House of Commons

Innovation, Universities, Science and Skills Committee

Engineering: turning ideas into reality: Government Response to the Committee's Fourth Report

Fifth Special Report of Session 2008–09

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The Innovation, Universities, Science & Skills Committee

The Innovation, Universities, Science & Skills Committee is appointed by the House of Commons to examine the expenditure, administration and policy of the Department for Innovation, Universities and Skills.

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The current staff of the Committee are: Sarah Davies (Clerk); Glenn McKee (Second Clerk); Dr Christopher Tyler (Committee Specialist); Ana Ferreira (Senior Committee Assistant); Camilla Brace (Committee Assistant); Anna Browning (Committee Assistant); Jim Hudson (Committee Support Assistant); and Becky Jones (Media Officer).

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Fifth Special Report

On 27 March 2009 the Innovation, Universities, Science and Skills Committee published its Fourth Report of Session 2008–09, *Engineering: turning ideas into reality* [HC 50–I]. On 19 June 2009 the Committee received a memorandum from the Government which contained a response to the Report. The memorandum is published as an appendix to this Report.

Appendix: Government response

The Government welcomes the Committee's report and its support for the UK's world class engineering base. This memorandum sets out the Government's response to the report.

This response has been prepared by the Department for Business, Innovation and Skills (BIS) with a major contribution from the Department of Energy and Climate Change (DECC) to the sections on Nuclear Engineering and Geo-engineering. It should be noted that since the Committee's Report was published the Department for innovation, Universities and Skills (DIUS) and the Department for Business, Enterprise & Regulatory Reform (BERR) were merged to form the Department for Business, Innovation and Skills (BIS).

The profession

1. The engineering community's approach to this inquiry has been coherent and co-ordinated, with the institutions working together to communicate a common message with and through the Royal Academy of Engineering. The Academy must take forward and formalise its leadership role, so that the engineering community can communicate—and co-ordinate—more effectively. (Paragraph 10)

While this is primarily for the Royal Academy of Engineering and the engineering community to determine, the Government values its excellent relationship with the Academy, and the advice that it offers. As noted in the response to recommendation 37 below, Government agrees that that Academy should generally be the first port of call for engineering advice. However, several Departments have strong and useful links directly with Engineering Institutions. The Government recognises the value of these, and would not want them to be overridden.

Nuclear engineering: skills

2. The Generic Design Assessment (GDA) process is important and requires highly skilled inspectors. The Government should make available sufficient resources to the Health and Safety Executive and the Environment Agency so that they can recruit enough staff to complete the GDA process in a timely fashion and to the high standards required. A clear timetable should be published by the end of 2009. (Paragraph 33)

The GDA process is a high priority for Government and is on the critical path in facilitating nuclear new build. Government is confident that GDA can be completed by June 2011 at the latest.

Effective regulation is a key aspect of this and we recognise the importance of ensuring that the nuclear regulators are sufficiently well resourced to undertake both GDA and their existing responsibilities to the same high standards that they always have. In particular, we recognise that the Nuclear Directorate of the Health and Safety Executive (ND) needs additional resources for its predicted future workload, both with and without new nuclear build.

In working to remedy this issue, a 3 year pay deal has been agreed for nuclear inspectors as part of the overall 2008–10 HSE Pay Settlement agreed in April 2009. Measures to improve recruitment as well as retention of inspectors close to or past retirement age are included.

In the longer term the ND will be restructured and the new organisation will have greater organisational and financial flexibility, which will enable it to resource itself in the context of a competitive recruitment market. The Environment Agency report no such resource issues for GDA.

3. We note the Government's optimism that delivering new nuclear power stations within ten years is possible. However, we are not convinced that the skills shortage in nuclear engineering can be bridged quite as easily as some have suggested. In particular, the General Design Assessment, which kick-starts the whole process, is already running slower than expected, and the remaining workforce is ageing. The Government must continue its investment in engineering and nuclear engineering skills and produce a clear skills plan by the end of 2009 (see Paragraph 33), to ensure its nuclear new build ambitions can be met. (Paragraph 41)

The Government recognises the challenge of ensuring that the UK has enough skilled workers to maintain and decommission existing nuclear power stations as well as building new ones. We recognise the need to have a greater understanding of what skills will be required to ensure its nuclear new build ambitions can be met. The Office for Nuclear Development is currently working with BIS, Cogent (Sector Skills Council for the nuclear sector), the National Skills Academy for Nuclear, the Nuclear Decommissioning Authority, Construction Skills and the Engineering Construction Industry Training Board to complete a study which will provide a detailed and holistic skills and capability plan for new nuclear build. This work will provide a clear picture of what skills are needed, how many and when from the initial stages of new nuclear build right through to the generating and commissioning stage. This plan should allow us to foresee any potential skills gaps and

direct resources to close these gaps before they appear. This piece of work will be complete by Autumn 2009.

4. We welcome the formation of the National Skills Academy for Nuclear: employer-led training is the best way to ensure that industry gets the skills it requires. However, we also believe that there should be greater clarity from industry and Government about which institutions do what in terms of skills provision. (Paragraph 47)

The National Skills Academy for Nuclear has a clear remit to develop and promote skills and career pathways within the UK nuclear industry and to ensure that the capacity exists to deliver skills to meet the different skill needs across the civil and defence programmes. It is employer–led, reflecting the breadth of its industry through its board and associate membership.

The Government believes that the programmes to develop skills within the energy sector and nuclear industry represent exemplary practice. The UK Commission on Employment and Skills has been asked by Government to advise on simplifying the skills system, so that whether accessing publically funded training or not, we do not just end up with a proliferation of schemes but a truly integrated and strategic approach to meeting demand for skills. The Office for Nuclear Development has developed a detailed skills map, in consultation with other government departments, skills bodies and higher education institutions, to provide greater clarity on the roles and responsibilities of the various institutions with an interest in nuclear skills. This map provides an explanation as to what the various bodies do as well as detailing the links, interactions and funding routes between them. This map was published in January 2009 and is available at the following link: http://www.berr.gov.uk/energy/sources/nuclear/skills/map/page49948.html

This map will be updated as the nuclear skills landscape develops.

The National Skills Academy for Nuclear and Cogent, the Sector Skills Council responsible for nuclear, are currently leading on a detailed review and analysis of the future skills challenges and issues facing the sector for Autumn 2009 and will complement the skills and capability plan for new nuclear outlined above. This will inform the National Skills Academy for Nuclear's five year plan. This will ensure that the National Skills Academy for Nuclear is absolutely focused on addressing both current and future strategic skill needs across the nuclear sector and ensuring that there is capacity available to deliver it.

5. The design of fourth generation nuclear reactors will go ahead with or without UK participation, and it is likely that the UK will want to start building fourth generation power stations in the future. The UK should avoid positioning itself so that it has little expertise in the very nuclear systems it needs in the future. In a post-oil economy, nuclear power will be a major player in the energy market and the UK should grasp enthusiastically the opportunity to take a lead role in the international nuclear industry. (Paragraph 50)

The Government's priority on nuclear energy is to create the right conditions to enable the private sector to invest in new nuclear power stations. This would be based on existing nuclear technologies, not fourth generation reactors that are not expected to be built commercially until 2030 or beyond. Research into aspects of fourth generation nuclear reactors will continue to receive funding through the UK Research Councils and the

European Union Euratom Research Framework Programme. The UK Research Councils' current portfolio of grants with direct relevance to fourth generation reactor systems runs at around £1.2m per annum. Euratom is an active member of the Generation IV International Forum (GIF), which co-ordinates international research efforts into some of the more promising advanced reactors systems. These research opportunities will enable the UK to keep in touch with technological developments and participate in leading edge international research projects where it has experience and expertise.

