as special advisers.

[16] These include the École Polytechnique, the École des Mines and the École des Ponts et Chaussées (Bridges and Roads).

India

98. Most key government departments/ministries in India have an engineering arm; notably in Ministry of Transport (Civil Engineering), Ministry of Railways, and the Ministry of Urban and Rural Development.

99. Public sector enterprises also play an important role in the heavy engineering sector in India. There are 34 public sector enterprises in this area.

Japan

100. Japanese ministries manage no permanent scientists, engineers of technologists inside their organisations, except some for nuclear safety and regulation. Instead, expertise is provided by companies, trade associations and national research institutes, with whom the Japanese government has close links. A scheme for recruiting specialists from such organisations on a temporary fixed-term basis is used when specialist advice is required.

101. It is understood that more detailed information will be provided by the British Embassy in Tokyo, ahead of the Committee's visit to Japan in October.

Spain

102. There is an autonomous organisation within the Ministerio de Fomento (Ministry of Development) that gives comprehensive engineering advice across a range of topics from infrastructure, environment and planning.

Central guidance and policy documents

Appointing Board Members to Public Bodies – Model Guidance (October 2004), http://www.civilservice.gov.uk/documents/pdf/appointments/exec_adv_codes_practice_23oct04.pdf

House of Commons: BSE Inquiry Report – The Inquiry into BSE and variant CJD in the United Kingdom (October 2000), http://www.bseinquiry.gov.uk/report/index.htm

Cabinet Office: Civil Service Code (June 2006), http://www.civilservice.gov.uk/publications/civilservicecode/index.asp

GO-Science: Code of Practice for Scientific Advisory Committees (CoPSAC) (December 2007), www.dius.gov.uk/publications/file42780.pdf

Cabinet Office: Consultation – Code of Practice (September 2005), http://bre.berr.gov.uk/regulation/consultation/code/introduction.asp

HM Treasury: Cross-Cutting Review of Science and Research (March 2002), www.hm-treasury.gov.uk/media/E/7/science_crosscutter.pdf)

Data Protection Act (1998), http://www.opsi.gov.uk/acts/acts1998/19980029.htm

The Environmental Information Regulations (2004), http://www.opsi.gov.uk/si/si2004/20043391.htm

Evidence-based policy-making – Evidence Hot links, http://www.nationalschool.gov.uk/policyhub/evidence_hotlinks/

Foresight and HSC http://www.foresight.gov.uk/ and http://www.foresight.gov.uk/horizonscanning

Freedom of Information Act Guidance, http://www.dca.gov.uk/foi/guidance/index.htm

DTI:Guidelines On Scientific Analysis In Policy Making (October 2005), http://www.berr.gov.uk/files/file9767.pdf

Nolan Principles (Seven Principles of Public Life), http://www.public-standards.gov.uk/about_us/seven_principles.htm

Council for Science and Technology: Policy Through Dialogue (2005), http://www2.cst.gov.uk/cst/reports/#8

PSAs – Public Service Agreements (2008), http://www.hm-treasury.gov.uk/pbr_csr/psa/pbr_csr07_psaindex.cfm

Public Appointments, http://www.civilservice.gov.uk/about/public/appointments.asp

Office of the Commissioner for Public Appointments: Public Appointments Code of Practice for Ministerial Appointments to Public Bodies (August 2005), http://www.ocpa.gov.uk/upload/assets/www.ocpa.gov.uk/codeofpractice_aug05.pdf

Public engagement in SET guidelines – Government response to nanotechnology report (February 2005), http://www.berr.gov.uk/files/file14873.pdf

BERR: Regulatory Impact Assessment Guidance, http://www.berr.gov.uk/employment/research-evaluation/ria/index.html

HM Treasury: Risk and Uncertainty. Managing risks to the public – appraisal guidance (June 2005), http://www.hmtreasury.gov.uk/media/8AB/54/Managing_risks_to_the_public.pdf

House of Lords: Risk and Uncertainty. Government Policy on the Management of Risk (7 June 2006), http://www.publications.parliament.uk/pa/ld200506/ldselect/ldeconaf/183/183i.pdf

Risk and Uncertainty. The Orange Book – Management of Risk – Principles and Concepts, http://www.hm-treasury.gov.uk/documents/public_spending_reporting/governance_risk/psr_governance_risk_riskguidance.cfm

Risk and Uncertainty. Thinking about risk – setting & communicating your risk appetite, including good practice examples, http://www.hm-treasury.gov.uk/documents/public_spending_reporting/governance_risk/psr_governance_risk_thinking_about_risk.cfm

Sainsbury Review, http://www.hm-treasury.gov.uk/independent_reviews/sainsbury_review/sainsbury_index.cfm

HM Treasury: Science and Innovation Investment Framework 2004-2014 (July 2004), http://www.hm-treasury.gov.uk/spending_review/spend_sr04/associated_documents/spending_sr04_science.cfm

Next Steps – Applied to Science Base and Innovation rather than GO-Science agendas http://www.berr.gov.uk/dius/science/science-funding/framework/next_steps/page28988.html

House of Lords S&T Committee: Third Report – Science and Society (February 2000), http://www.parliament.the-stationery-office.co.uk/pa/ld199900/ldselect/ldsctech/38/3801.htm

DIUS: Science in Government, http://www.dius.gov.uk/policy/science.html

Science Reviews website http://www.dti.gov.uk/science/science-reviews/page24572.html

Scientific Advice, Risk and Evidence Based Policy Making: Government Response to the House of Commons Select Committee 7th Report (2005-6) (February 2007), http://www.parliament.the-stationery-office.com/pa/cm200607/cmselect/cmsctech/307/307.pdf

Spending Reviews: 2002 –Investing in Innovation: A Strategy for Science, Engineering and Technology (2002) – Chapter 7 (Science in Government), http://www.hm-treasury.gov.uk/spending_review/spend_sr02/spend_sr02_science.cfm

Spending Reviews: 2004 – Spending Review, http://www.hm-treasury.gov.uk/spending_review/spend_sr04/spend_sr04_index.cfm

Spending Reviews: 2007 – Long Term Opportunities and Challenges in the 2007 CSR (November 2006), http://www.hm-treasury.gov.uk./spending_review/spend_csr07/spend_csr07_longterm.cfm

Spending Reviews: 2007 – Comprehensive Spending Review http://www.hm-treasury.gov.uk/spending_review/spend_csr07/spend_csr07_index.cfm

DIUS: Universal Ethical Code for Scientists (September 2007), http://www.berr.gov.uk/files/file41318.pdf

Synthetic Biological Engineering

In late 2006, the Horizon Scanning Centre conducted a small project with MoD on the defence implications of synthetic biological engineering (SBE). Engineering was explicitly included in the title in recognition that the field of synthetic biology[17] is rapidly acquiring all the key characteristics of one of the classical engineering disciplines:

- a set of standard components 'BioBricks', such as the 700 available parts in a growing current catalogue co-ordinated by MIT http://partsregistry.org/cgi/partsdb/search.cgi;
- a set of rules that describe how those components can (and can not) be fitted together to produce useful devices and systems with known characteristics and predictable behaviours;
- a significant-sized skilled workforce who understand the rules, and can apply them consistently, and who have ready access to the components.

The project found that SBE may be of relevance to and influenced by a wide range of major issues affecting the UK and its position in the world. These include, but are not limited to, energy and resource availability, pollution control, health, especially drug development, and IT. There was agreement that a country with a large and well-supported science base will have an advantage in making the most of SBE as the business and social opportunities which it offers start to develop.

SBE might matter to MoD for a number of reasons, including:

- It could be used to create a wide range of devices, weapons etc
- SBE might be used by small organisations to create threats rapidly – no long build-up times or massive factories to alert the target
- It might offer value to the UK military, such as the ability to make sensors and other battlefield devices that run on ambient energy and which cost fractions of a penny each
- Some of SBE's pollution-cleaning potential might be of military use, for example if SBE devices can remove radioactive or chemical pollution
- SBE devices that could turn almost anything biological into energy would allow the military, both machines and people, to live off the land more easily. They might also be able to use sunlight more effectively than inorganic solar collectors
- Medical SBE devices might revolutionise diagnosis and treatment in the field

[17] The Royal Society has described synthetic biology in broad terms as “the design and construction of novel artificial biological pathways, organisms or devices, or the redesign of existing natural biological systems. It has enormous potential applications and benefits, including the development of cheap anti-malarial drugs, the production of cheap, green hydrogen for fuel and the use of programmable cells to treat cancer and similar illnesses.”

Glossary of Abbreviations

AdESAB – Advanced Engineering Sector Advisory Board

BERR – Department for Business, Enterprise and Regulatory Reform

CAETS – International Council of Academies of Engineering and Technological Sciences

CIG – Core Issues Group

CPNI – Centre for the Protection of National Infrastructure

CST – Council for Science and Technology

CSAC – Chief Scientific Advisers Committee

DCSA – Departmental Chief Scientific Adviser

DE&S – Defence Equipment and Support

Defra – Department for Environment, Food and Rural Affairs

DESG – Defence Engineering and Science Group

DfT – Department for Transport

DIUS – Department for Innovation, Universities and Skills

ECWVTA – European Community Whole Vehicle Type Approval

EPSRC – Engineering and Physical Sciences Research Council

ETI – Energy Technologies Institute

FREng – Fellow of the Royal Academy of Engineering

GCSA – Government Chief Scientific Adviser

GES – Government Economic Service

GORS – Government Operational Research Service

GO-Science – Government Office for Science

GSIF – Global Science & Innovation Forum

GSR – Government Social Research

GSS – Government Statistical Service

HoSEP – Head of Science and Engineering Profession

HSC – Horizon Scanning Centre

HSE – Health and Safety Executive

IP – Innovation Platform

KTN – Knowledge Transfer Networks

LWEC – Living with Environmental Change programme

MIT – Massachusetts Institute of Technology

MoD – Ministry of Defence

NATO – North Atlantic Treaty Organisation

NERC – Natural Environment Research Council

NMS – National Measurement System

PSG – Professional Skills for Government

R&D – research and development

RDD&D – research, development, demonstration and deployment

RAEng – Royal Academy of Engineering

SBE – synthetic biological engineering

SEAs – Science and Engineering Ambassadors

SEFS – Science and Engineering Fast Stream

SMEs – small and medium-sized enterprises

STEM – Science, Technology, Engineering and Mathematics

STEMNET – Science, Technology, Engineering and Mathematics Network

TSB – Technology Strategy Board

UK – United Kingdom

UKTI – UK Trade & Investment

US – United States

VOSA – Vehicle and Operator Services Agency

Memorandum 2

Submission from Professor David Fisk, Imperial College London, Former Departmental Chief Scientist

Summary

- Central Government has seen a very large transfer of engineering knowledge and skills to Agencies and more latterly the private sector.
- The engineering skills that remain in Government are an ad hoc legacy, rather than the consequence of a formal downsizing plan.
- If Governments wish to have policies and public procurement marked out for innovation rather than costly novelty it seems likely that the transfer has gone too far.
- The most effective redress would be a much tougher external scrutiny of the engineering judgements that underlie Government action.

Introduction

1. I was Chief Scientist in DOE and then subsequently DETR, DTLR, ODPM and DCLG from 1988 to 2005. My submission offers some reflections as Head of Profession over that period. I was previously Head of the Mechanical and Electrical Engineering Division at the Building Research Establishment. I am a member of the Research Assessment Exercise General Engineering Sub Panel and a Fellow of the Royal Academy of Engineering. For the purposes of this evidence I am taking 'engineering' to be the art of devising something that one group of people will want to make and another group of people will want to use. This contrasts with 'science and technology' which I take to be knowledge just about 'things'. The main consequence of this distinction is that 'engineering advice' will almost always contain an element of risk and professional judgement.

3. This evidence focuses on engineering skills in Government which I choose to measure by 'Chartered Engineer' status. While this is not ideal it covers some fifty accreditation bodies and ensures some formal process to keep engineering skills and knowledge up to date. There is a wider informal sphere of engineering knowledge in Government but my working 'professional' definition is no more than would be taken for granted in an inquiry into, say, the Government legal service. I have no direct experience of MoD and have therefore not included its important engineering role in this evidence.

How many engineers are there in Government?

4. Unlike the economist and statisticians classes, Government has kept no central record of engineers in Government since the mid-1980's. My evidence has had to rely on FOI inquiries at Departmental and Agency level. Some organisations are in the process of building their databases (as in the CAA), but in other cases (e.g. Scottish Executive) personal data on professional competences are not held at all. In central government the numbers of professionally qualified engineers are to say the least modest. DTI in its last year did not know the precise number of Chartered Engineers though it 'could recall ten'. If this is really true it is a smaller number than the number of members of the Chinese Politburo with engineering qualifications! DfT's Rail

Group which undertakes much of the role of the old Strategic Rail Authority has just twelve chartered engineers in a staff of almost 300.

5. These figures are in stark contrast to those of the 1960's when a great deal of engineering was undertaken in, or close to, Central Government. Bodies like the Property Services Agency or the Central Electricity Generating Board were headed by formidable individuals with extraordinary grasp of their engineering. At this time the Civil Service had a well defined class called 'Professional and Technical Officer' that paralleled 'Scientific Officer' class. Between 1939 and 1959 the numbers in both classes rose from 11,000 to 70,000. The dramatic reduction since then reflects a change in Government structure rather than the amount of engineering undertaken in the name of the public sector. If anything, engineering issues have increased both in scale and complexity. When Executive Agencies and Regulators were formed they took from the home Department most of the engineers with the relevant experience. Some bodies like the Research Establishments were subsequently privatised. Pressure on civil service headcounts encouraged both Central Government and Agencies to 'buy in' engineering expertise. It should be borne in mind that the small numbers quoted in this evidence for the headcount of engineers in Departments refers to individuals who were in post in the late-1980's-early-1990's. This cohort represents a vast field of personal experience. The issue of public interest is then not the small number currently in post but that coherent plans for the recruitment of their successors are hard to find.

6. Indeed the whole transformation of Departmental engineering skills took place ad hoc. While there may be no magic number for engineers in Government I can advance circumstantial evidence suggesting that the UK has undershot. The transformation did not begin from a comfortable beginning. Despite the impressive number of engineers in Government the 1960's was not a Golden Era. Sampson's 1965 *Anatomy of Britain* devotes a whole section to the 'problems of the scientific and technical' specialists in the Civil Service and the tension with 'generalists'. This tension eventually led to the Holdgate Report in 1980. Even this report limited itself to just the 'science class'. It was to be the last time that the Cabinet Office reflected publicly on using technical specialist advice for 20 years. Few of Holdgate's recommendations were implemented given the changes that were starting to happen in parallel.