6. The Government should consider which research programmes—including the Generation IV programme, EURATOM, and IAEA and OECD research programmes—are required to support its nuclear activities. We strongly recommend that the Government commission the National Nuclear Laboratory to conduct a cost-benefit analysis on what international R&D offers the UK in relation to maintaining UK nuclear engineering capability and ensuring future UK energy policy is supported. (Paragraph 52)

The Government recognises the benefits of international collaboration and the UK will continue to take a lead role in the international nuclear scene. The UK is historically a strong participant in the EU's Research Framework Programme Euratom and has played a key role in the more recently established Global Nuclear Energy Partnership (GNEP). GNEP is focused on making nuclear power readily available worldwide in the near future, while reducing the risks of non-proliferation.

Most recently, in March this year, the Prime Minister said that the UK would lead on bringing forward proposals internationally for multilateral control of the fuel cycle and would seek an innovative partnership between industry, academia and government for further research and development to tackle the technical challenges involved in developing a proliferation-proof nuclear fuel cycle.

A consortium led by Serco with Battelle and The University of Manchester was appointed in April as commercial operators to run the National Nuclear Laboratory (NNL) and a new management team is now in place. The Government's vision is for a successful centre of excellence, serving primarily the needs of legacy nuclear waste clean up but also extending beyond this to seek wider opportunities. The NNL will have a "hub and spoke model" that will allow it to link up with wider UK nuclear research capability and international organisations. In developing its operations the NNL will be looking closely at international research opportunities and will be well placed to keep Government informed.

7. We support the formation of the Office for Nuclear Development, but remain concerned about the lack of a clear and detailed plan for delivering the next generation of nuclear power stations. There should be a master roadmap for all major engineering projects, including nuclear new build. The Office for Nuclear Development should take ownership of the roadmap for nuclear. The roadmap should include consideration of: what skills are required over time and what will be needed to deliver the skills capacity ahead of time; other general engineering programmes and nuclear engineering programmes, both national and international; potential bottlenecks in the supply chain; and who is responsible for the delivery of each part of the roadmap. There should be six-monthly progress reports against the roadmap. The roadmap should be in place by the end of 2009. (Paragraph 57)

The Government welcomes the notion that there should be a master road-map in place for all major engineering projects including new nuclear. The Office for Nuclear Development published an integrated programme plan for new nuclear in January 2009. This timeline shows how the various workstreams in the nuclear programme fit together, and who is responsible for what, to enable the first new nuclear power stations to be built by around 2018. The skills and capability plan which is currently underway will be designed in conjunction with this roadmap so that the two timelines can be used together. The programme plan has been well received by industry, and is used as a common template for those involved in delivering new nuclear power in the UK. We will continue to work closely with industry to develop and update the plan over the coming months. This programme plan is available at:

http://www.berr.gov.uk/energy/sources/nuclear/index.html.

Plastic electronics engineering: innovation and commercialisation

8. The UK is well placed to capitalise on the economic potential of the growing plastic electronics industry. However, we are concerned that without a clear understanding of how best to build on and market the UK's strengths in this sector this opportunity might not be fully realised. We urge BERR to engage with the Technology Strategy Board, UK Trade and Investment, UK Displays and Lighting Knowledge Transfer Network and the plastic electronics community to develop a technology roadmap. In constructing this roadmap it is essential that stakeholders across the sector be consulted, from spin-out companies to multinationals. (Paragraph 72)

We welcome the Committee's recognition of the UK's position to develop new products and capitalise on the potential of this emerging industry, which is in part the product of past investments by the former Department of Trade and Industry (DTI), the Technology Strategy Board, the Engineering and Physical Sciences Research Council (EPSRC), the Regional Development Agencies of England and the Devolved Administrations of Northern Ireland, Scotland and Wales.

The recently published strategic policy statement, 'Building Britain's Future: New Industry, New Jobs', outlined that Government can and must be intelligent about ensuring its actions deliver a high value, high skilled economy able to respond to long-term opportunity. It highlighted the need for concerted action to back businesses in markets and sectors, such as plastic electronics, where Britain has strength and Government can make a difference by clearing obstacles or correcting market failure.

In this context, BIS officials, Technology Strategy Board staff and KTN staff will work alongside key players from within the UK's plastic electronics sector to develop a UK Strategy for Plastic Electronics that will identify the UK's main strengths and how businesses throughout the supply chain can best take advantage of future commercial opportunities. Due for publication in the autumn of 2009, the strategy will also define the role for Government in unlocking competitive potential of this emerging industry.

A draft for consultation is planned for Summer 2009 with the formal launch of the strategy in Autumn 2009.

9. We welcome the support for plastic electronics research and development provided by EPSRC and the Technology Strategy Board, and believe sustained support by these organisations is vital to the growth of the industry. (Paragraph 80)

Plastic Electronics remains a central theme within the Technology Strategy Board's technology strategy and significant levels of support have already been delivered through direct support from the Technology Strategy Board, the Research Councils, the RDAs and the National Measurement System.

The Engineering and Physical Sciences Research Council is currently funding over £73m of research of direct relevance to plastic electronics and the Technology Strategy Board has committed a further £9.6m investment in projects in the field of Plastic and Printed Electronics, in the last 18 months, including funding a £12m project (£6m grant) to develop full colour flexible displays.

10. We do not believe that the Technology Strategy Board's grant schemes and the Managed Programme proposed by UKDL KTN and the former-DTI are mutually exclusive forms of support. UKDL KTN champions the needs of the plastic electronic community, and as such we urge BERR and the Technology Strategy Board to engage with it, and to reconsider the deployment of a Managed Programme in this area. (Paragraph 89)

As noted above, Plastic Electronics remains a central theme within the Technology Strategy Board's technology strategy and as part of its programme to stimulate innovation in the field of Plastic and Printed Electronics it will hold a 'sandpit' in January 2010 with an £8m Challenge—"To exploit the UK wealth potential of plastic and printed electronics". The sandpit will aim to identify unique UK capability in plastic electronics and that will result in end-use applications and also produce demonstrators by engaging new players, end-users, business leaders and creative designers.

The Technology Strategy Board is also working with the Regional Development Agencies and Research Councils to co-ordinate investments that are informed by the work of the KTN and BIS, which will help define the needs of business.

11. The future success of the UK plastic electronics industry not only lies in its ability to lever public and private finance, but also in the co-ordination of funding sources. We recommend that BERR, the Technology Strategy Board and UKDL KTN take immediate steps to increase the understanding of technological risk in the private sector, and to review the funding landscape. (Paragraph 95)

Following Lord Sainsbury's 2007 Review of Science and Innovation, the Technology Strategy Board has made good progress in working with other funding partners to address fragmented technology and innovation landscape, and create critical mass and coherence to the support provided to improve the technology and innovation capability of UK business.

Furthermore, the Government recently announced Solutions for Business (a simplified framework for business support), which is now in place to offer real help to companies with common issues such as accessing finance, support for research and development, skills and training, exporting and overseas trade.

Finally, in the context of securing access to Venture Capital, there are now 10 Enterprise Capital Funds providing venture capital investment in amounts of up to £2 million and a number of these Funds have a strong technology focus. Further measures have also been taken to support businesses during the downturn including Enterprise Finance Guarantee and the Capital for Enterprise Fund. The Government's recently published strategic policy statement, 'Building Britain's Future: New Industry, New Jobs', outlined a commitment to consider whether, and in what form, further intervention could help increase the supply of long term growth capital to small and medium sized businesses. This will include options for a Public-Private Partnership similar to the predecessor of 3i, the Industrial and Commercial Finance Corporation, leveraging private sector capital to address gaps in growth finance and risk capital.

We also recognise the important role that the Technology Strategy Board and KTNs have in increasing the understanding of this emerging industry amongst private investors. The KTNs in particular bring together a variety of organisations, such as businesses (suppliers and customers), universities, research and technology organisations, with the finance community and other intermediaries to provide a range of activities and initiatives to enable the exchange of knowledge, which can help address any information deficiency that could hinder private investment in the sector.

12. PETeC's location is a function of the fact that it was established as a regional initiative. It is an open question whether PETeC would have been sited elsewhere had it been founded as a national resource, something that it undeniably is. However, we do not see further discussion on this issue as constructive or worthwhile, and wish to see a line drawn under the debate. (Paragraph 100)

We welcome the Committee's support for this important initiative and agree with its conclusion.

13. We are sympathetic to PETeC's need to generate income in order both to assure its future survival and to allow it to participate in UK grant competitions. The Technology Strategy Board and OneNorthEast should review whether the requirement for self-sustainability within five years is realistic. (Paragraph 104)

It is important that PETeC works towards independence from regional development funding as befits its status as a technology and innovation facility for a national and international audience.

However, there is no restriction on PETeC participating in industry led projects seeking grant funding from the Technology Strategy Board. Furthermore, the role and value of PETeC will be considered in the context of the UK Plastic Electronics strategy highlighted above

14. We urge PETeC to continue developing its relationships with other Research Centres, and to liaise with these Centres to ensure national capability in facilitating R&D across the spectrum of plastic electronic technologies. (Paragraph 106)

We agree with the Committee's recommendation that tying PeTEC into world class research centres will be critical to its success. The Displays and Lighting KTN is coordinating links with other centres so that they provide a national, complementary, capability addressing a broad range of issues across key areas. Furthermore, the Technology Strategy Board and BIS staff sit on PETeC's advisory board, with a view to ensuring such links are developed and maintained.

15. The plastic electronics industry is likely to grow substantially over the next few years. Although the UK's research base puts it in a unique position to capitalise on this growth, we must not be complacent as countries such as Germany and the USA are becoming increasingly competitive. We recommend that the Research Centres supporting UK plastic electronics R&D engage with the academic research base to ensure state-of-the-art facilities are accessible to the academic community. (Paragraph 112)

PETeC expertise is available to academic institutions, and there is scope for academics to utilise the facility in the context of specific industry led projects funded by the Technology Strategy Board.

Furthermore, the Research Councils provide support for Innovative Manufacturing Research Centres (IMRC) such as the Innovative electronics Manufacturing Research Centre (IeMRC) with a 'hub' at the University of Loughborough and partners from a number of Universities across the UK. IMRCs provide the UK's leading manufacturing researchers with a base of stable yet flexible funding to pursue strategic research themes that are responsive to the needs of UK industry.

16. The UK academic research base should be applauded for its strong record in 'spinning out' start-up companies. Focused support, however, is needed to ensure these businesses grow into world-class enterprises. We recommend that the Technology Strategy Board, BERR and UKTI consult with UK business, from start-ups to multinationals, to identify how best to support the growth of innovative businesses in emerging industries. (Paragraph 120)

Following the recommendations of Lord Sainsbury's review, the Technology Strategy Board has established an Emerging Technologies Steering Group to bring together various agencies involved to drive a competitive position and significant value creation for the UK in new high growth markets or industries based on emerging technologies.

The Technology Strategy Board will publish a final strategy highlighting its approach to supporting emerging industries this year.

UKTI will continue to use the Regional Challenge Fund to promote UK plastic electronics capability internationally.

17. We encourage the Technology Strategy Board to engage with multinational companies across Europe to determine whether pan-European consortia could be

established to progress the development of emerging industries with the potential for high economic returns. (Paragraph 128)

We agree with the Committee's assessment that there are benefits to be had from closer collaboration with companies across Europe.

UK businesses and researchers have to date benefited from funding and collaboration provided in the European Framework Programme 6, and BIS have successfully influenced the European Commission to include plastic electronics as a key theme in Framework 7.

The Technology Strategy Board has also, since its establishment as an NDPB, taken over support for the EUREKA programme, and the offer of advice and guidance on Framework Programme 7 to encourage more UK businesses to take advantage of significant opportunities for collaboration with European partners through EU funding programmes.

Furthermore, the Technology Strategy Board will also increase the support its KTNs give to international activities, recognising the increasingly global nature of innovation and business in general.

More details on the Technology Strategy Board's international strategy will be published shortly.

18. The manufacture of plastic electronics devices is not destined to occur outside of the UK. However, we are extremely concerned that without urgent action by the Government this will be the reality. As in our previous recommendation (Paragraph 72), we urge the Government to engage with the plastic electronics community, and to articulate a strategic vision for the development of this innovative industry. (Paragraph 130)

We agree with the Committee, and the UK Plastic Electronics strategy currently under development will consider the role of manufacturing and the role of wider Government in securing high value-added activities here in the UK.

19. Support for innovative businesses as they transition from being primarily R&D focused to launching pilot manufacturing lines is imperative. We recommend that the Government consider whether there is merit in establishing an open access fabrication facility for the manufacture of Plastics Electronic devices by UK SMEs. (Paragraph 133)

We agree with the Committee and believe this is a role fulfilled by PETeC.

20. The economic opportunities provided by this growing industry do not only lie in the manufacture of devices, but also in the development of enabling technologies. It is imperative that any national strategy for this industry must embrace the materials supply chain, particularly as this sector holds huge potential for UK industry participation. (Paragraph 138)

We agree that in order for the sector to be successful we need to consider the entire value chain and engage in areas where UK can have the most impact. This will form part of the UK Plastic Electronics strategy that is currently being developed.

21. Public procurement has the potential to be a valuable tool in driving innovation. We welcome the Government's efforts to develop innovative procurement mechanisms, and recommend it supports pilot projects in the area of plastic electronics in order to stimulate product development and manufacture. (Paragraph 148)

We agree with the Committee's assessment of the role of public procurement, and believe that the commitment that during 2009, all Government Departments must publish Innovation Procurement Plans, will embed a clear obligation to procure goods and services in a way that drives innovation, and to identify clearly the areas in which they are seeking to procure innovative solutions to help deliver their objectives.

Expansion of the Small Business Research Initiative (SBRI) will help reinforce this by using the chance to compete for Government procurement contracts to incentivise early-stage, high-technology businesses and support these companies through a critical stage in their development.

However, we do not believe that procurement should be designed with a view to supporting a platform technology such as Plastic Electronics, but believe that a clearly articulated need or application by a Government Department could provide opportunities to support the growth of UK companies in this area.

22. The Small Business Research Initiative (SBRI) is potentially a valuable source of funding for innovative companies in the UK. Our concern is that unless this support mechanism is re-launched in a format accessible to SMEs developing future technologies, UK companies will refocus their business models to engage with the lucrative procurement opportunities offered by the US under its Small Business Innovation Research programme. We ask that DIUS keep us updated on progress made in rolling-out the revised SBRI. (Paragraph 155)

Following Lord Sainsbury's Review and the Innovation Nation White Paper, the SBRI programme has been reformed with a view to:

- Help with development of leading-edge technologies and innovative products to meet the Government's future needs ahead of commercial procurement.
- Increase access and opportunity by high-tech SMEs to Government R&D contracts which develop hard technologies and innovative products.
- Drive an increase in demand for R&D services from early-stage—high-tech SMEs, and to support them through a critical stage in their development and thus establish future industry in the UK.
- Ensure that the SBRI programme complements and where appropriate enhances the Government's other business support products for SMEs.

Building on the successful pilot competitions run by the Department of Health and the Ministry of Defence in 2008–09, the reformed SBRI programme will be implemented by the Technology Strategy Board and extended in 2009 to involve a wider range of departments and an increased number and value of competitions.

The revised structure is well-structured, focused on technology development and demonstration (£300k to £1m per project), phased to reduce risk, and attractive and accessible to industry. As an example, the pilot competition in Health is seeking technologies for hand hygiene and rapid pathogen detection in hospitals—two essential tools for conquering healthcare-associated infections—which will save cost and lives compared with what is available today.

The Technology Strategy Board has recently used the mechanism to help develop sustainable construction technologies suitable for retrofitting into social housing, and we will keep the Committee informed of developments in rolling out SBRI more widely.

The programme will also be annually monitored and evaluated by the Technology Strategy Board in order to ensure its effective performance and impact on both the buying Departments and suppliers. The annual performance results will be published on BIS and TSB websites.

Geo-engineering: a new policy area

23. At this stage, we do not consider a narrow definition of geo-engineering technologies to be helpful. Technologies to reduce solar insolation and to increase carbon sequestration should both be considered as geo-engineering options. (Paragraph 182)

The Government agrees that technologies which reduce solar insolation or increase carbon sequestration from the atmosphere (excluding Carbon Capture and Storage) should both be considered as forms of geo-engineering.