7. Moving engineering competence out of Departments to Next Step Agencies was consistent with giving the latter more freedoms. But it is hard not to suspect that the more specialists that could be shifted the more the old tiresome tensions could be relieved. The number of engineering specialists in the Centre was further shaved by the collateral damage of other well-intentioned reforms. The Fulton Report had already removed the broad career flexibility of the 'un-established' civil servant. In the 1980's wider reforms absorbed technical generalists into the main generalist policy adviser stream of the Civil Service, while retaining Economists and Statisticians as identified classes. This was also the time when MoD chose to distance itself from civil departments. The consequence was that there was no common career pool and the few engineers remaining in Departments were effectively in specialist ghettos. External pressure on staff head count encouraged both the central Departments and Agencies to outsource engineering advice rather than replace retirees.

8. The *Modernising Government* White Paper in 1999 addressed the revolution demanded by the new Administration. But it makes no reference to specialists. Its reforms included the extension of the Senior Civil Service to 'Divisional Manager' level. But this meant the imposition on the natural career grade for senior specialist advisers of formal competency requirements appropriate to managers of administrative Divisions. The Senior Civil Service is no country for young expert

engineers! More recently the Mottram report (*Professional Skills – Death of the Generalist*) identified three kinds of civil service function but it is hard to see where engineering experience outside of IT was supposed to fit in. The career problems of specialists are recognised in the Professional Skills for Government agenda, but this area has been left to Departments and as far as can be judged nothing has been done. Somewhat surprisingly, given these reforms, the Capability Reviews give rather little weighting to a Department actually mastering the substance underlying its patch To date the Science Reviews have not probed engineering competence at all. It became clear from my inquiries that human resources divisions have something of a general blind spot on professionalism. While seeking some kind of calibration I was told that the Finance Services Authority knows it has 2,670 employees but does not know how many have Chartered Accountant status.

9. It is too easy to focus on Central Departments and forget that most engineering decisions affecting citizens' daily lives take place in statutory agencies. Amongst enforcement agencies, HSE seemedd well informed on its expertise. Of its 4000 staff, 252 are Chartered Engineers. The Environment Agency which has to make significant engineering judgements has 12,000 staff, 200 of which are in 'engineering roles', and of those 23 are classed MEICA (mechanical, electrical, information, control and automation) engineers. It does not know if they hold Chartered Engineer status.

10. 'Economic' regulators spend a great deal of time probing capital expenditure plans proposed by industry that require substantial engineering judgements. For example Ofwat has six chartered engineers in a staff of 200. Ofcom a little surprisingly given the technical complexity of its tasks in a world of information technology is not sure how many of its 800 staff are chartered engineers, but does know it pays CEng fees for six. The Civil Aviation Authority is still assembling its database.

11. Thus the numbers of engineers in agencies and regulators is higher as is to be expected but not dramatically so. Incident investigation units were the honourable exception to these modest percentages. My broad conclusion is that the strength of engineering knowledge in government is largely the result of accident; that, despite the Professional Skills Agenda, there is not much evidence of nurturing professional skills; that neither sponsor departments nor supervisory boards seem to take much interest in human capital in engineering as part of a statutory function's 'balanced scorecard'; that, while there may be no magic percentage of engineers in public service, other pressures mean the UK is likely to have ended up with too few not too many..

Buying in Engineering Advice.

12. Whether any organisation actually needs in-house engineering skills depends on what it wants to do. You don't need to know how to build a bus to buy a bus ticket. When the organisation intends to do something that has never been done before it needs to be equipped to make judgements.

13. The least contentious case is when in-house staff outsources engineering analysis that they could have completed themselves so that they have more time to focus on the most difficult issues. The organisation is then always able to appraise the advice it receives. The case where the organisation is able to formulate the problem but is not able to devise any solution itself is more problematic. Who bears the risk if the ill-equipped organisation takes the advice offered? Again if the issue is simple there is no issue. But if the organisation's intention is to be 'innovative' without it acquiring the capacity to assess risks, the picture changes. In particular the consultant in formulating advice needs to be more diffident bearing in mind the need for due diligence. This is especially true if public discourse is content to allow a failure to be

blamed on the contractor not the contract! The weaker the in-house expertise the less likely the organisation itself realises the change in the style of advice provoked by contractor risk management. Governments of course are faced with a barrage of counter proposals by lobbyists whenever they propose to act. The less able they are to evaluate these the more likely they are to end up prevaricating. The worse case of all is when the organisation is capable of only a poor formulation of the problem let alone any assessment of conflicting 'answers'.

14. In my experience contractors would much prefer to work with the first case's 'intelligent customers'. The need for these beings has been posited since the days of the Rothschild 'Customer-Contractor' model of research procurement, periodically repeated in reviews, but seldom realised. While the first case is presumably the ideal, the immediate public interest priority is to avoid the UK public sector slipping into the third case of bemused organisational ignorance.

15. As a recent example of the issues, Government accepted the recommendation of the Commission on Environmental Markets and Economic Performance on which I served to have a more technically proactive procurement policy. *Innovation Nation* rightly proposes obtaining private sector advice in formulating tenders to provoke more innovative proposals but it is silent as to how in the proposals received the innovative are to be distinguished from the disasters. In contrast Transport for London staffed itself not only to procure but also to assess innovative proposals. The DCLG call for 'Eco-town' made much of proposals needing to showcase innovative technology, but as the Royal Academy of Engineering noted in its response it did not actually include any engineers on the proposal review panel. This is despite engineering failures of untested technologies playing an important role in the difficulties of many 'third wave' New Towns in the 1970's.

16. There is a particular problem in the UK because Treasury often has a formative part in shaping as well as funding initiatives. While acknowledging the undoubted skill set of public sector economists, there is no reason to expect that they have much experience in either the risk management issues or the modality of operation of real world engineering enterprises. The Treasury Green Book used as the basis for policy appraisal does not distinguish engineering innovation issues at all. Treasury of course does not have a Chief Scientist.

Is it different abroad?

17. I have given advice on using scientific advice to policy making to Commonwealth Governments and the European Commission. It would seem that the tension between political and specialist advice is here to stay. Outsourcing of engineering advice is widespread. The European Commission retained a single consultant to inform its antitrust action against the might of Microsoft. But none, including the US, seem to have gone as far as the UK in the degree to which they have distanced engineering knowledge from the Centre. Almost all countries, including the European Commission, have at least retained some engineering research capability that can serve as a resource for staffing headquarters functions. The US has a much more flexible career relationship between private and public sectors at Federal and State level. The US National Academy of Engineering records 7% of its members as in the 'government and not-for-profit' sector, in contrast to around 3% (my estimate of the NAE equivalent) in the Royal Academy of Engineering. In stark contrast the 'Asian Tiger' Model has been to throw the throttle full on in the other direction with very strong technocratic administrations.

Training and Skills

18. If the public sector has forgotten about engineering, engineering education seems to have forgotten about work in the public sector. The much applauded Royal Academy of Engineering report on engineering education (*Educating Engineers for the 21st Century 2007*) makes no mention of training to acquire skills to work within Government and Agencies. Imperial and Cambridge, amongst the top five European engineering schools record less than 2% of their UK resident engineering graduates entering the whole public sector. I have not myself ever given much credibility to Civil Service 'science and technology fast stream' entry. Its current undemanding first degree requirements underlie the point. In any case it is far more important to understand how engineers with real world experience are brought into the public sector, and how they are trained to work within public policy. Of the 16 specialist programmes at the National School of Government (NSG), none are designed for mature entry engineering specialists. The only NSG induction programme I have found was for economists. Indeed none of the six qualities highlighted by the Civil Service Commission Recruitment Gateway for 'experienced professionals' entry seems to require actually knowing anything in any detail. There are more demanding entry requirements for 'professionals' but none of these classes cover engineering or science in civil departments.

19. There well may be some 'executive' induction training for new Chief Scientists. But I doubt the problem is at this high level. After all if Ministers were uncertain about a submission, the Private Office could always invite the President of the relevant engineering institution in for a chat! The difficulty is in the many more low profile decisions taking place across the whole civil side of the public sector.

Recommendations

20. Based on past experience I doubt that procedural recommendations will have much real traction. The deployment of specialist resources within the Government on say legal services, or the economics service or press offices is not capricious. Departments have to combat citizens in the Courts, Treasury in the reviews of spending and rebut the Press on a daily basis. I believe it is no accident that the one area that has been robust to my own inquiries is the high profile area of incident investigation. From outside MoD appears to take more interest in its engineering, but then its decisions are tested on the modern battlefield. If Departments were to be held more effectively accountable for 'winging it' on engineering, I am confident that resources would redeploy with great ingenuity and rapidity.

21. Unfortunately those able to spot the engineering errors can be represented in uninformed public debate as interested parties, or they have little incentive to correct reasoning because they are in a good position to be paid later for putting errors right. While our journalists are required to meet standards of professionalism and in the BBC's case, impartiality, this does not include, with some outstanding exceptions, actually understanding the substance on which they are reporting. A good technical press operates in a cognoscente's world of its own. All this is of course is the public interest rationale for Departments and Agencies having some internal mastery of what they are doing. For some reason blaming the contractor not the contract has become an accepted explanation for failure in delivery. *Caveat emptor* no longer applies. That itself brings new dubious rewards for the Executive to contract out what it does not understand.

22. If the Executive was minded to be more self-reflective on its engineering capabilities my guess is that it would rapidly devise a flexible employment contract suitable for employing engineering expertise that was not a life sentence. It would correctly address the induction needed to bring in experienced engineers to work in the public

sector and identify appropriate competencies at career grade. It would create a proper service-wide career pool and a proper professional development programme appropriate to public service.

Note In obtaining information through FOI requests I have been at pains not to burden Departments and Agencies. No doubt in preparing their own evidence they would devote more time to precision, and if there are any discrepancies I bow to their figures. In most cases the numbers are so bald that I cannot believe the differences would be significant to my conclusions.

Memorandum 3

Submission from Semta

Summary

1. Semta would like to see government use the Sector Skills Council (SSC) network more effectively when engaging with the engineering sector. We are happy to work with officials in any capacity which would enable government to address the needs of the sector more appropriately. We can offer expertise on all areas of the skills landscape, as well as facilitating direct government contact with employers.
2. We would like to see consultations, legislation, and other proposals scrutinised for their impact on engineering BEFORE they reach the public domain, as we are continually having to raise these issues at a late stage in the process. Semta would be happy to contribute at an earlier stage of the consultation process.
3. An engineering 'Champion' in government would be welcome – a named, high profile, authoritative advocate of engineering to speak on behalf of the sector and work across departments to raise its profile. This individual could be supported by a group of civil servants who scrutinise activity across departments to raise issues where it will impact negatively on the sector.

Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies

4. Industry owned and led, Semta aims to increase the impact of skilled people throughout the science, engineering and manufacturing technologies sectors.
5. We work with employers to determine their current and future skills needs and to provide short and long term skills solutions, whether that be training and skills development, or campaigning with government and other organisations to change things for the better. Through our labour market intelligence and insights from employers across our sectors, we identify change needed in education and skills policy and practice, and engage with key industry partners and partners in the education and training sector, to help increase productivity at all levels in the workforce.
6. The sectors we represent are: Aerospace; Automotive; Bioscience; Electrical; Electronics; Maintenance; Marine; Mathematics; Mechanical; Metals and Engineered Metal Products.
7. Semta is part of the Skills for Business network of 25 employer-led Sector Skills Councils.

Engineering advice and government policy-making

Representation on skills

8. We feel that government currently does not effectively use the network of Sector Skills Councils to gather information and opinion before making decisions. Through SSCs, government can access expertise and experience on a range of skills-related issues, and bring employers effectively into the policy-making process. The network was created to

be ‘the voice’ of its employers, yet SSCs sometimes feel that we are the last to be considered. Semta has processes in place which would enable government to access employers directly, to present their proposals and gain feedback.

9. Semta directly represents the views of its employers at all levels of government. This is done through a variety of routes, detailed as follows, together with Semta’s view on their efficacy (or otherwise).

Face-to-face meetings with ministers and officials on particular issues and subjects

10. Semta is reasonably confident that it is able to arrange meetings with appropriate ministers and officials, both on its own behalf, and on behalf of its employers. We naturally only approach government and officials for meetings where there is a subject of substance for discussion. These meetings are sometimes initiated by Semta, and sometimes by government.

11. Our experience of these meetings is that ministers and officials are generally responsive to employer concerns, and sympathetic to their needs. However, their knowledge of engineering can be low, and understanding of some of the more complex issues facing companies can be simplistic. Of course, Semta (and our employers) are keen to address this, and ministers and officials often show great enthusiasm for learning more about the sector. We are not aware of any issues around the attitude of ministers and officials to engineering – they appear interested and engaged.

Formal responses to consultations

12. Semta submits responses to consultations as part of its policy representation. These consultations are usually compiled from direct employer input (where time permits). The number and frequency of consultations coming from government which are of relevance to the engineering sector means that it can be problematic to gather meaningful responses. Semta is also observing an increasing level of cynicism, and belief that the formal consultation process is not a serious attempt to gain feedback and establish the right direction, but rather a ‘final stage’ before implementation.

Regular meetings as part of projects and programmes underdevelopment or activity underway.

13. Semta meets with officials when working of specific projects and funded programmes, as part of the process of project management and delivery

Indirect communication through others

14. This relies on the third party to accurately communicate our views to the right people in government. This can be problematic, and our experience suggests that, on occasion, the ‘message’ is not relayed in the right way to the right person. For example, Semta is currently experiencing a great deal of difficulty around qualifications in our sector, and their incorporation into the new Qualifications and Credit Framework in England. Our concerns are being filtered through third parties (the regulatory bodies) to civil servants. We are not confident that these third parties and their civil servant partners are then reflecting our concerns upwards to the appropriate people. This can leave ministers and senior officials in an embarrassing position, as they are unaware of any problems until we are forced to contact them directly. A specific government ‘Champion’ for engineering might enable the sector to have a more effective voice in government.