24. Like the Minister of State for Science and Innovation, we believe that Government should give the full range of policy options for managing climate change due consideration, and we share the view of the Tyndall Centre that geo-engineering technologies should be evaluated as part of a portfolio of responses to climate change, alongside mainstream mitigation and adaptation efforts. (Paragraph 185)

25. Given the need for urgent action in addressing the challenge of climate change, we can see no reason for not considering geo-engineering technologies as a 'plan B'. Quite the opposite, the decision not to consider any initiative other than 'plan A' could be considered negligent particularly, for example, if 'plan A' fails to act as planned or climate sensitivity is greater than expected. (Paragraph 187)

[Combined response to 24 and 25:]

The Government's foremost ('Plan A') priorities for tackling climate change are developing and deploying methods for emissions reductions, reaching a global agreement on emissions abatement and adapting to unavoidable change. Geo-engineering options currently do not represent viable alternatives to reducing greenhouse-gas emissions. However, we recognise that it is important to keep such options under review as some might ultimately have a role to play in helping to ameliorate climate change, if emissions

reductions are not achieved quickly enough. We therefore see a need for some research on the potential of geo-engineering technologies, to determine whether any of them could be used as an additional ('Plan B') policy option for managing climate change, to complement the conventional mitigation and adaptation approaches.

26. We find the divergent views of DECC and DIUS, as outlined by Lord Drayson and Joan Ruddock, as to the future potential of geo-engineering research to be confusing, and urge the Government to establish a clear view on the matter. (Paragraph 190)

We disagree with the Committee's conclusion that DECC and the former DIUS (now part of BIS) have divergent views on the future potential of geo-engineering research; rather the views of the two Departments are complementary and the Government has already established a clear view on this matter. Whilst there is merit in undertaking some further research, particularly modelling studies, to evaluate the feasibility and suitability of geo-engineering technologies in more detail, it is also vital to ensure that developing and implementing solutions for emissions abatement remains the primary engineering focus. Research into the more speculative geo-engineering technologies should not therefore take precedence over engineering research into proven technologies to reduce emissions. This should be seen in the context of the international negotiations on climate change, where the priority is to achieve an agreement on emissions reductions.

Although DECC is not intending to provide any significant funding for geo-engineering research, the Department is closely involved in supporting the Met Office Hadley Centre's development of its climate modelling capabilities and has also funded some modelling studies there into the environmental effects of geo-engineering options. Similarly, BIS continues to support the Research Councils' activities, which are noted in response to Recommendation 29.

27. Further, we conclude that it would not be appropriate or sensible for opinion-leaders or the public to see any policy on the potential use of geo-engineering schemes as implying a lack of ongoing commitment to the development of conventional emission mitigation strategies or adaptation responses. We urge the Government to be proactive in communication efforts to dispel any incorrect perceptions. (Paragraph 191)

The Government recognises an effective communications strategy would be needed if any geo-engineering options were also to be incorporated into climate change policy approaches, to minimise the risk of any public misperceptions about a continued commitment to using conventional mitigation and adaptation measures.

28. In order 'to sort the wheat from the chaff' and identify those geo-engineering options it may be feasible to deploy safely in the future, it is essential that a detailed assessment of individual technologies be conducted. This assessment must consider the costs and benefits of geo-engineering options including their full life-cycle environmental impact and whether they are reversible. We welcome the efforts of the Royal Society to review the geo-engineering sector, and urge it to engage with the Royal Academy of Engineering and the Science and Engineering Academies of other nations in this regard. (Paragraph 197)

We agree that a detailed (and independent) assessment of geo-engineering options is needed and, like the Committee, also welcome the study that the Royal Society has been undertaking into climate engineering. The stated aims of this study are to provide a balanced assessment of a range of different climate geo-engineering proposals, assessing their feasibility, efficacy, likely environmental impacts, and any possible unintended consequences. We will consider carefully the findings of this study, which are expected to be reported in the Autumn of 2009, and use it to inform our policy development on geo-engineering.

29. Support for detailed modelling studies will be essential for the development of future geo-engineering options, and to the construction of a credible cost-benefit analysis of technological feasibility. We urge the Research Councils to support research in this area. (Paragraph 203)

The Government agrees with the Committee's view that support for detailed modelling studies will be essential, to help evaluate the feasibility and suitability of different geo-engineering options. As indicated in the Committee's report, the nature of geo-engineering research means that much of it will need to be done on a 'virtual' basis and the use of climate models will also enable a risk assessment of individual options.

The Government and the Research Councils recognise the need for scientific studies in this area, though the Research Councils set their own detailed research priorities. As part of the Cross Research Council Energy Programme a geo-engineering 'Sandpit'[1] is planned for early 2010. The sandpit will intensively discuss engineering, physical science, economic, social and environmental aspects of geo-engineering projects. A £3M funding pot will be made available for research projects developed during the sandpit, though a variety of outcomes are possible. The Natural Environment Research Council (NERC) will take the Committee's report on geo-engineering and the outcome of the Royal Society study into account when refreshing its strategy, starting later this year

30. The Tyndall Centre for Climate Change is well-placed to co-ordinate geo-engineering research, and we would welcome the conduct of geo-engineering-related work as an additional work-stream. Further, we recommend that the Government engage with organisations including the Tyndall Centre, Hadley Centre, Research Councils UK and the Carbon Trust to develop a publicly-funded programme of geo-engineering research. Research grants should be awarded on the basis of excellence after a process of competitive peer review. (Paragraph 217)

The Government notes that it is already possible to carry out publicly-funded geo-engineering research. However, we acknowledge there is a need to co-ordinate any future UK research into geo-engineering and consider that the Tyndall Centre for Climate Change is one of several research organisations which could undertake an overall co-ordinating role.

The Tyndall Centre capability built through Research Council funding to 2010 is well-placed to compete for geo-engineering research should this area be within the Tyndall

[1] http://www.epsrc.ac.uk/ResearchFunding/Opportunities/Networking/IDEASFactory/WhatIsASandpit.htm

Centre's future strategy. NERC will consider geo-engineering as part of a review/refresh of NERC strategy later this year, and would welcome engagement with Government and other stakeholders as part of this.

31. Before deploying any technology with the capacity to geo-engineer the climate, it is essential that a rational debate on the ethics of geo-engineering be conducted. We urge the Department for Energy and Climate Change to lead this debate, and to consult on the full-range of geo-engineering options with representatives of the science, social science, and engineering communities and implementing agencies e.g. national Governments, international bodies or private sector organisations. (Paragraph 226)

We recognise there are a number of ethical issues around geo-engineering, some of which at least were identified in the discussion paper that Defra/DECC submitted as part of the Department's evidence to the Committee's geo-engineering case study inquiry. We agree this aspect of geo-engineering needs further, rational debate across a wide range of disciplines and other interested parties to address the various and complex issues it raises at an international level. We suggest this is an area of work that could be undertaken as part of a wider publicly-funded programme of geo-engineering research.

32. It is essential that the Government support socio-economic research with regard to geo-engineering technologies in order that the UK can engage in informed, international discussions to develop a framework for any future legislation relating to technological deployment by nation states or industry. (Paragraph 229)

Geo-engineering technologies raise a number of very significant and difficult socio-economic issues and the Government agrees that some publicly-funded research on this aspect will also be needed, to inform and underpin its policy position in any future international negotiations that might take place on the possible deployment of individual geo-engineering options.

As the main funding body in the UK for social science research the Economic and Social Research Council (ESRC) is in principle also open to supporting such research. The ESRC would welcome opportunities to explore research collaborations in this area in dialogue with stakeholders. Particular topics worth exploring would include issues relating to public acceptability of large scale geo-engineering deployment. In advance of any future research funding opportunities which may arise from these discussions the ESRC would draw attention to its responsive mode scheme through which it would be happy to receive proposals on geo-engineering.

Engineering in Government

The Government welcomes the Committee's focus on engineering in Government. Engineering advice is key to good policy and delivery in a huge range of areas from tidal power generation to medicine. The Government Chief Scientific Adviser (GCSA) is working to ensure the good management and use of engineering across Government, and has the Government's full support and confidence in doing this. In doing this he works

closely with Departmental Chief Scientific Advisers (DCSAs), a number of whom are engineers.

The Government largely agrees with the Committee's analysis of engineering in Government. In general terms, the Government shares the Committee's view that, although considerable progress has been made, more work is needed to improve the availability, quality and impact of engineering advice.

33. We conclude that engineering advice and scientific advice offer different things to the policy formulation process and that the benefits of both should be recognised. Further, it should not be assumed that a scientific adviser can offer competent engineering advice or even know when it is needed. (Paragraph 248)

The Government agrees that it is important that engineering advice is reflected alongside scientific advice in the formulation of policy and the delivery process. The two are interlinked and complementary.

We respond further to this recommendation together with recommendations 44–48 below.

34. We conclude that the Government, in several policy areas of several departments, does not have sufficient in-house engineering expertise to act as an intelligent customer. (Paragraph 257)

The Government agrees that in-house expertise is an important element of ensuring that Government decision making is informed by the best engineering advice. It is clear that there are insufficient visible and appropriate engineering skills available within Government at present. The Government is determined to find more effective ways to increase the visibility and impact of civil servants with engineering skills and expertise.

The GCSA, in his capacity as Head of Science and Engineering Profession (HoSEP) across Government, is currently consulting OGDs about a Skills Framework for the Science and Engineering Profession within the Professional Skills for Government (PSG) initiative. This Framework will be published by the end of July, and then adopted by all Departments. It will outline the job related professional expertise that scientists and engineers at all grades are expected to have, including whether or not they should have chartered status. We expect this to include requirements to maintain and develop expertise, apply technical knowledge, and improve the profile of engineering and science within departments.

Another key strand is the GCSA's efforts as HoSEP to raise the profile of the Science and Engineering Profession across government. The Government Science and Engineering (GSE) Community was formally launched in January this year and already has around 1,600 members drawn from across Government, but this is not enough. The Government has set a target to increase this number to 5,000 over the next 2 years.

While the PSG and HoSEP agendas will provide a structured way for thinking about engineering capacity and capability within departments, importantly, they will also address policy makers' understanding and appreciation of engineering. We believe that this two-pronged approach is essential to ensuring the effective use of engineering in Government.

That said, the Government is of the view that external advisory bodies are a necessary complement to in-house expertise in ensuring that science and engineering are used effectively across government.

A number of the Government's top-level advisory bodies include prominent engineers within their membership. These include the Council for Science and Technology (CST), Lead Expert Groups on Foresight projects and the Chief Scientific Adviser's Committee (CSAC). Four of the current group of CSAs are engineers by background.

Like the Committee, the Government welcomes the significant improvements made to the effectiveness of the CSAC network under the current GCSA, whose role includes making sure that high quality, wide-ranging engineering advice is sought and used appropriately in policy development.

More widely across government, Departmental Scientific (including Engineering) Advisory Committees and Councils (SACs) provide departments with independent expertise and advice to inform all stages of the policy process and the evidence used to support it.

An important element of delivering engineering advice across government is through ensuring that these SACs operate effectively in all relevant areas. To facilitate more effective management and use of these committees, GO-Science has a programme of events (seminars and workshops) for their Secretariats. In addition the GCSA recently held a networking event for Science Advisory Committee Chairs and Secretariats, which will be repeated annually.

As part of its independent advisory role, the Royal Academy of Engineering 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.

We are currently working on baseline data for the number of engineers working in Government (see response to recommendation 39 below). Once the position is clearer, the GCSA as HoSEP will work with departments to encourage them to ensure that their workforce has sufficient engineering expertise to deliver their department's requirements for both in-house expertise and for engagement with external engineering advisors.

35. The Guidelines on Scientific Analysis in Policy Making should explicitly include engineering advice. We are pleased that Professor Beddington has already agreed to review these guidelines, and suggest that the research and engineering community be consulted on the content of the guidelines. (Paragraph 260)

The *Guidelines on Scientific Analysis in Policy Making* will be reviewed in 2009-10, taking account of the Committee's comments. This will involve consultation with the science and engineering community.

36. Engineering advice should be sought early in policy formulation and before policy is agreed, not just in project delivery. We recommend that the Secretary of State for Innovation, Universities and Skills and the Minister for Science and Innovation act as champions in cabinet for the early engagement of engineers in policy making. Further,

this issue should also be central to discussions in the Science and Innovation Cabinet Sub-Committee. (Paragraph 265)

The Government agrees that engineering advice should be sought early in policy formulation. The early identification of issues needing specialist advice is a key message of the *Guidelines on Scientific Analysis in Policy Making*. It is an issue also shared by the other analytical professions and is therefore being looked at in parallel by the Heads of Analysis group, part of whose remit is to improve the effective use of analysis and evidence.

The Minister for Science and Innovation already acts both in public and in Cabinet as an enthusiastic champion for science and engineering, in all aspects of Government. The Minister is personally committed to working continuously to improve the availability, quality and impact of engineering advice within Government. As an engineer himself, he feels very strongly about this issue, and will continue to press his colleagues in Cabinet to ensure it receives the attention that it deserves. As chair of the Science and Innovation (ED(SI)) Cabinet Sub-Committee, he will work to improve not just the engagement of engineers in policy formulation, but the profile and importance of all science and engineering within Government. He will personally ensure that progress is made on this issue as rapidly and effectively as possible.

37. For engineering advice, the Government should consider the Royal Academy of Engineering as its first port of call. The Academy can then bring together the relevant experts, including representation from the relevant professional institutions, to provide impartial, expert and timely input to policy formulation. (Paragraph 272)

The Royal Academy of Engineering is a major source of authoritative, impartial and coherent advice for Government on issues with an engineering dimension, and the Government agrees that it should generally be seen as the first port of call for engineering advice. On issues where there is a good understanding of where to seek advice and where effective working relationships already exist, the Government reserves the right to consult particular Engineering Institutions directly.

38. The Government should set up a Working Group with the Royal Society, the Royal Academy of Engineering, the British Academy and the Academy of Medical Sciences to explore how and whether the relationship between Government and the Academies could be formalised so as to improve policy making. We reiterate the 2006 Science and Technology Committee recommendation that strong consideration should be given to the US model. (Paragraph 273)

The Government accepts that we should continue to strengthen links with the Academies. The advice and guidance provided by the National Academies is invaluable to Government, and there are many examples of that advice improving policy making. Nevertheless, better use could be made of the National Academies, and we will continue to work with the Academies to ensure that our relationships with them are as effective as possible. The Government will be exploring how it can make greater use of these bodies in its response to recommendations made in the CST's 2008 report on *How academia and government can work together*.

However, the Government is not convinced that formalising these relationships is necessarily likely to improve them. The key challenge, which the Government accepts, is

the timely identification of when advice is needed, and what advice is required, on a case-by-case basis. An overly formal relationship could even hinder the flexible and responsive way in which Government needs to work with the Academies to meet this challenge.

39. We reiterate the 2006 Science and Technology Committee's previous recommendation that: "the Government implement the 2002 recommendation of the Cross-Cutting Review of Science and Research to maintain records on specialist staff in order to identify their qualities and experience". (Paragraph 281)

Government shares the Committee's concern that engineers should be more visible, better utilised and better developed in the civil service. Government is working as a matter of urgency to address these problems.

One key issue highlighted by the Committee is the need for collection of better data on the numbers of engineers (and scientists) in the civil service, and on their skills and experience. Without knowledge of what expertise is available, it is not possible to make best use of it—or to plan properly to secure the right level of such expertise in future. Government accepts that the current data are not adequate and must be improved.

In March this year Government Skills launched a Skills Survey that will be a significant step forward in obtaining professional workforce data across Government. The Skills Survey will report in the autumn and, in particular, it should aid identification of staff with engineering and science backgrounds who are currently working in areas such as policy or operational delivery.