Example of policy decision-making to illustrate concerns

15. The current apprenticeships proposals are causing considerable concern for engineering employers, who feel that many of the proposals are being introduced to support and encourage non-traditional apprenticeship sectors. The proposals suggest a single approach across the economy to address the needs of non-traditional sectors (the creation of the National Apprenticeship Service, the move of 'ownership' of the apprenticeship blueprint from SSCs to the NAS, etc). We expressed these concerns on behalf of our employers early in the consultation process, but received no reassurances. It was only a meeting with David Lammy, which Semta attended with employers, which began to address these issues, with confirmation that the proposals are designed to support non-traditional sectors, but will not be allowed to compromise existing good practice in traditional sectors. Even with the minister's assertions, Semta is still unsure as to whether officials, and those who will be implementing the proposals, are aware of the minister's views, and we will continue to speak strongly in this issue until the official documentation reflects our employers' concerns.

Engineering across government

16. The engineering sector would benefit from someone with authority in government to 'speak up' for its requirements across all government departments, who led a group of civil servants tasked with protecting the interests of the sector. Perhaps it would be appropriate to take equal opportunities as a model – it is common practice to scrutinise proposals and ensure any implications in this area are known and addressed. A similar approach is needed for the engineering sector. If the government accepts that the sector is key to the future prosperity of UK plc, then officials working in areas such as taxation, company law, inward investment strategy, etc must consider the impact on engineering. This would require expertise within the civil service, and the authority to influence developments.

Current levels of knowledge about engineering

17. As stated previously, while enthusiasm to support the sector is not necessarily lacking, understanding of the sector can be deficient. We have sometimes observed a lack of clarity around the definitions of 'manufacturing' and 'engineering', which leads to confusion and lack of confidence. The needs of the two sectors are actually quite different in many areas, as they are at very different stages of their economic cycles, and are affected by different external drivers. Civil servants need to improve their understanding of these issues, and their appreciation of the complexity of the economic landscape.

In the devolved administrations

Wales

The experience of Semta in Wales is reflected in the comments made previously, but with the additional comment that the newly-formed Manufacturing Forum is likely to be very helpful in raising the profile of manufacturing (and engineering), as well as improving understanding. Semta is looking forward to playing its part in this welcome initiative.

Scotland

The experience of Semta in Scotland is reflected in some of the comments made previously. Government in Scotland is supportive of engineering, but could use the SSC network more effectively in its decision-making and policy formation. However, the Scottish government has made additional commitment to the engineering sector in areas such as adult apprenticeships, which suggest it has a strong understanding of the particular needs of the sector.

Semta

September 2008

Memorandum 4

Submission from the Royal Academy of Engineering

1. Introduction

1.1. The overriding messages of this response are that the Government must recognise the difference between scientific advice and engineering advice and ensure that policy is appropriately informed by engineering advice at all stages of development and delivery. Presently, the Government does not articulate a clear view of the role of engineering in society or in policy making. Too often, phrases such as "science and technology" or scientific "innovation" are fielded as a substitute for "engineering".

1.2. Engineering is concerned with the art and practice of changing the world in which we live. In doing this, engineers seek to achieve useful and beneficial outcomes in the physical world and in a business context. Much Government policy is delivered by means that require engineering solutions, which need to be developed, informed and tested by engineers as part of the policy development process.

1.3. As well as informing the delivery of policy, engineers can bring perspectives to policy formation that can enhance decision-making at all stages of the policy cycle. Engineers understand how to work with risk and uncertainty in project delivery, a key element of identifying and weighing options in policy formation. In articulating the engineering issues inherent in and raised by a policy, engineers can help identify potential barriers to implementation and ways of avoiding them.

1.4. A number of key policies fundamental to the long-term national well-being have suffered and been found wanting as a result of a lack of good engineering advice being taken at the formulation stage. The Climate Change Bill, Sustainability and Planning Bill and recent Energy Bills over the last five years failed to address engineering risks and reality in delivering the engineering assets required to enable policy to be realised and targets to be met.

1.5. Government should make better use of the expertise that resides in the engineering institutions and their overarching bodies to obtain engineering advice at all stages of the policy cycle. The Royal Academy of Engineering could act as a broker in the preparation, collation and submission of profession-wide[1] advice where and when it is required.

1.6. Government needs to be an intelligent customer for the engineering advice it receives. This means having civil service staff who are able to understand and evaluate engineering advice. With the focus strongly on evidence-based policy, the civil service should have amongst its staff engineers who are able to source and assess technical evidence. Evidence-based policy in key areas such as climate change, energy supply and low-carbon transport is only achievable with the input of policy advisers with an understanding of the required evidence – and that will include engineering evidence.

[1] Engineering encompasses pure civil, electrical, process and mechanical engineering, of course, but also engineering directly related to building, transportation, ICT, materials, utilities, agriculture, healthcare, and mining

1.7. There always have been highly qualified engineers employed within Government, but because engineering has generally always been seen as a policy delivery issue rather than a policy development issue, those engineers have predominantly been employed in Agencies rather than Departments. As political ideas and imperatives are developed into policy within Departments, there is a need to embed engineering advice within them.

2. Recommendations

2.1. The response makes the following recommendations which appear here in the same order as they do in the text:-

a). Certain key Departments should have Chief Engineering Advisers, rather than or as well as Chief Scientific Advisers to reflect the increased importance of engineering to those Departments. Chief Engineering Advisers in these Departments are likely to be engineers by profession (as some DCSAs already are). This would allow them to articulate and address the engineering issues faced by those Departments and would ensure that the Government Chief Scientific Adviser has access to engineering advice within his or her team. Chief Scientific Advisors and Chief Engineering Advisors also require high quality staff support within their Departments if they are to provide a service with the required breadth.

b). Effort should be made to recruit engineers with practical experience of large-scale projects to these posts. The required remuneration package and terms of employment to attract a senior engineer from industry to a DCSA post will be necessarily different from that offered to an academic engineer expected to maintain his or her post at a university and return to it after the term of office as a DCSA.

c). The GCSA and the DCSAs should meet regularly with the engineering profession (through the Royal Academy of Engineering, the engineering Institutions and their overarching bodies) to communicate issues of current interest and discuss the sourcing of engineering advice.

d). Engineering advice should be sought early in the policy development process even if the engineering aspect of a problem is not obvious to policy makers.

e). Any large-scale project should be carried out with the advice of engineers – engineers have project management skills relevant to complex projects, especially those with a technical component.

f). Advisory committees should be established in Government Departments which should be used to identify when engineering advice is needed and on what issues. The engineering community, through the engineering institutions and the Royal Academy of Engineering could advise on members for such committees.

g). Open and formal processes for inviting engineering advice at the onset of policy consideration should be established.

h). Recruitment of engineers through the Fast Stream should be increased, with more engineering graduates able to forge careers within the civil service,

leading to senior positions, but with the opportunity to retain engineering as a specialism.

i). Government should actively advertise the role for engineering graduates in the civil service for policy development functions as well as through delivery Agencies, so that it is perceived to be a viable career path.

j). The Government should require the professional registration of both its technical staff and also the staff of its consultants and suppliers to ensure that it receives the best advice from fully qualified, up to date engineers.

k). Government should be encouraged to consider the engineering community as a resource for informing policy at all stages as the US government does with the National Academies.

l). An understanding should be developed of how Governments in other countries take engineering advice as part of the policy process.

2.2. In addition to making these recommendations, the professional engineering community offers:

a). To continue to undertake policy studies that identify matters of importance to Government policymaking, provided there is a willing recipient for those reports.

b). To respond, as a coordinated body, to requests to give advice on draft policy and to peer review research carried out for Government, when invited.

c). To agree a process with Government whereby the professional engineering community can provide advice on key policy topics to support Government decision-making.

3. The role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across Government and communicating issues relating to engineering in Government to the public.

3.1. The system of Departmental Chief Scientific Advisers (DCSAs) is new – the result of an initiative of the previous Governmental Chief Scientific Adviser (GCSA), Sir David King. At this stage, it is difficult to judge the effectiveness of the system. Some general comments can, however, be made.

3.2. Firstly, the role of the GCSA is broad, intended to encompass both science and engineering. This is not, however, reflected in the department's title (Government Office for Science), unless it is simply assumed that engineering is a sub-discipline of science. But engineering is a quite different discipline, pursued in a different manner towards different ends. Engineering is concerned with solving practical problems and in changing the physical world, using scientific, technical and business skills. Science, on the other hand, is principally about understanding the nature of the world. The practical nature of engineering means that engineering advice and expertise is of great value in developing policy and delivering projects. For example, the need for engineering advice is particularly pertinent in the area of climate change. The big challenge is no longer the search for evidence for climate change but rather the search for means of avoiding its advance and mitigating its effects, many of which will be matters of engineering and technology.

3.3. The impact of the GCSA depends to a large extent on the influence of the individual DCSAs within their Departments and the strong leadership provided by the GCSA ensuring the role of the DCSAs is appreciated and understood at Cabinet level. The recent GCSAs have done a very effective job of raising the profile of the scientific aspects of policy issues, especially in the arena of climate change. The status and impact of the DCSAs depend in part on how many opportunities they have to speak to ministers. The support they get in terms of staff is also an issue as most of the DCSAs are part-time positions. Building the influence of DCSAs within their Departments might be helped by making the posts full-time and ensuring that DCSAs have appropriate and effective staff resources within Departments.

3.4. There are some Departments in which it is important that an engineer fills the DCSA role – the DfT, the MoD and potentially BERR and DIUS. In these cases, it would make sense to call these advisers Chief Engineering Advisers, to reflect the kinds of expertise needed and the advice required. In the MoD for example, there is a Chief Scientist, and the Defence Science Advisory Board. The MoD is a Department where the budgetary spend on engineering is ten times that spent on science. Science advice in MOD is a combination of blue sky research, management of applied research, operational analysis and scrutiny of technical requirements and project approvals. Engineers are involved in this but are mainly engaged in delivering equipment projects. The CSA's role is an essential element of the checks and balances over £Bns of public expenditure on mainly high-tech projects. Although DSTL is an agency of the MOD (employing more engineers and scientists than any other Government agency), its expertise does appear to be used by the MOD in policy formation far more than any other agency in Government. In other Departments both scientific and

engineering advice is needed – DEFRA is a clear example where the life sciences and engineering are both relevant, yet the current description of the role of its CSA does not include the provision of engineering advice[2]. In these Departments, it should be made clear in the job description and potentially in the job title that providing and assessing engineering advice is a core role. It is also important that the expertise of advisers is not limited to their own Department. Many issues and the successful delivery of many policies cut across Departmental boundaries and a free exchange of engineering advice across Departments is necessary. For example, a transport issue being considered by the DCSA for the DfT might impinge on local community issues addressed by the DCLG and environmental issues addressed by DEFRA.

3.5. Many of the current DCSAs are scientists and engineers working in academia who may not have current experience of delivering major industrial projects. This could result in the CSA service struggling to provide robust advice on practical application of scientific and technical knowledge and therefore in the successful delivery of policies even where they are based on robust scientific and technical evidence. The search for DCSAs should extend beyond the world of academic research into business and industry where there is a wealth of skill in finding appropriate, cost-effective solutions to practical problems. This experience would be invaluable in helping Departments to understand practicalities of rolling out technology at scale and understanding the breadth of engineering research in the private sector, research that the Government can stimulate and can gain from.

3.6. We recommend that:

3.6.1. Certain key Departments should have Chief Engineering Advisers, rather than or as well as Chief Scientific Advisers to reflect the increased importance of engineering to those Departments. Chief Engineering Advisers in these Departments are likely to be engineers by profession (as some DCSAs already are). This would allow them to articulate and address the engineering issues faced by those Departments and would ensure that the Government Chief Scientific Adviser has access to engineering advice within his or her team. Chief Scientific Advisors and Chief Engineering Advisors also require high quality staff support within their Departments if they are to provide a service with the required breadth.

3.6.2. Effort should be made to recruit engineers with practical experience of large-scale projects to these posts. The required remuneration package and terms of employment to attract a senior engineer from industry to a DCSA post will be necessarily different from that offered to an academic engineer expected to maintain his or her post at a university and return to it after the term of office as a DCSA.

3.6.3. The GCSA and the DCSAs should meet regularly with the engineering profession (through the Royal Academy of Engineering, the engineering Institutions and their overarching bodies) to communicate issues of current interest and discuss the sourcing of engineering advice.

[2] See http://www.defra.gov.uk/science/how/adviser.htm

4. The use of engineering advice in Government policy making and project delivery, including examples of policy decisions or project delivery that have been or will be taken with or without engineering advice.

4.1. Engineers are not sufficiently often invited to contribute to policy development – their role seems to be restricted to implementation and checking of policy after the fact. But the routine engineering practices of comparing solutions for cost-effectiveness, efficacy and public acceptability would be highly valuable in informing policy decision-making at the earliest stage. Engineers' skills in project management would also be useful in scrutinising complex policy delivery.

4.2. Recent energy policy is an area of policy development that appears to have suffered as a result of lack of engineering input at an early stage. We have been told privately by reliable sources that unrealistic estimates have been made about the contribution of non-fossil fuel sources to energy supply and CO_2 emissions reduction as well as the potential carbon emissions savings of various energy efficiency measures. A sound engineering insight would have given a clearer picture of the contributions of the different energy technologies, the timescales in which they could feasibly come on-stream and the measures necessary to mitigate risk – whether technical, political, commercial or otherwise. Engineers' views are also essential to identify barriers to certain policy solutions as well as ways to circumvent or overcome them. For example, while the use of microgeneration of electricity through wind power might be recommended, this recommendation is undermined by the fact that the electricity grid is not currently[3] designed to deal with the feeding back of large amounts of power into the grid – the distribution system is designed to be one-way.

4.3. Recent plans for developing Eco-towns were drawn up with the help of a steering committee (the Eco Towns Challenge Panel) which had no engineering input. The contribution of an engineer in this case would have been to look at the intended outcome – reducing domestic carbon emissions within the UK – and assessing whether this was the best means to meet that outcome. Engineers would have been highly likely to conclude that the outcome would be better served by retro-fitting existing housing to reduce its carbon emissions, a view that seems to be emerging through the consultation process.

4.4. Large IT systems are an area of Government procurement that has and continues to experience both bad press and implementation problems. Some would assert that specifications have been driven by political imperatives rather than being derived from operational requirements; a situation which would apply to both the ID Card project and the National IT Programme (Connecting for Health). It is possible that this approach has led to decisions about the architecture of systems being taken or assumed before detailed expert advice was taken. Here, a distinction needs to be made between the advice received by Government in the procurement of systems, which is often good and realistic, and the advice received in the development of policies which are delivered through the procurement of IT, which is often lacking.

[3] Although, with some planning and investment, engineered solutions can be provided.

4.5. The MoD has the Defence Science Advisory Council, but there are limited opportunities for inputting engineering advice through this structure. Advisors have said that they are unable to get close to the real engineering problems themselves, and have a somewhat distant role, being asked to comment on the scientific quality of advice received in terms of the bibliometric citation rate of the authors rather than addressing the real world problems the advice has been sought to address. Although the MoD continues to struggle to deliver projects to time, cost and performance, it appears more likely to take engineering advice than other Departments. The recent review of the Royal Navy procurement of two large aircraft carriers by Sir John Parker FREng was instigated at a late stage to give the Government comfort that the contract could be managed and delivered by industry. It is welcome that the Government should seek such advice, but it could be an integral part of the procurement process for difficult projects rather than a late stage add-on.

4.6. Although aspects of risk are routinely addressed in the assessment and development of policy, the specifics of engineering risk are more often than not entirely missed. As an engineering concept of risk is wide, including project risk as well as risk of failure or catastrophe, an appreciation of it in the policy development phase when implementation relies on engineering would be advisable. In many cases, particularly in energy policy, the financial risk that investors are expected to take on has been badly assessed, leading to financial incentive structures being put into place that can actually increase risk to investors.

4.7. We recommend that:

4.7.1. Engineering advice should be sought early in the policy development process even if the engineering aspect of a problem is not obvious to policy makers.

4.7.2. Any large-scale project should be carried out with the advice of engineers – engineers have project management skills relevant to complex projects, especially those with a technical component.

5. How Government identifies the need for engineering advice and how Government sources engineering advice.

5.1. From the point of view of the profession, there are neither established means by which Government decides when engineering advice is required nor what advice specifically is needed. There is also no clear, open and formal process by which individuals or groups are invited to provide advice or proposals. This style of much policy making has led to some individual engineers and industrialists being called on to provide policy advice, however this advice is seldom peer reviewed. It would, however, be possible for Government to access a broader range of engineering advice by means of a more formal policy-making process that would call for advice and ideas at a much earlier stage than at present. The current formal consultation stage in policy-making, where open invitations for evidence are made, is generally at a late stage of policy development by which time the direction of travel is often already framed and the opportunities to explore alternative solutions are closed.

5.2. The Government often procures engineering advice from external consultants which is of variable quality. For instance, we understand that some reports produced for the DfT Low Carbon Cars strategy produced by third party consultants under extreme time pressures contained inaccuracies that would be obvious to an engineer with relevant expertise, but not necessarily to an official without that expertise or access to it. Engineering expertise is needed within Government Departments to ensure the quality of the procurement and quality control of that advice.

5.3. Advisory committees such as DSAC in the MoD and the interdisciplinary committee in the Home Office have great potential value in advising Departments on whether engineering advice would be valuable to inform policy development and planning policy implementation. There are engineers with the relevant experience on these committees to fulfill this role and it is the duty of the relevant Departments to engage them appropriately.

5.4. Greater use could also be made of university research, but there are obstacles to academic-Government interaction. As will be discussed in a forthcoming Council for Science and Technology (CST) report, there are disincentives for academics to carry out research for Government use. The results are often secret, or at least not published, so they cannot be used by the academic as examples of their work. Government Departments may offer little remuneration or may expect work to be carried out pro bono. Often the process of setting out what advice is needed is too extended, meaning that academics may have moved on to other projects between being invited to provide advice to Government and receiving the details of the arrangement. The Academy's experience of helping to place engineers on advisory panels for various Departments and Agencies is that remuneration or honoraria range from average to inadequate considering the amount of expertise and engagement requested.

5.5. The CST itself is a valuable source of advice on engineering. Although the title does not include "Engineering", the Council includes many engineers amongst its membership (with more Fellows of The Royal Academy of Engineering than of The Royal Society). But Government rarely proactively seeks advice from the CST and the reports produced by the CST are not always heeded. The CST's report *Better use of personal information:*

opportunities and risks (November 2005), is a salient case in point that contained timely advice the Government would have done well to heed.

5.6. The issue of engineering advice also extends to advice about how to ensure an adequate supply of competent professional engineers and technicians. Here, the Royal Academy of Engineering and the engineering institutions have worked closely to respond to Government wish to clarify and strengthen careers advice. However, in the field of education, despite the importance of engineering to the economy, advice tends to be sought first from the Sector Skills Councils, and rarely specifically solicited from the profession. This can lead to short-sightedness on the part of Government on such issues as the Bologna Declaration, and the development of the new points-based immigration rules (which fail to recognise professional qualifications).

5.7. We recommend that:

5.7.1. Advisory committees should be established in Government Departments which should be used to identify when engineering advice is needed and on what issues. The engineering community, through the engineering institutions and the Royal Academy of Engineering could advise on members for such committees.

5.7.2. Open and formal processes for inviting engineering advice at the onset of policy consideration should be established.

6. The status of engineering and engineers within the civil service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service.

6.1. The Fast Stream of the Civil Service encourages a culture of educated generalism. Fast streamers spend time in all parts of a Department to gain an understanding of all aspects – giving the ability to take a broader view. However, the focus on handling a new brief every 2-3 years and delivering ministerial advice pulls against the retention of specialist skills and knowledge. Within the Science and Engineering Fast Stream it may be possible for engineering graduates to specialise in engineering-related projects, but the numbers of graduates entering via this route is small – 15 in 2007-2008 compared with 190 recruited to central departments and 100 into the Economics Fast Stream. And of course, this number encompasses both science and engineering graduates and it is likely that the greater proportion is from science.

6.2. In Government, the focus is strongly on evidence-based policy, so it would seem important that it has amongst its staff engineers and scientists able to source and assess technical evidence. Evidence-based policy in key areas such as climate change, energy supply, low carbon transport and so on is only achievable with the input of policy advisers with an understanding of the required evidence – and that will include engineering and other technical evidence, whereas this is currently done by analysis professionals, usually with an economics background.

6.3. More engineers are needed within the civil service if Government is to be a genuinely intelligent customer of external advice, with sufficient expertise to be certain of knowing what questions to ask and to assess the accuracy of answers returned. The potential for establishing Government policy on incorrect evidence is of concern. For example, the errors in the reports on low carbon cars for the DfT could have been used to make policy decisions. There is therefore a pressing need for more engineers within the civil service, as lack of engineering expertise can lead to financially and politically costly errors. There must not only be a recognised career path for engineers within the civil service, but engineers must be recognised for their contribution to the policy making process and must not be perceived as career limited as compared to other professions within the civil service.

6.4. However it is not just a numbers game. The competence of those in post should not be taken for granted in such a fast moving profession. The engineering institutions exist, in part, to develop and maintain high professional standards in engineering. The institutions assess and register engineers to the standards agreed by ECuk and all require their members to comply with a professional code of conduct. Most provide information, continuing professional development and networking opportunities that enable engineers to stay up to date and competent. Whilst this may appear to be self promotion on the part of the engineering institutions, we contend that Government can only be confident with the advice it receives if it has been provided by a competent, assessed practitioner.

6.5. We recommend that:

6.5.1. Recruitment of engineers through the Fast Stream should be increased, with more engineering graduates able to forge careers within the civil service, leading to senior positions, but with the opportunity to retain engineering as a specialism.

6.5.2. Government should actively advertise the role for engineering graduates in the civil service for policy development functions as well as through delivery Agencies, so that it is perceived to be a viable career path.

6.5.3. The Government should require the professional registration of both its technical staff and also the staff of its consultants and suppliers to ensure that it receives the best advice from fully qualified, up to date engineers.

7. The role and effectiveness of professional engineers and the engineering community in promoting engineering and providing engineering advice to Government and the civil service.

7.1. The professional engineering organisations have the potential to make a significant contribution to Government policy. The focus of the professions is the public good and the engineering profession seeks to improve quality of life through its work. Therefore, professional bodies have a duty to input to public policy processes. The engineering bodies have a greater interest in providing such advice than does industry which naturally focuses on growing a market, shareholder value, international competitiveness and so on. We support the advice of the erstwhile Science and Technology Committee in its 2006 report *Scientific advice, risk and evidence-based policy making* that Government should turn more readily to the profession and learned societies.

7.2. Individually and collectively, the engineering institutions offer what advice they can but recognise that this advice must be well co-ordinated and focused. The institutions, with The Royal Academy of Engineering acting as focal point, are, however, able to commit to provide Government with detailed, co-ordinated, professional advice. However, for this to work optimally, an agreed, clear mechanism for dialogue will be needed. A number of engineering institutions as well as the Academy already publish high quality policy advice to Government,[4] but better communication would ensure that this advice were more timely, constructive and informative.

7.3. The institutions and The Royal Academy of Engineering could help provide engineering advisory committees for key Government Departments to assist Departments in scoping questions for consultants and peer-reviewing the resulting work. Such committees could also comment on the feasibility of policies such as the national ID card plan to highlight strategic engineering and technical issues around their delivery. A positive example of such an undertaking is the engineering advisory group convened by BERR for the Severn Barrage feasibility study, comprising members of The Royal Academy of Engineering, the IET, IMechE, IChemE and the ICE.

7.4. However, there is always a limit on how quickly a group of professional engineers providing advice on a voluntary basis can produce the information needed by Government Departments. The engineering community should not be the sole source of engineering advice – there must also be competent engineers within Departments who can provide engineering expertise and assess the work of consultants. It is most important that engineering is embedded in the civil service so that policymakers are alive to the engineering aspects of policy and know when to ask for advice and how to use it.

7.5. A more structured process for the provision of advice, agreed by Government and the professional engineering community, would greatly improve the effectiveness of the provision of independent advice.

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[4] Some recent examples are recent typical examples being the Flooding Report issued by the Institution of Civil Engineers in June 2008 http://www.ice.org.uk/downloads/2008_flooding.pdf, the IMechE Low Carbon Transport Report in March 2008 http://tinyurl.com/6bq2bm, and the Need for Domestic Air Services in the UK, published by the Royal Aeronautical Society in August 2008 http://tinyurl.com/5td67z.

7.6. We offer:

7.6.1. To continue to undertake policy studies that identify matters of importance to Government policymaking, provided there is a willing recipient for those reports.

7.6.2. To respond, as a coordinated body, to requests to give advice on draft policy and to peer review research carried out for Government, when invited.

7.6.3. To agree a process with Government whereby the professional engineering community can provide advice on key policy topics to support Government decision-making.

8. International examples of how engineers and engineering advice are embedded in Government.

8.1. In the USA, there is a constitutional relationship between the Executive, the Legislature and the National Academies, with the Executive and Congress procuring research through the National Research Council (NRC). As a result, the US National Academy of Engineering (which stands in a similar relationship to the US engineering societies as The Royal Academy of Engineering does to the engineering institutions in the UK), is a large, well-staffed organisation that is able to be responsive to the needs of Government. Although the National Academies in the USA were established with this relationship intended from the outset, the engineering community in the UK, with The Royal Academy of Engineering as the co-ordinating body, could develop a similar role. This could become a two-way communications channel between the community and Government, with Government requesting advice and the community responding promptly. The collaboration between The Royal Academy of Engineering and the Royal Society on the Nanoscience and Nanotechnologies report, which was commissioned by Government, is very much in the US mould. Opportunities for similar projects that bring together experts from the engineering community should be sought by both Government and the engineering community. In summer 2007, an offer was made to the Treasury and BERR by the engineering community to produce a report on the engineering aspects of climate change. This was not taken up but would have been a substantial piece of work of great value in informing energy policy.

8.2. Another initiative to adopt from the USA might be the secondment of senior engineers to Government departments. In the USA engineers are seconded to departments such as Department of Defense and Department of Energy. This would be an effective way for Government to make use of the experience of engineers in industry.

8.3. In China the engineering professions and government have strong links. Obviously the political systems in this country differs significantly from that in China, but the close relationship between engineering and government and the status of engineers within government is something that the UK should learn from. If it is possible to understand why engineers have this greater involvement and if it were possible to make some steps toward creating such a situation in the UK, it could have great benefit for the Government in being able to deal with engineering challenges.

8.4. The Australian Government is focusing effort on exploiting engineering expertise through the Prime Minister's Innovation, Science & Engineering Council. The title of the relevant senior position, held recently by former Institution of Chemical Engineers President Dr Robin Batterham FREng, was Chief Scientist; however the Council's scope clearly included engineering. The Australian government is also developing a body of experts on software systems engineering and looking for international expertise to populate it. It is essential that our Government recognises the need to use global engineering expertise as engineering challenges require the best thinkers from around the world.

8.5. We recommend that:

8.5.1. Government should be encouraged to consider the engineering community as a resource for informing policy at all stages as the US government does with the National Academies.

8.5.2. An understanding should be developed of how Governments in other countries take engineering advice as part of the policy process.

This response has been prepared by The Royal Academy of Engineering with the input and support of a large body of organisations from across the engineering community, whose names are listed below:

Signatories

The British Computer Society
The British Nuclear Engineering Society
The Chartered Institution of Building Services Engineers
The Engineering and Technology Board
The Energy Institute
Engineering Council UK
The Institute of Acoustics
The Institute of Healthcare Engineering and Estate Management
The Institute of Highway Incorporated Engineers
The Institute of Marine Engineering Science and Technology
The Institute of Materials, Minerals and Mining
The Institute of Measurement and Control
The Institution of Agricultural Engineers
The Institution of Civil Engineers
The Institution of Chemical Engineers
The Institution of Engineering and Technology
The Institution of Engineering Designers
The Institution of Lighting Engineers
The Institution of Mechanical Engineers
The Institution of Nuclear Engineers
The Institution of Railway Signal Engineers
The Institution of Royal Engineers
The Institution of Structural Engineers
The Institution of Water Officers
The Royal Academy of Engineering
The Royal Aeronautical Society
The Royal Institution of Naval Architects
The Society of Environmental Engineers
The Welding Institute

Memorandum 5

Submission from the Institution of Engineering and Technology

1. Introduction.

- The IET fully supports the evidence submitted jointly by the engineering institutions. We provide the following information as additional evidence from IET members.

- In general the IET considers that the Government's use of engineering advice and in particular its use of the engineering resource represented by the engineering institutions has been ad-hoc and uncoordinated in nature. Whilst the engineering profession might not fully appreciate the Government's position or its requirements, we would argue that the Government does not formally acknowledge the role of engineering in policy making and perhaps does not realise the resources available.

- We are confident that the profession, through the Institutions and engineering organisations, would welcome the opportunity to work with the Government to establish an engineering strategy for the UK.