Although the Skills Survey will improve the data available in this area, it was not specifically designed to gather information on engineering and science or other specialist qualifications. The then Department for Innovation, Universities and Skills (DIUS) launched on 3rd June a more detailed and comprehensive Skills Audit of its staff against PSG criteria, as part of which every member of the former DIUS has been asked to record their highest academic or professional qualification and its subject. In addition, this survey allows members of all professions to highlight details of their engineering and science experience. This information will be personal and will be shared with line managers. Aggregated data will be available to others. This audit of former DIUS staff builds on a similar exercise carried out by the Department for Children Schools and Families, which achieved a 99% return rate. Completion of the audits of SDCFS and former DIUS staff should demonstrate the value of recording this sort of information to other Departments.

Once the data are clearer, the GCSA will work with the HoSEP network to ensure that departments have plans in place to ensure that they have access to an appropriate level of both in-house and external engineering expertise to deliver their remits. We will report back to the Committee's successor with proposed next steps later in the year when the results of both the Government-wide Skills Survey and the Skills Audit of former DIUS staff are available.

On the specific issue of the number of scientists and engineers in the Senior Civil Service (para 285), the GCSA stands by his interpretation of the Cabinet Office figures that, as a starting point, the number of scientists and engineers compares reasonably with other professions (whether one considers the 2007 as he used in his evidence or the 2008 data that that Committee used). The data does not allow accurate comparisons to be made

between professions, given the substantial numbers in the "policy delivery", "operational delivery" and "unknown" categories are likely to include unknown numbers of individuals with engineering, science and other qualifications.

40. The Government could promote the importance of professional accreditation in engineering by insisting that staff and consultants in technical roles are chartered. Additionally, the Government should keep proper records of the professional qualifications of its staff so as to improve its human resources information and continuing professional development. (Paragraph 284)

Each role within the Civil Service requires a particular set of skills. In some cases, a Chartered Engineer will be required. At least six departments have posts for which chartered status is a prerequisite; there are over 700 such jobs in the MoD alone. However, other roles might require a different skill set. While the Government fully recognise the benefits and value of this qualification, it would not seem sensible to exclude a well-qualified candidate with valuable engineering experience on the grounds that they were not chartered if the role did not require someone qualified to Chartered Engineer status.

Where appropriate, Government departments support their staff in maintaining their professional memberships and qualifications. Decisions on this are made a local level, based on both business objectives and the individual's needs, which may mean that chartership (either Chartered Scientist or Chartered Engineer) is required for some posts but not others. As Head of Science and Engineering Profession, the GCSA is currently refreshing and extending (to grades below Grade 7) the Skills Framework for Government Scientists and Engineers, which forms part of the PSG initiative. This document emphasises the importance of continuing professional development, with a suggestion that chartership is a reasonable goal.

The new Science and Engineering Assurance exercises (which replace the Science Review Programme) will look at departments' science and engineering capacity and capability and will help departments to focus on areas where improvements might be made. Drawing on these, Lord Drayson and the GCSA will work with colleagues on the ED(SI) Cabinet Sub-committee to establish where in Government additional engineering resource is needed and how best to provide it.

41. The Government claims that the Science and Engineering Fast Stream is highly valued, yet only four departments recruit from it. We ask the Government to explain why this situation has arisen and what steps it plans to take to ensure that all Departments recruit from the Science and Engineering Fast Stream. (Paragraph 287)

42. There should be more trained and experienced engineers in the civil service at all levels. One way of helping to achieve this would be to expand and adapt the Science and Engineering Fast Stream (SEFS) so that more scientists and engineers are recruited, more departments recruit from this cohort and SEFS recruits have the option to pursue careers as policy specialists. We also recommend that the Government prioritise training in the civil service to improve the ability of generalist civil servants to identify issues where engineering advice will be critical to the viability of a policy. (Paragraph 291)

[Combined response to recommendations 41 & 42]

The Government agrees the there is great value in bringing in talented staff who have engineering experience. The Science and Engineering Fast Stream (SEFS) is one of doing this, and it is indeed highly valued.

The Cabinet Office recruits Science and Engineering Fast Streamers (SEFSers) through the Graduate Fast Stream (GFS) scheme in response to requests from departments, and it is for individual departments to decide whether they need to recruit SEFSers and how many they need each year. It is open to all Government departments to recruit to SEFS if they wish; currently four departments do so and other departments have done so in previous years.

The Committee recommends that SEFSers should have the option to pursue careers as policy specialists. This is already available to them through SEFS. SEFS is an option within the GFS for people with science and engineering degrees who do not wish to pursue a career as a scientist or engineer, but who would like to put their scientific or engineering background to use while working in Policy Delivery or Operational Delivery like other Graduate Fast Streamers. There are other schemes operated in individual departments, such as MoD, for graduate scientists and engineers who wish to work in their specialist disciplines.

The GFS—including the SEFS—is a highly effective way of bringing high calibre, high performing graduates into departments. As part of the GCSA and HoSEP's objectives to raise the profile of science and engineering across Government, GO-Science will be talking to the Cabinet Office this year to explore how they can better promote the SEFS. The Government would welcome a wider distribution of SEFSers across departments for the particular skillset they bring and will continue working to ensure the scheme attracts the best applicants and to encourage more departments to take SEFSers.

More broadly, GO-Science has also been working with the other analytical professions and the National School of Government to ensure that generalist civil servants are able to identify when engineering advice is needed and how to obtain it. As part of this ongoing effort, a short guidance document *Analysis and Use of Evidence (Research and analysis in government)* has recently been published.

43. The Government should seek ways to improve the career flexibility between industry and the public sector. Both sides would benefit: engineers from the private sector would improve their understanding of Government, and civil servants would improve their understanding of industry; additionally, the public sector would benefit from using the skills of engineers who have managed major projects in the private sector. (Paragraph 295)

The Government strongly favours the career flexibility proposed by the Committee. Departments already operate a range of schemes for secondments to and from the private sector, which are complemented by schemes for academics to work in departments.

As one example, engineers, scientists and surveyors on the Defence Engineering and Science Group's Graduate Trainee Scheme to undertake secondment to MOD's Trading Funds and Agencies; industry and other Government Departments, as well as international

secondments (US DoD and NATO). 42 MoD staff were seconded to industry on this scheme during 2008.

GO-Science and the Royal Society launched a new Civil Servant-Scientist pairing scheme in January 2009. The aim of the scheme is to support and promote wider understanding of science and how this feeds into the policy process. GO-Science will explore the potential to expand this scheme with the Royal Academy of Engineering.

This issue is being looked at further in the response to the CST's 2008 report on *How academia and government can work together*

44. We share our predecessor Committee's concern that the Treasury does not have scientific or engineering advice at the highest level. The Treasury should appoint both a Chief Scientific Adviser and a Chief Engineering Adviser. (Paragraph 299)

45. The Government could easily support its claim to recognise the importance of engineering and engineers by appointing Chief Engineering Advisers, at a minimum in positions where existing Chief Scientific Advisers act as Chief Engineering Advisers. (Paragraph 305)

46. The Government has argued on several occasions that 'science' includes engineering, and therefore there is no need for a Chief Engineer. But it also argues that 'science' includes social science and statistics, yet there is a Chief Social Scientist and a National Statistician. The Government's position is illogical. (Paragraph 306)

47. Some departments should have Departmental Chief Engineering Advisers (DCEAs), some Departmental Chief Scientific Advisers (DCSAs), and some should have both. The Government Chief Scientific Adviser should liaise with Departments to determine which arrangement is most appropriate. (Paragraph 307)

48. The role of the GCSA should be altered. We suggest that the GCSA should be renamed the Government Chief Scientific and Engineering Adviser (GCSEA). This person would be the head of profession for science, engineering, social science and statistics and should have a more senior role in the Government with direct access to the Prime Minister. The GCSEA would head up the Government Office for Science and Engineering, which should be placed in the Cabinet Office. Beneath the GCSEA should be a Government Chief Engineer, a Government Chief Scientist and a Government Chief Social Scientist. We recommend that the Government implement these changes as a priority. (Paragraph 313)

[Combined response to recommendations 33, 4–48]

The Government accepts that, although considerable progress has been made ensuring that appropriate scientific and engineering advice is available to Departments, there remains room for improvement and it is fully confident in the ability of the GCSA to take this forward within the newly formed Department for Business, Innovation and Skills.