2. **The status of engineering and engineers within the civil service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service.**

2.1. As one might expect, the status of engineering varies from department to department. For example there are many engineers in the MOD, the DfT and particularly within their agencies. Evidence for policymaking in departments is gathered from the engineering experts, who are in turn expected to present their expertise in terms of policy options. The very nature of engineering can and does result in different experts presenting contrary advice, particularly where there is incomplete evidence available. In some circumstances, a generalist civil servant would have to weigh up the options and recommend one course of action to their Minister.

2.2. Other departments have seen a reduction in their engineering competence. For example, following Government's "arms length" approach to the liberalised energy market, we believe that the internal engineering expertise within BERR has reduced. For example, when Dr. Peter Fenwick retired as Chief Engineering Inspector at BERR he was not replaced. That is not to say that the department does not seek relevant expertise, however the use of consultants and seconding engineers from industry may not provide the impartial advice that is required.

2.3. Where external engineering advice is obtained, there is some concern that there is often only low level management of these activities, which focuses on meeting the political drivers, with much of the complexity of the engineering challenges filtered out to in order to provide easily digestible "sound bites".

2.4. In some departments there is a poor understanding of science and engineering within the non specialist Civil Service (as within society as a whole). This leads not only to misunderstanding, but also to distrust as suspicions may arise that engineers and scientists are deliberately taking the debate outside of the non specialist's understanding for their own advantage.

2.5. There is a fear that there has been a general fall in the status of engineering and engineers with the central Civil Service, caused in part by the separation of policy execution from policy formation which takes the experts "away from the action". This may be an area the Committee may wish to investigate.

2.6. The Civil Service moves its senior staff regularly across departments; however in complex areas of policy such as energy, this does result in a damaging loss of understanding and continuity and ultimately adversely affects the credibility of the department. We contend that the length of the learning curve required in such department should be considered when placing and moving senior staff.

2.7. Information Technology is another area where the complexity of the issues requires greater technical understanding and which could benefit from independent, impartial advice. IT systems tend to be treated by government departments as purely technical projects, rather than business change programmes. Examples include the CSA, tax credits and the DfH's National Programme for IT. The engineering profession has proposed a procurement model for IT systems, but there seems little evidence that it will be accepted by government departments despite the successive failures of Government IT projects

2.8. Regarding Civil Service career paths, there used to be special complementary schemes within the Civil Service to reflect three things:

- A technical expert would normally be expected to become a manager at a middling level but there was still a need for out and out specialists:

- Special Merit permitted promoting an expert in post up to Grade 6 and was generally assumed to mean working on full time engineering duties with no administrative responsibilities.

- Individual Merit Promotion took this even further and there was no limit: a central CSC committee assessed and promoted the very few who were seen as world class experts to be managed off complement and treated as special assets.

2.9. Making career progression possible without management responsibility is a common problem across the engineering profession. Many technical experts find themselves encouraged to leave "real engineering" and go into management positions in order to progress their careers. The Civil Service merit schemes provided the opportunity for individuals to retain their engineering focus and gain "promotion" whilst maintaining the corporate

technical knowledge within departments. The Committee may wish to investigate if the current Professional Skills for Government framework allows expertise to be rewarded, nurtured and maintained.

3. **International examples of how engineers and engineering advice are embedded in Government.**

3.1. The following evidence is the experience of some IET members in those countries.

3.2. New Zealand

3.3. The Institution of Professional Engineers of New Zealand (IPENZ) provides a central focus for government to seek advice. The size of the population and the less formal atmosphere allows for easier communication between organisations such as the IPENZ and policymakers.

3.4. Italy

3.5. The engineering profession is more formally controlled in Italy, with the National Council of Engineers (CNI) representing the profession at the national level. The CNI is regulated by law and gives its opinion on parliamentary bills and regulations relevant to the profession, including the setting of professional fees. The CNI performs a primary role of promoting, developing and enhancing engineers' activities to increase their incidence in the society where they operate. It has become more active in pursuing the development of the technical and cultural knowledge of engineers and in enhancing a higher social and political recognition of the leading role engineers have in the evolution and change processes. Unlike the UK, in Italy professional registration is compulsory, and is achieved through academic attainment and passing a State examination.

3.6. Despite this formal relationship, anecdotal evidence would suggest that the Italian Government seldom appoints individual expert engineers onto working groups and committees

3.7. Hong Kong.

3.8. The Hong Kong Special Administrative Region (HKSAR) Government has two major Policy Bureaus – the Development Bureau and the Environment Bureau - that are formulating engineering-related policies and overseeing numerous departments and agencies responsible for the capital project works and everyday works covering water supplies, drainage, civil, structural, E&M, geotechnical, town planning, etc. The Permanent Secretary (Works) is normally a veteran engineer who advises the HKSAR Government at the Policy Bureau level. The Heads of Works Departments are, again, experienced engineers in respective disciplines.

3.9. The 60 member Legislative Council (LegCo), under Basic Law, has its main functions to enact laws; examine and approve budget; and monitor the works

of the HKSAR Government. One half of the LegCo Members are directly elected while the remaining half represents functional constituencies including one seat from engineering. That particular LegCo Member is, by default, an engineer, elected by the professional registered engineers who are normally members of the Hong Kong Institution of Engineers (HKIE). This LegCo Member has a mandate to advise Government on the engineering-related policies with his voice representing engineers-at-large in Hong Kong.

3.10. As in the UK, from time to time, the HKSAR Government conducts public consultations to seek comments and views from the public, including the professional bodies as part and partial of their policy making process. It is up to the professional bodies to submit their views and opinions to HKSAR Government with a view to influencing the Chief Executive and Principal Officials on the matters of policy, budget allocations, and priorities settings.

September 2008

Memorandum 6

Submission from the Engineering and Technology Board

Summary

Engineering is vital not only to our economy but also to solving many of society's most pressing problems. Engineers are key to providing solutions to global challenges such as climate change, renewable energy and clean water. Consequently it is vital that the UK can access a ready supply of highly skilled engineers and technicians. Government, through its Science and Innovation policy and programmes, has a vital role to play in ensuring a well founded science and technology base. Within Government, whilst DIUS leads on Science, Innovation and Skills, the role and contribution of engineers, engineering and technology impact upon virtually all Government Departments.

The Engineering and Technology Board's (ETB) purpose is *'to promote the vital role of engineers, engineering and technology in our society and to inspire people to pursue careers at all levels in engineering and technology'*.

Its strategic goals are:

- To improve the perception of engineers and engineering;
- To improve the supply of engineers; and
- To raise awareness and credibility of the ETB with key stakeholders.

The ETB partners business and industry, Government and the wider science and technology community: producing evidence on the state of engineering; sharing knowledge within engineering; and inspiring young people to choose a career in engineering, matching employers' demand for skills.

We recognise the crucial role that government plays in driving forwad the innovation agenda and specifically welcome its interest in harnessing enginering skills and technologies for UK plc through its Enginering Inquiry. The ETB has already responded to this major inquiry into engineering and supports the undertaking of this case study *Engineering in Government*. In this regard we would remind the committee that ETB-commissioned research, which quantifies the contribution of Science, Engineering and Technology (SET) to the UK economy, indicates that SET-intensive sectors produced £252.3 billion (27.3%) of the total UK gross value added (GVA) in 2002 and that the high SET-intensive sectors contributed 27.1% of the improvement in labour productivity over 1993 to 2000: science, engineering and technology are key drivers of productivity.

Additionally, there are about 2.5 million people in SET occupations in the UK, both within the SET intensive sectors and elsewhere, including services. SET skills are fundamental to our economy's success, yet among SET employers and occupations, women represent a significantly under-utilised resource. Also appropriate skills at the technician level are becoming scarce.

As well as the above general comment, the ETB also provides the following specific response to issues cited in the Engineering in Government case study:

1. ***the role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across Government and communicating issues relating to engineering in Government to the public;***

    a. We note that many of the science and technology issues facing Government are common to several Departments, so individual Chief Scientific Advisers (CSA) will be frequently called upon to advise on matters which have common technological foundations. We also note that the individual backgrounds of CSA's are diverse and complementary. Despite the formal job title, it should be recognised that some are distinguished engineers. The input for engineering from suitably qualified personnel must be maintained.
    b. We commend the coordinating initiatives of the Government Chief Scientific Adviser and groups of individual CSAs in tapping into their collective experience and the UK expert base through the Royal Society, the Royal Academy of Engineering and individual science and engineering institutions. This is particularly important in new and emerging areas of which sustainable systems engineering is a good example.

2. ***the use of engineering advice in Government policy making and project delivery, including examples of policy decisions or project delivery that have been or will be taken with or without engineering advice;***

    a. Science, engineering and technology have evolved into a continuum. Thus it is often difficult to separate their individual roles in providing solutions to the sorts of problems that impinge upon Government policy. Government is, therefore, unlikely to seek engineering advice in isolation but rather advice that is underpinned by mathematics, science engineering and technology. For example, dealing with the outbreak of Foot and Mouth depended upon the combined advice of mathematicians, chemists, biochemists and engineers. Similarly the risk management of flooding in the UK (post Hurricane Katrina) involved advice from across the spectrum of leading edge mathematical modelling to heavy civil engineering advice sourced from our Institutions.

3. ***how Government identifies the need for engineering advice and how Government sources engineering advice;***

    a. Engineering professionals are members of Institutions and networks of peers. The Chief Scientific Advisers and their staff are well plugged into these networks so they are likely to be only one or two steps away from independent authoritative specialist advice.
    b. The vast majority of the UK's top engineers are Fellows of the Royal Society, the Royal Academy of Engineering and the major Professional Engineering Institutions. The Chief Scientific Advisers fall into this group themselves. The Fellows are, therefore, the group that are the source of expert engineering advice.
    c. The major challenge is for the Chief Scientific Adviser on behalf of the Government, to determine the nature of the advice that is currently

needed and importantly identify future issues where early advice could be sought.

4. ***the status of engineering and engineers within the civil service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service;***

    a. In some Government Departments the term "engineer" was synonymous with "technician" so that professional engineers were described as "scientists". It is important that the civil service recognises and embraces the professionalism and contribution of its graduate scientists and engineers.
    b. The science and engineering institutions have professional competence-based grades of membership that have international currency.
    c. The ETB recommends that the effectiveness, status and career prospects of the science and engineering members the civil service, including fast streamers, would be greatly improved if they were encouraged to follow the initial and continuous professional development (IPD/ CPD) offered by a science or engineering institution.
    d. Governments Departments should pay the fees for such membership and professional development.
    e. We also note and welcome the recent announcement by DIUS through its current 'A Vision for Science and Society' consultation para. 6.12. which states; *Within government, the Government's Chief Scientific Adviser (GCSA) is leading work to strengthen the skills and raise the profile of the science and engineering community within the Civil Service, a major employer of scientifically skilled workers. Key to achieving this is the revitalisation of the HoSEP (Head of Science and Engineering Profession) network*.

5. ***the role and effectiveness of professional engineers and the engineering community in promoting engineering and providing engineering advice to Government and the civil service; and***

    a. The role of the ETB is to promote the vital contribution of engineers, engineering and technology to our society. This includes their promotion to Government and the civil service.
    b. In this context "the ETB" means the Chairman, Chief Executive and the other fifteen members of the ETB Board.
    c. The ETB believes that with a newly constituted Board which is more representative of the broad engineering community coupled with a proactive partnership based engagement strategy the Government and the civil service will experience a step change in the effectiveness of the promotion of engineering.

6. ***international examples of how engineers and engineering advice are imbedded in Government.***

a. Generally, other nations do not have the multiplicity of engineering institutions (nor the rich science and technology base). In these cases, independent advice is achieved through the single professional institution/academy. In others, there are large Government funded agencies that provide expert advice. We would suggest that DIUS should look at these different national models with the view to extracting best practice that can be translated into the UK.

September 2008

Memorandum 7

Submission from the Engineering Council UK

1. The Engineering Council UK has contacts with many engineers' organisations around the world, both informally and through membership of the European association, FEANI (the European Federation of National Engineering Associations - www.feani.org) and worldwide through the International Engineering Alliance - www.ieagreements.org). EC^{UK} used these contacts to canvas equivalent regulatory authorities around the world in order to provide an up to date response to this question. This paper is therefore directly based on their responses.

2. In the **USA** the Government largely interacts with engineering on policy matters and seeks advice through the National Academy of Engineering (equivalent to The Royal Academy of Engineering) and the National Research Council. On occasion, on a topical matter, they will interact with one of the engineering societies, of which there are several dozen. The Office of Science and Technology Policy (an office of the President) advises the President on science policy and seeks input from the science and engineering community from time to time. Government agencies have advisory boards, and ad hoc advisory panels to varying degrees.

3. However, on professional engineering and professional registration matters, the individual States work closely with the State Boards (statutory regulators) and the National Council for Examination of Engineering and Surveying.

4. The European Federation of National Engineering Associations (FEANI), of which EC^{UK} is a leading member, has close links with the **European Commission**, in particular the Internal Market DG and the Employment, Social Affairs and Equal Opportunities DG. Typically, the Energy and Transport DG recently asked FEANI to collaborate by providing advice in an initiative reviewing shortages of nuclear engineers across Europe. FEANI is increasing its links with the European Parliament and as a result was the only professional association asked to present evidence at the European Parliament hearing on the European Institute of Technology.

5. Within Europe, the engineering profession in **Germany** has the loosest formal relationships with Government. These are mainly conducted through the joint technical and scientific organisation, the DVT (Deutscher Verband technisch-wissenschaftlicher Vereine). The DVT and the society of German engineers, VDI (Vereine Deutscher Ingeniuere) have good relations with governmental authorities, who regularly consult them on general engineering matters. Examples include the introduction of energy performance certification for buildings, and the Ingenieurgesetze der Lander (Engineering laws in the regional departments of Germany), which were drafted with the input of the VDI and DVT. At the official hearing of the Ministry concerned with the recent draft Energy Savings Order, VDI experts were able to demonstrate how the Bill could be improved. VDI is one of the largest organisations of its type, and includes many specialist divisions

6. In Italy and Greece, there are formal organisations that both regulate engineers and advise Government. In **Italy**, the Consiglio Nazionale degli Ingenieri (CNI - National Council of Engineers) is an association set up by public law for the purpose of overseeing the organisation of the engineering sector at a national level. It operates under the jurisdiction of the Ministry of Justice. CNI acts as a consultant to both Parliament and the Government on the practice of the profession and on general engineering issues.