It is the central responsibility of each departmental CSA to ensure that appropriate scientific advice is taken into account by their Department when it is required. The GCSA oversees this capability for Government as a whole. The nature of the advice required will

vary between situations, and may include engineering advice, as it might include advice on social science, statistics, economics, medicine or any other scientific discipline. Each of these disciplines has its own features. The DCSA does not provide all of this advice personally; it would be impossible for any one person to have expertise in all relevant areas. Rather, the role of the DCSA is to consult with experts both within Government and outside to identify what advice is needed, and to obtain it.

Nearly all major science-using departments now have departmental CSAs in place, or are recruiting them. GO-Science are in discussion with Treasury over the role that a Treasury CSA might take. DCSAs cover both science and engineering as part of their remits; it is part of this role to ensure that each department has sufficient expertise and capacity to manage and use the engineering advice it needs. It is also noteworthy that the Ministry of Defence (MoD), the Department for Business, Innovation and Skills (BIS), the Department for Transport (DfT), the Department for International Development (DFID) and Communities and Local Government (CLG) currently have engineers and/or Fellows of the Royal Academy of Engineering (FREngs) in the DCSA role. And past GCSAs have included Sir John Fairclough and Sir Robin Nicholson, who were engineers.

There many individuals within the Civil Service who are specifically appointed for their expertise in a particular area. The Committee rightly identifies some of these: for example the National Statistician for statistics. Examples for engineering would include the many holders of posts for which Chartered Engineer status is a prerequisite. The Government recognises and values the contribution made by the holders of these specialist posts. The role of the GCSA and of departmental CSAs are fundamentally different. They are not appointed for their personal specialist expertise (although this may often be valuable), but rather for their ability to marshal advice from all of the other specialists, both inside and outside Government, to provide whatever scientific advice their Department requires across the full spectrum of science and engineering.

The Government does not therefore accept the case for separate Chief Engineering Advisers at Government-wide or departmental levels. The Committee's proposals would involve additional management layers and complication which would likely be counter-productive and confusing. The Government does however accept the need to build stronger links between the different parts of the evidence base: this is a priority for departments and DCSAs. The GCSA works through the Chief Scientific Advisers Committee (CSAC) and its sub-committees to facilitate interdepartmental working and knowledge sharing, and seeks to improve interdisciplinary working with the other analytic professions through GO-Science's Foresight Programme and his active participation in the Heads of Analysis group.

Having said that, the, title and responsibilities of the GCSA and the GO-Science are a matter for the Prime Minister and will be kept under review.

Overview and general conclusions

49. We were greatly impressed by the high quality and wide-ranging work to give young people experience of engineering. We are supportive of all efforts to make young people aware of the rewarding and challenging nature of a career in engineering. While we would not advocate that geo-engineering be championed as a research field above any other, we believe that it might have the 'X-factor' when it comes to alerting young people to global engineering challenges and we welcome its inclusion in engineering events. We are concerned, however, that engineering is not always promoted as a worthwhile, challenging and exciting career option, and advocate that it feature more prominently in the provision of careers advice at schools. (Paragraph 323)

Provision of engineering, and wider Science, Technology, Engineering and Mathematics (STEM), careers advice is a central part of the Government's STEM programme. Accordingly, the Government fully supports this recommendation, and will continue to work towards its full implementation with the support of delivery partners including the Royal Academy of Engineering and STEMNET.

The Academy has developed The *Shape the Future* Programme to cover an extensive range of schemes and activities available for schools wishing to explore engineering in all its facets, and these are now widely disseminated through the STEM Directories, launched in September 2008. STEMNET is responsible for the promotion and dissemination of the directories at the regional level, as part of their wider responsibility for brokering STEM enrichment and enhancement activities.

STEMNET are also responsible for the STEM Ambassadors (formerly Science and Engineering Ambassadors) programme, which aims to have 27,000 ambassadors in place by March 2011. The RCUK Researchers in Residence programme fulfils a similar function by facilitating young people's encounters with practising scientists and engineers.

In conjunction with the Engineering and Technology Board (ETB) and the Royal Academy of Engineering, BIS and DCSF (Government) remain committed to the future of the Big Bang Fair, which earlier this year attracted over 7,000 visitors, and included the presentation of the first National Science Competition prize.

Careers awareness was a key theme within responses to the 2008 *A Vision for Science and Society* consultation. We announced recently the establishment of 5 expert groups to take forward the Science and Society strategy The careers group will address myths and disincentives that inhibit students from entering science and engineering careers, and build on the Science: [So what? So everything] campaign in communicating the possibilities.

This will supplement the important careers activity that DCSF has already introduced—for example through FutureMorph, introduced as part of their £140 million programme to promote and raise awareness of STEM careers to both children and parents.

50. The key to solving sector-specific shortages of engineers will ultimately lie in the UK's ability to train the next generation of generalist engineers, who will then specialise after university. Plastics electronics is one example of an industry that would benefit from the introduction of post-graduate programmes that offered generalist engineers

specialised training. We recommend that EPSRC engage with industry to assess the potential for establishing a range of conversion courses according to need across the engineering sector to upskill generalist engineers. (Paragraph 331)

EPSRC supports the Committee's view concerning the importance of engaging with industry and is already working with industry representatives to identify priorities for postgraduate training.

For example, EPSRC recently announced funding for 45 new Centres for Doctoral Training, which will create communities of highly qualified students from a range of disciplines, focused on specific mission and research areas such as plastic electronics. The announcement included 17 Industrial Doctorate Centres, many of which focus on engineering, which were required to demonstrate significant industry demand as part of the criteria for funding. All such centres include taught coursework to develop technical and transferable skills. EPSRC believes that combining the development of transferable skills alongside training in research represents a strong model for delivering the advanced skills needed for the UK.

As a further example, within the recent £44M investment in Knowledge Transfer Accounts (KTAs), funding has been provided for a range of Continual Professional Development (CPD) courses which will afford those already working in industry the opportunity to enhance their existing skills or to develop advanced skills in new areas.

Specifically in the area of plastic electronics, EPSRC has funded a number of activities to develop industrial collaboration, research capacity and skills. These include:

- An Innovation and Knowledge Centre in Advanced Manufacturing Technologies for Photonics and Electronics, at the University of Cambridge (awarded in January 2007).
- A Doctoral Training Centre in Plastic Electronics at Imperial College London (awarded in December 2008).
- A £6.9M programme grant led by Professor Sir Richard Friend at the University of Cambridge to develop and sustain a world-class research centre in organic semiconductor devices (awarded in March 2009).

51. We believe there to be value in incorporating management skills in post-graduate masters and doctoral programmes. We recommend that HEFCE, EPSRC, the Royal Academy of Engineering and the professional institutions co-ordinate to advise on best-practice in the delivery of this training by higher and further education institutes. (Paragraph 336)

The Government has facilitated through the Sector Skills Councils a richer dialogue between universities and employers so that course content can evolve to meet contemporary needs. Many taught masters programmes in engineering already have some elements of management in them.

EPSRC encourages universities to consider what management training should be included in the curriculum for postgraduate training, but considers that the primary responsibility for delivering skills training should lie with universities. EPSRC's Industrial Doctorate

Centres are one approach to doctoral training that provides management training, usually in partnership with the university's business school, to prepare students for a career in industry. EPSRC would certainly be willing to engage further with other funding bodies to demonstrate the benefits of this particular approach and also to explore best practice models for training.

More broadly, the Research Councils provide Career Development and Transferable Skills Training (Roberts) Payments to universities. These amounted to £22M in 2007–08 and are for the development of research students and staff employed on research grants.