7. The Technical Chamber of **Greece** (TEE) is the official advisor to the State on all technical matters (part 2 article 4 Law 1486/1984). All qualified engineers are members.

8. TEE contributes to Government permanent and special scientific committees and supervises six thematic offices that study scientific, technological and development issues that concern society. TEE also provides specifications and technical directives that facilitate the work of engineers and contribute to the quality improvement of services and products offered to society.

9. In **Ireland**, Government has an Office of Public Works, retaining considerable engineering expertise to advise them on infrastructure and utilities. The Government works closely with Engineers Ireland, the Irish equivalent of the Engineering Council and the professional engineering societies combined, co-funding their work to promote engineering, and their project to encourage greater take-up of continuing professional development (CPD) of engineers.

10. In the Far East the engineering profession is embedded in the legislative process**. Hong Kong** provides a place as of right for the engineering profession in their Legislative Council.

11. In **Taiwan** the Government has several high level offices and committees who provide engineering advice. The Office of the President has a Technology Advisory Committee as well as the Economic Development Advisory Committee. Members of these committees are senior academics or senior industry leaders. The following five offices govern national policy issues within the Executive Yuan (the Cabinet), under the premier:

    - Public Construction Commission (the licensing body for professional engineers);
    - Department of Engineering and Applied Sciences of the National Science Council;
    - Advisory Office of the Ministry of Education;
    - National Energy Conference/ Bureau of Energy, Ministry of Economic Affairs Council for Economic Planning and Development.

12. In both Hong Kong and Taiwan, professional engineering societies play key roles in shaping Government policies. Members of these societies are often invited by Government to offer professional advice on national projects, or in other related capacities.

13. **In Japan,** Government ministries that are responsible for matters related to science and technology retain engineering officials in their administrations. However, those who engage in policy making, planning legislation, project planning and management tasks related to science and technology are administrative officers with law and economics backgrounds. In most cases, engineering officials play a subsidiary role in these matters.

14. Besides their engineering officials, each government ministry has an associated research institute. In recent times most of them have become independent administrative corporations. These agencies (institutes) provide the controlling ministry with necessary supporting information for administrative activities. Administrative bodies that are in charge of public works employ many engineers in house.

15. In general, government decision making follows Basic Plans. However, for non-routine decision-making, advisory panels or commissions draw on academia and other experts to provide opinions and suggestions.

Conclusions

16. The responses received indicate a range of ways in which engineers inform overseas governments' policies and operation but the common feature is that there is a greater interaction, particularly in a structured way, than is the case in the UK.

17. The overseas organisations who replied have a variety of structures and remits so are not exactly parallel to the UK case. However, it does appear that national Governments' willingness to seek advice from the leading professional bodies has made them more cohesive and better able to respond quickly to policy development needs. It is possible to perceive a system in which the Royal Academy and the discipline-specific expertise of the UK professional engineering institutions would be used to inform *engineering* policy. EC^{UK}'s knowledge of the requirements for professional competence and academic qualifications (including their international benchmarks) could be used to inform government on *engineers,* particularly their education and training, recognition of competence and supply and demand.

Further Information

18. Further information can be provided through EC^{UK} CEO Andrew Ramsay, Head of International Recognition Dr Jim Birch, or Chairman of the EC^{UK} International Advisory Committee, David Long.

September 2008

Memorandum 8

Submission from Prospect

INTRODUCTION

1. Prospect is a trade union representing 102,000 scientific, technical, managerial and specialist staff in the Civil Service and related bodies and major companies. We represent engineers across a range of disciplines, functions and sectors. Prospect represents more professional engineers than any other UK union. Across government we represent 18,000 engineers and technical staff. However, the engineering community in government has declined significantly over the last ten years.

2. For example, the number of civilian personnel employed by the MOD fell from 133,000 in 1997 to 90,000 currently. The union believes that up to 7,000 more jobs will be cut as part of the Chancellor's pre-budget report in October. These new cuts will be in addition to the 7,000 or so job losses already in train and a significant proportion will be in engineering and technical functions, falling disproportionately on Army, Navy and RAF front line commands with a direct and immediate effect on support to military operations. This exercise typifies Prospect's concerns about Government's approach to management of specialist staff, including engineers, since there is no central knowledge of the location, functions or specialist expertise – and hence no clarity of what capability is being lost or whether retained capability will be sufficient to cope with future demands. A similarly short-sighted approach was evident during privatisation of the Property Services Agency fifteen years ago and has since occurred with depressing regularity.

2. Prospect contributed evidence at an earlier stage of the Committee's inquiry, in March 2008, and this brief submission builds on that evidence. We are fortunate in being able to draw on the knowledge and first hand experience of our members to inform our views. Responses to the specific issues highlighted by the Select Committee are set out below.

The role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across Government and communicating issues relating to engineering in Government to the public

3. Prospect believes that the Government Office for Science has an important and significant role to play, though it is not well resourced to deal with a complex and wide-ranging engineering community. The initiative by the new Chief Scientific Adviser to establish a science and engineering community of interest is very welcome but, in practice, its impact will be limited because it depends on voluntary self-identification and is limited to core government departments and agencies. Prospect played an active role in promoting this initiative to our members, many of whom had not heard of it from their own employer. Others who wished to become involved were barred from doing so because they work outside the core civil service, despite the fact that this is where much of the Government's practical engineering work is undertaken.

4. At departmental level Chief Scientific Advisers and Heads of Science and Engineering Profession tend to be even less well resourced, and many combine this responsibility with other professional roles. Prospect did have high hopes that Government Skills, the Sector Skills Council for central government, would provide additional support to the network of scientific advisers. However, it is becoming increasingly evident that Government Skills' priorities lie elsewhere. This is of particular concern given that many of the key challenges for government, such as climate change and defence security, depend crucially on engineering and technical expertise. Indeed a recent initiative by the Ministry of Defence to review its current skills base was abandoned because it was, by their own assessment, 'too difficult'.

5. Although Prospect does closely monitor government policy advice, we would be very hard pressed to identify examples of either the Government Office for Science or Chief Scientific Advisers communicating issues relating to engineering to the public.

The use of engineering advice in Government policy making and project delivery, including examples of policy decisions or project delivery that have been or will be taken with or without engineering advice

6. Prospect members are concerned that, in part due to recruitment difficulties, Government's capacity as an 'intelligent customer' of engineering projects has eroded. There is insufficient technical expertise both among Senior Civil Service policy and decision makers and at levels below Chief Scientific Adviser, resulting in increased use of external consultants without either contextual knowledge or 'corporate memory'. Thus, one member reported that administration managers are faced with answering questions on bridge design. Conversely in-house engineers can contribute to innovative solutions through intimate understanding of project requirements and partnering with other engineers, for example in universities, to develop value for money approaches that would not arise within the confines of a consultancy contract.

How Government identifies the need for engineering advice and how Government sources engineering advice

7. Prospect members report examples where engineering advice feeds effectively through to policy makers, though often this is through informal means and dependent upon personal relationships with colleagues in policy teams. In effect, engineering advice is 'loaned out' through the goodwill of individual engineers and their managers. Whilst this can work well, the informality of such arrangements means that consultation does not occur as a matter of course and so there are likely to be many instances where policy decisions are made without engineering input.

8. Too often engineering and scientific advice are called on simply in times of crisis and, on occasion, to rectify poor quality work done by external consultants.

The status of engineers and engineering within the Civil Service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service

9. Prospect recently conducted a survey of members in the Civil Service, attracting 5,300 responses of which around one fifth are from engineers and technical experts. The survey findings show the engineers' own frustration over the lack of status that engineering enjoys within the Civil Service as well as frustration over career prospects.

- Three quarters of engineers responding to the survey are more dissatisfied in their job now than they were a year ago. This level of dissatisfaction is higher than for civil servants as a whole, for which the dissatisfaction rating was 63%.

- 76% of engineers are either dissatisfied or very dissatisfied with their level of pay compared with 63% of all civil servants, and 79% are angry at the lack of pay progression compared with 74% of civil servants generally.

- Just one third of engineers are satisfied with training and development opportunities, reflecting the wider view of civil servants.

10. It is clear that there is considerable anger underlying these responses. For example, members have variously commented that:

"Engineering in [department] is a joke".

"With so few engineers available to give advice, the generalists will never see how valuable their contribution could be".

"[Department] is by far the worst employer I have ever come across in my entire working life".

"The structure of the Civil Service is such that it does not see engineers as playing an essential role in its policy-making decisions".

"My advice to engineers is not to go within a million miles of government".

"There is no real career opportunity for engineers unless we are willing to take a pay cut and move into a generalist post".

The role and effectiveness of professional engineers and the engineering community in promoting engineering and providing engineering advice to Government and the Civil Service

11. As previously indicated, many Prospect members are also members of professional engineering bodies, and Prospect seeks to work collaboratively with such bodies on projects of common interest. Initiatives such as WISE and UKRC provide valuable expertise and resources to enhance diversity, and Prospect has some involvement with both bodies. The engineering community faces major challenges to ensure an adequate skills base for the future, as highlighted in recent work both by the Department for Business, Enterprise and Regulatory Reform[1] and the Department for Environment, Food and Rural Affairs.[2] Sector Skills Councils are

[1] Energy Skills – Opportunity and Challenge

[2] Skills for a Low Carbon Resource Efficient Economy

starting to address these challenges, albeit with varying degrees of enthusiasm, but Government itself needs to ensure a cross-sectoral and cross-departmental approach to resolving the engineering challenge. In Prospect's view, the Commission for Employment and Skills could play a valuable role in taking this work forward.

September 2008

Memorandum 9

Submission from the Royal Society

Summary of key points

- Two overarching considerations should underpin the provision and use of science and engineering advice by Government:
    a. Scientific advice to Government must be independent;
    b. All scientific research or evidence used by Government should be exposed to independent and rigorous peer review.

- In fulfilling their roles Chief Scientific Advisers (CSAs) act as conduits for scientific and engineering advice: by gathering, synthesising and communicating advice from experts. To deliver effective advice to Departments they therefore need to access and maintain extensive networks of contacts in the UK, Europe and the international scientific community.

- Where departmental CSAs have been appointed at a senior level from outside Government this has led to an improvement in the use of science (including engineering) across Departments and has assisted in the development of a clear strategy for science. However, it is vital that the CSA is involved in all the key strategic decisions within a Department.

- Some departments – for example, Defra and the Home Office – have created independent Science Advisory Councils to provide independent advice, support and challenge to the departmental CSA. We believe that to maximise effectiveness, there is scope for further sharing of best practice between departmental Science Advisory Councils. Departmental science advisory committees should be involved in all major policy issues involving scientific evidence.

- We welcome the designation of the Government Chief Scientific Adviser (GCSA) as the pan-governmental 'Head of Profession' for science and engineering. This development, coupled with the creation of similar Head of Science and Engineering Profession (HoSEP) positions within each department, should make a positive difference to career prospects for scientists and engineers within the civil service. We are exploring ways in which we can support HoSEPs and the use of science across government, as we do with our scientist-civil servant pairing scheme (see paragraph 19).

Introduction

1. The Royal Society welcomes the opportunity to contribute to the Committee's Engineering in Government case study. This submission has been approved by the Royal Society's Physical Secretary, on behalf of the Council of the Royal Society.

2. From its inception, the Society has used a broad definition of science which encompasses both engineering and medicine. Our responses to the Committee's questions draw on this wide perspective, meaning that where we use the term 'science', we do so meaning all areas of the sciences, engineering, mathematics and medicine.

3. A number of important principles and observations have informed the Royal Society's response:

- We believe that policy decisions should be informed by the best available scientific advice and analysis; indeed it is the Society's objective to 'influence policymaking with the best scientific advice'.

- Many of the key challenges faced by the UK and other nations (such as demographic and socio-economic change, globalisation, climate and environmental change, global uncertainty, and technological change[i]) are characterised by their complexity and their far-reaching, often global, impacts. Scientific research and advice will play a major role in Governments' abilities to respond to these and other challenges. Given the nature and scale of these issues, government departments and agencies must be able to draw widely on the best available scientific expertise, wherever in the world it is to be found.

- The nature and complexity of these problems will require, in many cases, collaborative and multidisciplinary responses by research and policy communities. This means that Government must frequently draw on and integrate scientific advice of various kinds; eg advice from economists and social scientists as well as scientists and engineers. It is therefore important not to artificially separate science from engineering or to treat different sorts of information and advice in isolation.

- Two overarching considerations should underpin the provision and use of science and engineering advice by Government:
    a. Scientific advice to Government must be independent;
    b. All scientific research or evidence used by Government should be exposed to independent and rigorous peer review.

The role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across Government and communicating issues relating to engineering in Government to the public;

4. In fulfilling their roles CSAs act as conduits for scientific advice: by gathering, synthesising and communicating advice from experts. To deliver effective advice to Departments they therefore need to access and maintain extensive networks of contacts in the UK, Europe and the international scientific community.

5. Where departmental CSAs have been appointed at a senior level from outside Government this has led to an improvement in the use of science across Departments and has assisted in the development of a clear strategy for science. However, it is vital that the CSA is involved in all the key strategic decisions within a Department.

6. The cross-departmental overview is a vital aspect of the Government Chief Scientific Adviser's work (GCSA). Work to bring together the departmental CSAs (for example the Government Chief Scientific Advisers Committee) and raise the profile of key cross-departmental issues, such as climate change and energy, has had positive impacts.

7. The Global Science and Innovation Forum (GSIF) provides an opportunity for CSAs to engage not only with each other, but also other important stakeholders from across Government. More active participation of CSAs in GSIF should ensure that it plays its proper role in the development of a coherent, strategic approach to science and innovation internationally.

8. These are valuable forums for the interchange of ideas and good practice which enable the CSAs to work together on cross-cutting issues. Though often private, these meetings can also provide good opportunities for CSAs and others to engage collectively with external parties on matters of scientific importance.

9. Input from public and wider stakeholder dialogue is important when forming policy responses to new developments in science and technology. While public engagement is not within the remit of the CSAs as we understand it, it is important for the CSAs to actively engage with the Science and Society Unit in the Department of Innovation, Universities and Skills and with other mechanisms that enable public dialogue on science and scientific issues, such as the Sciencewise Expert Resource Centre.

10. It is important that public communication of science and technology issues emphasises the special position of the CSAs and GCSA who are required to maintain their professional independence while working as civil servants. This independence ensures that there is no political interference with the scientific advice given to Government and, as a result, gives the GCSA an autonomous media profile. It is important not only that the GCSA and departmental CSAs are independent, but that they are perceived as such by the public.

The use of engineering advice in Government policy making and project delivery, including examples of policy decisions or project delivery that have been or will be taken with or without engineering advice;

11. Policy decisions should be informed by the best available scientific advice and analysis; indeed, it is the Society's objective to 'influence policymaking with the best scientific advice'. We need to be mindful of both our present and future science and engineering needs, in terms of practical expertise and policy analysis. For example, our response to the Committee's earlier inquiry on nuclear engineering (Royal Society 2008[ii]) highlighted the fact that a lack of indigenous nuclear technical skills could mean that the UK lacks the expertise needed for future nuclear activity (including expansion, decommissioning etc). This lack of skills would also diminish the UK's ability to be an intelligent customer since policy advice and economic, technical and security judgements might be flawed.

How Government identifies the need for engineering advice and how Government sources engineering advice;

12. Our response to the House of Commons Science & Technology Select Committee's 2006 inquiry on scientific advice, risk and evidence included a suggestion that a panel (or, in some cases, panels) of independent experts should be available to each Government Department to support the use of science and engineering advice in decision making. We note that there are now approximately 80 Scientific Advisory Committees across government and welcome the revised Code of Practice for Scientific Advisory Committees published in December 2007.

13. We believe that these advisory committees should be involved in all major policy issues involving scientific evidence. They should include internationally recognised scientists (covering an appropriate range of disciplines) in addition to other stakeholders. External advice about the membership of such committees should be sought from learned societies and appropriate professional bodies. The chairperson should have access to ministers when appropriate.

14. Some departments – for example, Defra and the Home Office – have created independent Science Advisory Councils to provide independent advice, support and challenge to the departmental CSA. We

believe that there is scope for further sharing of best practice between departmental Science Advisory Councils in order to maximise effectiveness.

The status of engineering and engineers within the civil service, including assessments of the effectiveness of the science and engineering fast streams, and the role and career prospects of specialist engineers in the civil service;

15. The departments and agencies of the UK Government are major employers of science and engineering graduates, including many who work in non-science and engineering posts. According to the Office for National Statistics there were 532,000 employees in the civil service in September 2007[iii]. For those permanent employees where a profession was reported, 2,280 were employed in engineering posts and, separately, 2,930 were employed in science posts.

16. We welcome the designation of the GCSA as the pan-governmental 'Head of Profession' for science and engineering. This development, coupled with the creation of similar Head of Science and Engineering Profession (HoSEP) positions within each department, should make a positive difference to career prospects for scientists and engineers within the civil service.

17. The creation of a network for HoSEPs, which provides an opportunity to meet regularly and share good practice, is especially welcome, as is the development of a Government wide 'community of interest' of scientists and engineers.

18. To encourage closer and more effective interaction, understanding and communication between professional scientists and engineers and the civil service, the Royal Society and the Government Office for Science (GO-Science) ran a pilot scheme in 2007 pairing scientists with civil servants working in relevant policy areas. The scientists and civil servants spent a week together in Whitehall and the civil servants also visited the scientists in return to find out more about the working environment of active researchers. Following the successful pilot, the scheme will be repeated annually by the Society and GO-Science.

The role and effectiveness of professional engineers and the engineering community in promoting engineering and providing engineering advice to Government and the civil service;

19. The Society is supportive of the number and diversity of bodies representing engineering interests, but is concerned that, as with other areas of science, it can be confusing for those outside the community to navigate the various institutions, or to identify the key messages and consensus issues and to understand when views diverge. We recognise that, on occasion, it is necessary for the science and engineering community to speak with one voice.

20. A good example of a collaborative approach is the Advisory Committee on Mathematics Education (ACME), established in January 2002 and based at the Royal Society. ACME is an independent committee which acts as a single voice for the mathematical community, seeking to improve the quality of education in schools and colleges. It advises Government on issues such as the curriculum, assessment and the supply and training of mathematics teachers and was established by the Society and the Joint Mathematical Council of the UK with the explicit backing of all major mathematics organisations, and is supported by the Gatsby Charitable Foundation.

21. Another education partnership to which the Society belongs is SCORE (Science Community Representing Education). SCORE operates on a different model to ACME, but also seeks to bring a collective voice to

science education. Although the Royal Academy of Engineering is not a member of SCORE, SCORE and the Royal Academy are actively seeking ways to work more closely together on education issues. In addition, the Royal Academy of Engineering has a representative on the Royal Society's Education Committee.

September 2008

References

[i] Long-term opportunities and challenges for the UK: analysis for the 2007 Comprehensive Spending Review, HM Treasury, November 2006 see: http://www.hm-treasury.gov.uk/media/6/F/csr_longterm271106.pdf

[ii] Royal Society response to the Innovation, Universities, Science and Skills Committee inquiry on nuclear engineering, March 2008 (RS Policy Document 12/08)

[iii] Civil Service Statistics, September 2007 (July 2008, ONS) see: http://www.statistics.gov.uk/pdfdir/cs0708.pdf

Memorandum 10

Submission from Research Councils UK (RCUK)

Executive Summary

The Research Councils believe engineering is vital both to the UK economy and to society in general. We seek to support a full spectrum of research and postgraduate training within engineering and work to ensure that the research climate for engineering in the UK is vibrant. Connectivity between the research base and users across engineering is crucial and there is strong engagement between Councils and Government Departments on areas of mutual interest. Research Council have signed Memoranda of Understanding with a number of Government Departments and there are regular meetings to review strategic priorities and areas of mutual interest in addition to considerable ad hoc engagement. A number of research programmes have been developed relevant to engineering and all the Councils participate in the MoD joint grant scheme.

Each of the Research Councils engages with key stakeholders to identify new research opportunities and needs and examine the impact of our research and training programmes. Such engagement will include advice from key groups such as the Chief Scientific Advisors and both EPSRC and BBSRC have Chief Scientist representation on their Councils. In addition, there is representation on primary advisory bodies, for example EPSRC has representation from Government Departments on the Technical Opportunities Panel. BBSRC has representation from Government Departments on a number of its Research Committees and Strategy Panels. The opportunity to influence policy making extends back into Departments with engineers supported by Research Council funding as members of their advisory bodies. Research Council staff also directly engage with such bodies for example, the CEO of EPSRC is a member of the Health Innovation Council and is able to provide a view on behalf of all the Councils.

Research Councils support high quality basic, strategic and applied research and related postgraduate training. The development of individual research projects are primarily researcher led; however, larger programmes of research include advisory boards are able to provide external benchmarking and context. The funding of major research centres and consortia have provided an opportunity for departments such as the MoD, Home Office, BERR, DfID, and Defra to advise research programmes. It is also vital that the outputs from research inform government policy and that there is a direct route for the outputs of those programmes to inform departments. Such major consortia funding is also an area where more than one Council will work together with a department and possibly other funding bodies such as the Technology Strategy Board in delivering a research programme.

RCUK Introduction

1. Research Councils UK is a strategic partnership set up to champion the research supported by the seven UK Research Councils. RCUK was established in 2002 to enable the Councils to work together more effectively to enhance the overall impact and effectiveness of their research, training and innovation activities, contributing to the delivery of the Government's objectives for science and innovation. Further details are available at www.rcuk.ac.uk.

2. This evidence is submitted by RCUK on behalf of all Research Councils and represents their independent views. It does not include or necessarily reflect the views of the Science and Innovation Group in the Department for Innovation, Universities and Skills. Separate written and oral evidence has been provided by RCUK and EPSRC to the Committee's main inquiry into engineering and to related case studies. This submission is made on behalf of the following Councils:

   Biotechnology and Biological Sciences Research Council (BBSRC) Engineering and Physical Sciences Research Council (EPSRC)
   Medical Research Council (MRC)
   Science and Technology Facilities Council (STFC)

Background

3. The spectrum of engineering research covered by this case study is as defined in the main RCUK submission. As highlighted in the main submission, the Research Councils believe engineering is vital to both the UK economy and to society in general. In supporting the full spectrum of research and postgraduate training, the Councils and the engineers supported have significant engagement with representatives across Government departments. The Research Councils engage with key departments in a variety of ways, to enable them to contribute to and influence the engineering research agenda, to access the engineering research portfolio, and to engage with the engineering research community. This case study has been structured around the primary mechanisms of engagement

Working agreements with Government Departments

4. The Research Councils and a number of departments work closely together on research and development issues of mutual interest with an emphasis on promoting wealth creation, quality of life and sustainable development. This level of engagement has been formalised through the agreement of a number of concordats. The concordat establishes a framework within which the two organisations can interact across areas where there is complementarity of roles and benefit can be gained from shared experience and cross-representation. Concordats are valuable in providing a clear statement of the respective roles of the two organisations to ensure that clear and open avenues of communication exist between the Department and the Council; and to ensure the effective and efficient management and operation of activities of mutual interest.

5. EPSRC has developed concordats with the former DOE, DOT, DETR, and DTLR. EPSRC and DfT have now built on these and have re-affirmed their intention to maintain and develop co-operation in science and research. In pursuing their common interests, both organisations have subscribed to 'Guidelines 2000'[1] on the use of scientific advice in policy making. In September 2006 a concordat was also signed with Defra, to encourage effective working between both parties with the aim of promoting future joint activities; the concordat will be updated in September 2008. Initial discussions have also taken place between EPSRC and CLG to explore the possibility of developing such a concordat which builds on the previous concordat with the Office of the Deputy Prime Minister, where activities focussed around the area of fire engineering.

[1] http://www.berr.gov.uk/dius/science/page15432.html

6. BBSRC have developed Memoranda of Understanding with FSA, Defra, MoD; DfID and Scottish Government which aim to provide mechanisms to deliver joint strategic research in important policy areas. These have the potential to impact in areas such as engineering of: food processing, food transport and the prevention of disease transmission in the food chain; engineering processes underpinning sustainable agriculture or to improve farm animal health; technologies for detection of pathogens and biological agents; and bioremediation and bioenergy technology development. In addition, BBSRC research activities applicable to addressing Millennium Development Goals have been delivered through collaboration with DFID.

7. EPSRC, the Ministry of Defence, the Atomic Weapons Establishment, British Nuclear Fuels plc (now Nexia Solutions) and British Energy plc work together under a formal agreement in areas of common interest in research and training to sustain critical nuclear related capabilities. Future developments are discussed and areas highlighted for Research Council activity, addressing stakeholder need. The Health and Safety Executive and the Nuclear Decommissioning Authority are also involved in the discussions

Representation on Research Council Advisory Groups

8. All Council members are appointed by the Secretary of State for Innovation, Universities and Skills and are drawn from both the academic and stakeholder communities. The EPSRC Council includes the Ministry of Defence Chief Scientific Advisor, Prof Mark Welland; BBSRC Council includes the Department for Environment, Food and Rural Affairs Chief Scientific Advisor, Prof Robert Watson. Council meetings also include representation from the Department for Innovation, Universities & Skills. In addition, Prof Brian Collins, Chief Scientific Advisor for DfT and for BERR, is a member of the Advisory Board for Digital Economy Cross Council Programme, and is also on the EPSRC Technical Opportunities Panel.

9. The Office for Strategic Coordination of Health Research (OSCHR) has been jointly established as a Government office by the Department of Heath in England (DH) and the Department for Innovation, Universities and Skills (DIUS). OSCHR's focus is to develop a coherent strategy for translational medicine research. EPSRC's relationship with OSCHR has been developed through regular meetings and Liam O'Toole (Head of Office) is a member of EPSRC User Panel.

10. The Research Councils' Energy Programme Scientific Advisory Committee (SAC) has representatives drawn from the providers and users of research who have an interest in ensuring that we have access to pertinent advice and comment to inform decision making. Advice from the SAC helps define the Programme's approach to supporting research and training. There is DIUS, BERR and Defra representation on the advisory committee.

Jointly commissioned research programmes

11. Strategic partnerships are formal arrangements between EPSRC and other organisations where we agree to jointly support research, training and other activities in UK universities. A partnership can involve one or several organisations, and gives a framework for supporting mutually-beneficial activities in areas of interest. Activities can include funding of research chairs, research grants and consortia and studentships. Such strategic partnerships have been developed between EPSRC and MoD, DSTL, DfT, which all have contributed to the development of engineering research activities. An example is the current activity with DSTL in the area of enhancing damage tolerance through materials science. This partnership is being taken forward with a new £2M activity in signal processing.

12. Interdisciplinary Research Collaborations (IRCs) are centres of internationally-acknowledged scientific and technological excellence, with sufficient critical mass to make a real impact in areas of key future industrial relevance to the UK. In 2002 an £19.6M investment funded jointly by BBSRC, EPSRC, MRC and the Ministry of Defence established two Interdisciplinary Research Collaborations in Nanotechnology:

    12.1 The aim of the Bionanotechnology IRC which is led by the Department of Physics, University of Oxford, is to learn from nature - to understand the structure and function of biological devices and to utilise nature's solutions in advancing science and engineering in areas as diverse as biosensors, genomics, the discovery of new medicines, diagnostics and drug delivery.
    12.2 The nanotechnology IRC is led by the Department of Engineering at the University of Cambridge and it aims to provide underpinning interdisciplinary activity in nanotechnology with the theme of understanding and controlling the physical properties of nanostructures and devices by fabrication at single molecule precision.

13. The LINK Programme was developed by DTI prior to the establishment of the Technology Programme as a means by which the Government encouraged collaborative research for innovative and industrially-relevant research to support its wealth creation and quality of life goals. Because of its relevance to industry and the collaborative nature of the work, the programme was supported by relevant Research Councils and other Government Departments.

14. The Bioremediation LINK Programme was launched in April 2001 to support the development of technologies that will provide UK industry with the multidisciplinary capability necessary to enable the commercial exploitation of biotechnology for the clean up of contaminated land, air and water. The core Programme sponsors were the Department of Trade & Industry (DTI), BBSRC, EPSRC and the Environment Agency (EA). Projects with engineering relevance include using microorganisms to clean up acidic mine waste and developing reactive barrier technologies for the bioremediation of cyanide.

15. Other examples include the following LINK programmes:

- Advanced Food Manufacturing LINK (jointly funded by Defra, Scottish Government, BBSRC and EPSRC) which encourage collaborative R&D that will strengthen and improve the UK industry’s technical base in process design, process capabilities and operational efficiency through diagnostics and control.
- Food Quality and Innovation LINK (jointly funded by Defra, Scottish Government, BBSRC and EPSRC) which aims to increase industry’s technical capability and

performance in producing safe, high quality nutritious food and to provide necessary information and direction in terms of ensuring these foods meet consumer expectations and needs. One BBSRC co-sponsored grant at the University of Leeds worked with engineers and the biscuit industry to optimise taste, colour and texture whilst reducing energy inpuys and the effect on the environment.