EPSRC will consider its role in this area in the light of the Higher Education Framework to be published by BIS this summer.

52. We support the Government's efforts to promote diversity in engineering. Its financial support for STEMNET and the Science and Engineering Ambassadors programme, WISE, the Computer Club for Girls, and the work of the Royal Academy of Engineering and the Engineering Development Trust is welcome and should continue. (Paragraph 344)

The Government fully supports this recommendation—diversity and inclusion underpin the Science and Society strategy's aim for a representative workforce, and Government will continue to stress this goal. We are not complacent, and recognise the extent of the ground which has to be made up to achieve greater representation of diverse groups.

We continue our support for the UK Resource Centre for Women in SET, and will encourage them to continue their support for women at all stages in their engineering careers. They are already promoting the long-term careers of women in academia the Athena SWAN Charter programme, and working with over 700 companies to improve workplace attitudes to diversity. They are also working with the Royal Academy of Engineering specifically to promote Diversity in Engineering. Their CEO Charter initiative is a good way to engage the engineering institutions, and through them their members, to develop effective practice in diversity in their organisations. We will encourage the Royal Academy of Engineering in their support for the Charter, and their ongoing work with UKRC. We will also continue to support both the Expert Group for Women in STEM and the WISE campaign.

HEFCE's National STEM programme will provide £20 million between 2009 and 2012 to support demand raising activities across the STEM landscape—this will enable expansion of programmes including the extension of the London Engineering Project.

We are particularly pleased that the Royal Academy of Engineering have signed up to the UKRC's CEO Charter, and would encourage other engineering organisations to do so.

While the work of UKRC helps support women who have already chosen a STEM career, we continue to support the WISE campaign, in recognition of the fact that work on diversity must begin at an early stage, at a point where they can reshape and influence career decisions.

STEMNET are also charged with ensuring that their ambassador cohort is representative and diverse; they will work to ensure that there are sufficient engineers from the broad diversity of backgrounds to inspire and motivate children to pursue similar paths.

Similarly, the BIS small grants scheme has the specific remit of enabling participation by under-represented groups in National Science and Engineering Week. Funding was doubled in 2009, and will continue into 2010.

Broadening access to engineering to women and the ethnic minorities is also a major aim of the London Engineering Project mentioned earlier, and it is hoped that the effective practice established there will be disseminated nationally through the HEFCE funded National STEM Programme, now being run by Birmingham University.

53. We are concerned that evidence is lacking on the factors that affect the career choices of women and other under-represented groups. We recommend that DIUS commission research to examine these factors. This evidence should then be used as a platform from which to develop and target widening participation initiatives. (Paragraph 345)

BIS is commissioning a research project to assess the reasons why around 50% of STEM graduates choose not to go into STEM careers. That research is expected to be published in 2010.

As detailed above, from the work of the WISE Campaign it has been recognised for some time that only 15% of engineering undergraduates are women. This correlates directly with the fact that only 20% of A level Physics candidates are women. The major issue is to encourage more women to take A level Physics. The Institute of Physics looked at this problem in its report *Girls in the Physics Classroom* (June 2006) which recommended pedagogic change at Key Stage 3 and Key Stage 4. It would seem that development of these ideas through practical (empirical) programmes in schools (again as done in the London Engineering Project) might prove more effective than to commission further abstract attitudinal research.

54. We suggest that the engineering institutions, Engineering Council UK and the Government (see Paragraph 284, Chapter 5) should do a better job of promoting Chartered Engineer status (CEng), Incorporated Engineer status (IEng) and Engineering Technician status (EngTech). In the same way the general public respects academic qualifications such as PhDs, Masters and Honours Degrees, or professional qualifications in law and medicine, so should it be possible to inform the public about the professional status of CEng, IEng and EngTech. (Paragraph 357)

This is primarily for the Engineering Council UK (EC^{UK}) and the major (accrediting) engineering institutions. Engineers should aspire to CEng status (and Institutional membership through the support and status which they bestow on them as professionals). This is to be achieved through demonstrating their relevance to professional engineers at all stages of their career and in ensuring that the standards, support and services are world-class on a par with, for example, the Institute of Electrical and Electronic Engineers (IEEE).

EC^{UK} has successfully promoted CEng recognition as an internationally recognised professional engineering qualification through the FEANI and Washington Accord

networks. The advantages of this to practising engineers need to be more widely publicised within the profession in the UK, particularly given the increasing uptake of Institution membership abroad, especially in China and South East Asia.

The engineering institutions must be able to demonstrate their relevance. The issue is related more widely to that of the retention of engineering graduates in the profession, which will be considered in part by the BIS-funded *Engineers for Enterprise Study*, which is looking at developing undergraduate engineering degree courses to better meet the diverse needs of industry.

55. There is a need for better trans-departmental management of engineering policy. The Government should adopt a practice of formulating and following roadmaps for each major engineering programme, including skills provision (see Chapter 2) with co-ordination between each of them. The Government should also be more strategic in its support for emerging industries and policy areas (see Chapters 3 and 4). Finally, Government would benefit from having senior officials tasked to oversee engineering roadmaps and strategic plans, and to manage engineering advice in a Civil Service with more residual and specialised engineering expertise. There should be two people responsible for this challenging body of work: a Government Chief Scientific and Engineering Adviser and a Government Chief Engineer (see Chapter 5). (Paragraph 360)

The Government recognises the need for improvement, and has already taken a number of steps to better facilitate the use of engineering in trans-departmental policy. These include the introduction of joint Public Service Agreement (PSA) targets, the increased effectiveness of the CSAC network, and improved links with the Royal Academy of Engineering and the Engineering Institutions.

The Government does not agree that the use of engineering in Government should be overseen by two separate people, as this would add an unnecessary layer of complexity and the potential to cause confusion.

56. We are convinced that the considerable strength of the UK's engineering base makes it both this nation's responsibility and in its economic interest to play a major part, through our engineering base, in solving global problems such as climate change, food and water supply, energy security and economic instability. The recent economic crisis has presented the Government with a once-in-generation opportunity to restructure the economy by building on the existing substantial strengths of UK engineering. (Paragraph 362)

The Government welcomes the Committee's support for the UK engineering base, and shares its view of the importance of engineering to the UK and its economy. The Government also recognises the opportunities presented by the economic situation, and on 20 April published *Building Britain's Future: New Industry, New Jobs*, setting out how we would take advantage of these opportunities. Engineering was one of the promising areas identified in this paper as being key to the economy of the future.

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2008–09

First Report	Re-skilling for recovery: After Leitch, implementing skills and training policies	HC 48–I (HC 365)
Second Report	The Work of the Committee 2007-08	HC 49
Third Report	DIUS's Departmental Report 2008	HC 51–I (HC 383)
Fourth Report	Engineering: turning ideas into reality	HC 50–I
Fourth Special Report	The future of science scrutiny following the merger of DIUS and BERR	HC 662

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First Report	UK Centre for Medical Research and Innovation	HC 185 (HC 459)
Second Report	The work and operation of the Copyright Tribunal	HC 245 (HC 637)
Third Report	Withdrawal of funding for equivalent or lower level qualifications (ELQs)	HC 187–I (HC 638)
Fourth Report	Science Budget Allocations	HC 215 (HC 639)
Fifth Report	Renewable electricity-generation technologies	HC 216–I (HC 1063)
Sixth Report	Biosecurity in UK research laboratories	HC 360–I (HC 1111)
Seventh Report	Pre-legislative Scrutiny of the Draft Apprenticeships Bill	HC 1062–I (HC (2008–09)262)
First Special Report	The Funding of Science and Discovery Centres: Government Response to the Eleventh Report from the Science and Technology Committee, Session 2006–07	HC 214
Second Special Report	The Last Report: Government Response to the Thirteenth Report from the Science and Technology Committee, Session 2006–07	HC 244
Fourth Special Report	Investigating the Oceans: Government Response to the Science and Technology Committee's Tenth Report of Session 2006–07	HC 506 [incorporating HC 469–i]