- Renewable Materials LINK (jointly funded by Defra and BBSRC) encourages investment in research and the exchange of knowledge between the private sector and the research base in furthering the non-food uses of renewable materials to support sustainable development. For example one grant to BBSRC's John Innes Centre looks at reducing the carbon footprint of lubricants by designing sustainable biological alternative to mineral oil; with basic biologist working with engineers to make sure the outputs can be integrated into UK industries.
- Horticulture LINK; Sustainable Livestock Production LINK; and Sustainable Arable LINK (jointly funded by BBSRC and government with ESRC involvement in SLP-LINK) all have objectives that include engineering solutions to improve agriculture production, adapt to and reduce the effect of climate change and lessen the effects of agriculture on the environment.

16. The Research Councils have been working with the Technology Strategy Board and the previous DTI technology programme since it started in 2004, and provide co-funding for academic partners. Through the Innovation Platforms two major research initiatives have been developed which involve direct partnership with Government Departments. The DTI, EPSRC and DfT came together to support research consortia in the area of Intelligent Transport Systems; the EPSRC and DTI invested a total of £9M, with a further £3M from industry. There has also been significant engagement with DfT through the Low Carbon Vehicles Innovation Platform. The TSB will invest £20 million in the programme; DfT and EPSRC will also each contribute at least £10 million. In addition the DfTs National Transport Innovation Incubator was co-funded by EPSRC.

17. EPSRC is set to announce grants through the "Integrated Risk Management Planning" initiative in collaboration with CLG. These grants were developed following a workshop hosted by CLG, which looked to identify ways in which IRMP can improve community safety, reduce the commercial, economic and social impact of fires and other emergency incidents (such as flooding and terrorism threats) and make a more productive use of Fire and Rescue Service resources to meet today's risks. Two grants were developed through this process: "Multi-Objective Decision Making for the Fire & Rescue Services – A scoping study" and "Evaluation of prevention and protection activities on commercial, public and heritage buildings". EPSRC has invested £658k; CLG will be providing on going support through involvement on the steering committees and will provide over £1M of in-kind support through involvement of staff and software access.

18. EPSRC has partnered with the Department for International Development (DfID) and a call has been issued looking to support research consortia in decentralised off grid electricity generation that will promote links between UK universities and developing country universities and facilitate the transfer of technologies that will help alleviate developing country poverty. EPSRC has allocated £3M to this call with DfID co-funding proposals up to a level of matched funding.

19. EPSRC has partnered with the Home Office to develop and fund research consortia. This partnership developed through the supporting of grants funded through the five calls of the Crime and Security Programme. The original programme had a wide remit and specific workshops were subsequently developed on key areas of interest; Gun Crime, Ensuring Privacy and Consent, and Cargo Screening (details below). A similar partnership with the Department for Transport has led to the organisation of an IDEAS Factory sandpit (to take place November 08) focusing on reducing the environmental impacts of airports.

    18.1 The Gun Crime workshop took place in September 2005 and explored long-term ideas preventing gun crime, protecting against gun crime and assisting in the detection of gun crime. Four proposals, including one network, arising from this were supported and include collaborations with a range of stakeholders including the Home Office, Forensic Science Service, Metropolitan Police, Association of Police Officers of England Wales and Northern Ireland, Greater Manchester Police, The Forensic Alliance Ltd and the National Firearms Centre.

    18.2 The Ensuring Privacy and Consent workshop (November 2007) was developed in association with the Home Office (HO) and Identity and Passport Service (IPS) with the aim of delivering solutions on how the next generation of identity management infrastructures can offer assured privacy, and depend on truly informed consent. Three resulting multidisciplinary projects were jointly funded by The Technology Strategy Board's Network Security Innovation Platform, the Engineering and Physical Sciences Research Council (EPSRC) and the Economic and Social Research Council (ESRC), representing a total investment of £5.5M.

    18.3 The Cargo Screening workshop took place in December 2007 following identification of the problem in association with the Home Office Scientific Development Branch. The aim of the workshop was to develop an understanding of the current barriers to efficient and effective screening of cargo and to develop multidisciplinary research projects capable of developing technological solutions to help overcome these barriers. EPSRC subsequently funded five research projects and one network arising from the sandpit, at a total cost of £2.5M.

Government Departments as direct collaborators on research grants

20. Across Engineering EPSRC currently has a research portfolio in excess of £100M, which has collaboration with either Government departments or Executive Agencies. Their contributions to these grants can be in cash but more frequently involve in kind support with the specific partner. There has been direct co-funding of proposals related to engineering and the portfolio with the DfT is £6.8M and Defra is currently £3.3M. The Ministry of Defence has the specific mechanism of the joint grant scheme which has led to a portfolio of £27M; however, in addition to this there has been an additional £2.5M co-funding of engineering grants.

21. Two members of CLG, including the Chief Scientific Adviser, are members of the Steering Committee for an EPSRC Sustainable Urban Environment Knowledge Transfer consortium. CLG are also involved in the Local Authority Research Councils' Initiative (LARCI), which aims to bring local authorities and the Research Councils into closer partnership to enhance the transfer of Research Council funded research to practitioners.

22. The Multidisciplinary Assessment of Technology Centre for Healthcare (MATCH) supports the healthcare sector with: new methods for establishing clinical value, new methods for capturing user needs for early design and in-use upgrades, best practice research on production and decision-making processes and a forum to engage the regulators and seek better ways forward all concerned. MATCH academic partners include: Brunel University (hosting institution), University of Ulster, University of Nottingham, University of Birmingham and King's College London. MATCH Plus is an additional initiative to address user needs jointly funded by EPSRC and the Department of Health to the total value of £1.7 million over 5 years. The aim of this project is to provide a toolkit and training to aid in the translation of MATCH project to the health service. EPSRC is contributing funds to the DoH initiative: Healthcare Technology Cooperatives (HTC) pilot cooperatives focussed on "Devices for Dignity" and "Bowel Function".

23. In October 2008, EPSRC will award a £1.2M grant to establish a Centre of Excellence in Managing and Understanding Natural and Environmental Risk at Cranfield University. The Centre will be joint funded by a consortia which will include Defra, EPSRC and other research councils and will involve two-way knowledge flow between academia and Defra including secondment of Engineering researchers into Defra. A representative of EPSRC will sit with representatives of Defra on the Centre's advisory board.

24. BBSRC currently fund Government Partnership Awards (GPAs) which recognise the importance of basic research in underpinning policy development and regulation. Such partnerships have been developed with Defra and the Food Standards Agency, which support process engineering in food production. One award to Professor Peter Fryer, at University of Birmingham (value: £236k), seeks a better understanding of fouling in food processing plants by carrying out an interdisciplinary approach (process engineering and materials science) of the processes of cleaning, and to develop a model which can be used to study real problems.

Research council representation on department committees and advisory groups

25. EPSRC Chief Executive is a member of Health Innovation Council, and is able to provide a view on behalf of the research councils. EPSRC is also represented on a number of DoH panels including HTC, Healthcare Technology Devices (HTD), New and Emerging Applications of Technology (NEAT) and Invention for Innovation (i4i) programme.

Research Council funded engineering researchers on Government advisory groups and informing Government policy

26. Engineering researchers funded through the Research Councils are directly involved in the development of policy through membership of Government advisory groups. Professor William Powrie, head of Southampton University's Civil Engineering Department, has a current portfolio of 11 EPSRC grants and is a member of the Defra Waste and Resources Research Advisory Group. Professor Peter Guthrie from Cambridge University, principal investigator on the £1.4M EPSRC Sustainable Urban Environment "ISSUES" project is a member of Defra's Science Advisory Council.

27. The cross-Research Council's Towards a Sustainable Energy Economy programme established the UK Energy Research Centre, (UKERC) leading whole systems research. UKERC technology and policy assessments, for example on intermittency of supply, have

informed government policy and UKERC modelling was used to shape the 2007 Energy White Paper. Professor Jim Skea, the UKERC Research Director, is a member of the Committee on Climate Change.

28. The Government's manufacturing strategy, Manufacturing: New Challenges, New Opportunities, published September 2008. In preparation of this BERR established a Ministerial Advisory Group on Manufacturing to provide advice during the Review. Membership included Prof Mike Gregory, Head of the Institute for Manufacturing and Director of one of the EPSRC Innovative Manufacturing Research Centres.

September 2008

Memorandum 11

Submission from the Campaign for Science & Engineering

Introduction

1. The Campaign for Science & Engineering (CaSE) is a pressure group aiming to improve the scientific and engineering health of the UK. Our objective is to communicate to Parliament and the nation as a whole the economic and cultural importance of science and engineering, and the vital need for its funding by government and industry. CaSE is supported by its members, which includes individuals, corporations, universities and learned societies.

2. CaSE has long been an advocate for improving the system of science and technical advice within Government. We strongly believe that government departments need appropriate research and development (R&D) budgets, internal scientific and engineering expertise, and systems to access independent external advice.

The role and effectiveness of the Government Office for Science and the Chief Scientific Advisers in providing engineering advice across government and communicating issues relating to engineering in Government to the public

3. The Government Office of Science (GO Science) and the Government Chief Scientific Adviser (GCSA) have important roles in providing engineering advice across government and for challenging departments to improve their scientific and engineering capabilities. Both GO Science and the GCSA have a cross-department responsibility for scientific and technical advice. However, it is critical that every department has their own internal capacity as well. Greater focus should be given to engineering and technical expertise within the scientific advisory system.

The use of engineering advice in Government policy making

4. Government departments need to have the same 'intelligent customer' function for engineering advice as the need to for scientific advice. For this to happen they need senior civil servants and members of Scientific Advisory Committees with relevant engineering and technical backgrounds. It cannot be expected that each Departmental Chief Scientific Adviser will have expertise in all of the scientific and technical issues relevant to their department. However, consideration should be given to having a balance of scientific and technical expertise within the Committee of Chief Scientific Advisers.

5. The Sainsbury Review recommendation 8.4 was that a "more robust mechanism should be put in place to identify and protect departmental R&D budgets." CaSE supports the development of a "robust mechanism" so that R&D budgets are maintained and strengthened in order to improve departmental capacity to procure the evidence and innovation relevant to their functions.

The status of engineering and engineers within the civil service

6. CaSE supports the science and engineering profession programme co-ordinated within the Government Office of Science. However, it is critical that each government department works to support their engineers. Each department and agency should have a head of profession for scientists and engineers. However, this is not yet the case. For example, even after numerous recommendation by various parliamentary and government reviews, the Department for Culture, Media and Sports still does not have a Departmental Chief Scientific Adviser, Scientific Advisory Committee or Head of Profession. As the lead Department responsible for the London Olympics and good design in the built environment, engineering expertise, as well as other scientific disciplines, should be better integrated into the DCMS by now.

7. As part of their work to improve the standing of engineers, departments need to provide the support, both in terms of finance and time, for membership and participation in professional engineering institutes relevant to their area of expertise.

8. CaSE strongly supports the need for a science and engineering fast stream into the civil service. Increasing the number of people within the civil service with engineering and technical skills should be a government priority. However, we are very concerned that there are very few opportunities available in the science and engineering fast stream. There were only 17 vacancies for the science and engineering fast track position in 2007. 9 out of the 249 successful candidates for the general fast stream, which includes the science and engineering fast stream, had an engineering degree.[i] CaSE recommends that the government recruit more individuals with an engineering background so that there is a better balance of skills within the civil service.

9. Secondments are another important route for improving engineering skills within government. Departments should support and facilitate both inward and outward secondments of engineers to improve the technical skills available.

10. As part of the Government's commitment to improving science and engineering skills, it should record the number of engineering specialists and secondments in each department. Departmental science reviews should examine if there is appropriate engineering and technical expertise within the department.

The role and effectiveness of professional engineers and the engineering community in providing engineering advice to Government and the civil service

11. The Royal Academy of Engineering has an important role in providing engineering advice to Government. Part of the Academy's Grant-in-Aid package from DIUS goes toward policy advice. The Academy produces important topical policy reports. However, it can be difficult to measure the effectiveness of reports and the Royal Academy of Engineering should strengthen its capacity for on-going dialogue and post-report follow-up to ensure the greatest impact on the policy process.

12. Professional engineering institutes also play an important role in facilitating the exchange of information between their respective communities and departments on relevant issues. Individual engineers also volunteer their time and expertise to sit on formal advisory committees, but there are also many contributions made through informal dialogue. Their important contribution to engineering advice to Government and the civil service should be supported, recognised and better facilitated.

International examples of how engineers and engineering advice are imbedded in Government

13. One example is the US Secretary of State's Science and Technology Adviser. Although the current incumbent is a biologist, the post provides both scientific and technical advice. The Foreign and Commonwealth Office should appointment a similar position to imbed scientific and engineering advice within the FCO. Many diplomatic issues have a scientific or technical component. The UK's diplomatic position on these issues would be strengthened by greater internal technical expertise.

September 2008

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[i] Cabinet Office (2008) Civil Service Fast Stream Recruitment 2007: http://www.cabinetoffice.gov.uk/reports/faststream/

Memorandum 12

Submission from Martin Sweeting

Here are my comments:

* The government does not appear to recognise engineering in the same way that it does science or indeed business.

* Govt has good communications channels to the Royal Society (science) and CBI (industry) but weaker links to the Royal Academy of Engineering - although the RAEng is endeavouring to grow these.

* Govt appears to understand 'science' as the basis for knowledge and industry/business as the means for creating wealth - but under-estimates the role of engineering in providing the bridge or the link connecting science to exploitation and wealth creation.

* in the space sector, which admittedly is somewhat special, government has tended to see it as primarily 'space science' funded via the STFC research council and 'space engineering' has somewhat fallen between the cracks (or research councils!).

* To some extent understandably 30 years ago, space was perceived as an expensive 'prestige club' -- however the position has changed dramatically. Space is now fundamental to our national wealth, security of supply, transport, communications, banking, navigation and so on. If space were to be somehow 'switched off', the UK economy and social order would rapidly collapse. This reliance of the UK on space technology and 'engineering' has crept up un-noticed and largely unrecognised by HMG.
The recent appointment of Lord Drayson with responsibility of Science & Space with a seat at Cabinet is a very welcome development of which I hope the government will make full use.

November 2008