



The Government Office
for Science:
ANNUAL REVIEW 2010-11

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Foreword



Science and engineering are critical both to the Government's effective and timely response to today's pressing issues and to its consideration of future priorities and policies. As Government Chief Scientific Adviser, I am responsible for ensuring that decision-makers at the highest levels in government have access to the very best advice and evidence from across the scientific and engineering disciplines. I am supported directly in this work by the Government Office for Science, and by the cross-government network of departmental Chief Scientific Advisers.

During the period covered by this report, the Government Office for Science led and supported a wide range of cross-Whitehall efforts to address today's global 'Grand Challenges'. This included engaging with the development and delivery of policy and practical solutions in the areas of, for example, the challenges of food, energy and water security, increasing population and urbanisation. These challenges are intimately linked, and developing action with global partners to meet them will rightfully continue to demand our attention over the forthcoming year and beyond.

The events of 2010-11 also served to demonstrate the Government's commitment to science and engineering underpinning the UK's response to unforeseen civil contingencies. A Scientific Advisory Group for Emergencies was activated on two occasions; following the eruption of the Eyjafjallajökull volcano in Iceland in April 2010, and again in March 2011 following the incident at the Fukushima nuclear power station, Japan. Chaired by me, each SAGE comprised experts from within government, academia and industry, and provided advice to the Cabinet on the unfolding scenarios and action that might be taken.

This report sets out these and other issues that my Office and I have been involved with over the past year, and shows science and engineering in government going from strength to strength. I have every confidence that this will continue.

Professor Sir John Beddington

About us

The Government Office for Science supports the Government Chief Scientific Adviser in ensuring that the UK Government uses the best science and engineering research and advice for policy development and delivery.

Role of the Government Chief Scientific Adviser

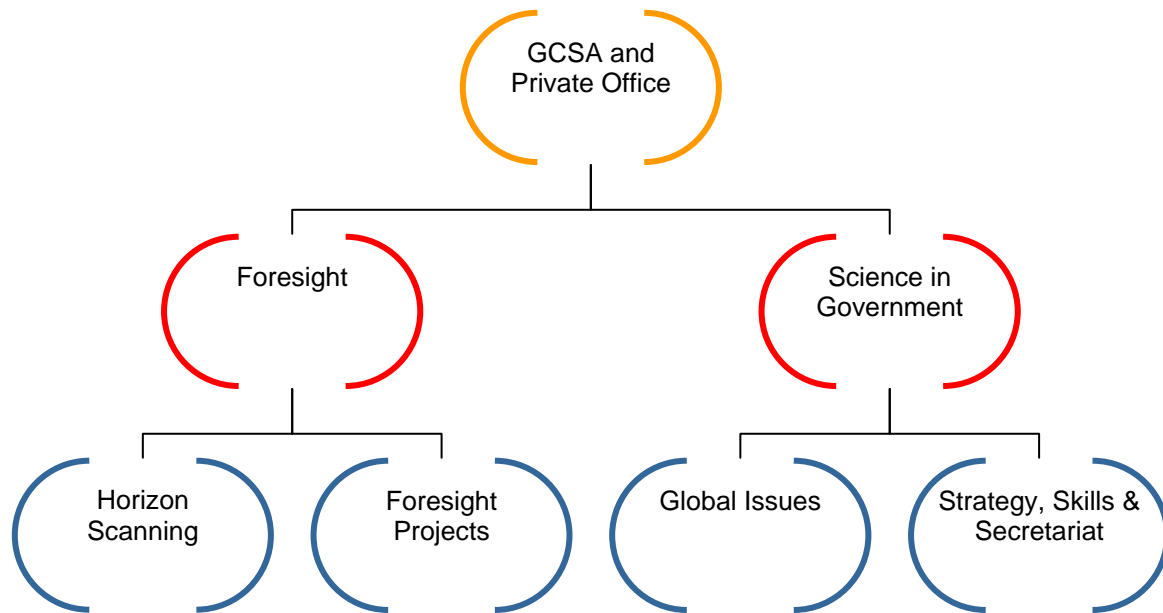
The Government Chief Scientific Adviser (GCSA), Professor Sir John Beddington, reports to the Prime Minister and, within the Civil Service, to the Cabinet Secretary. The GCSA advises Cabinet and works closely with the Minister for Universities and Science.

The Government Office for Science (GO-Science) supports the GCSA and is located in the Department for Business, Innovation and Skills (BIS) but is semi-autonomous from it. The roles of the GCSA and of GO-Science are outlined in more detail in Box 1.

Every major science-using department now has a Chief Scientific Adviser (CSA) post. CSAs work together under the GCSA's leadership to address issues which cut across departments. CSAs also work closely with economists, statisticians, operational researchers and social researchers within and across departments.

The GCSA's role is to:	To deliver this the GCSA and GO-Science:
<ul style="list-style-type: none"> • provide scientific advice to the Prime Minister and members of Cabinet personally • advise the Prime Minister and Cabinet on aspects of policy on science, engineering and technology • assure and improve the use of science and engineering evidence in Government • lead the science and engineering profession in the Civil Service • work with the Heads of the other analytical professions in Government to deliver on integrated evidence base • engage internationally on science and engineering issues to help achieve UK objectives • strengthen relations between research communities and policy makers 	<ul style="list-style-type: none"> • take a strategic overview of departmental investment in science and research • identify and drive forward cross-cutting issues • scope the future of issues where developments in science, engineering and technology will have a significant impact • act on security and counter-terrorism, working closely with the Home and Cabinet Offices, for example on Olympic security • lead on civil contingencies, including swine flu, the effects of Icelandic volcanic eruptions, and the nuclear incident at the Fukushima plant, Japan • engage in global environmental and resource challenges including climate change, energy, biomass, food, water and demography • strengthen confidence in climate science • manage the relationship between scientific advisers and Government • scope potential future developments in technology

GO-Science at a glance



Foresight

Foresight uses the latest scientific and other evidence, combined with futures analysis, to tackle complex issues and help policy makers take decisions affecting our future. Foresight's work makes a critical contribution to meeting important challenges of the 21st century – such as food security, flooding and obesity. Foresight teams undertake in-depth studies examining major issues up to 100 years in the future¹ and the Foresight Horizon Scanning Centre² carries out short projects looking at discrete issues across the entire public policy spectrum.

Science in Government

Global Issues

The GO-Science Global Issues teams help the GCSA to ensure that major policy decisions are well-handled by the Government and that science and engineering evidence is properly considered. Particular areas of focus are issues that cut across several departments' responsibilities. These include: climate change, energy, food, health and the effective use of science in emergencies and to safeguard against threats.

Strategy, Skills & Secretariat

The Strategy, Skills & Secretariat teams support the GCSA in a number of ways. They provide underpinning support for the network of CSAs, maintain the GCSA's guidance to colleagues across government, keep abreast of science and technology activities in

¹ Foresight Projects: <http://www.bis.gov.uk/foresight/our-work/projects>

² Foresight Horizon Scanning Centre: <http://www.bis.gov.uk/foresight/our-work/horizon-scanning-centre>

departments, and support the GCSA in his role as Head of the Science and Engineering Profession.

The Science and Engineering Assurance (SEA) teams support the independent external review panels which assess departmental arrangements for the access, management and use of scientific, technical and engineering advice and research in government. The reviews provide the GCSA an assessment of the fitness of departmental arrangements for using evidence in policy development and delivery, identify areas of good practice, and make recommendations where further development is needed.

Secretariat to the Council for Science and Technology (CST)

CST is the UK's premier advisory body on science and technology policy matters, reporting directly to the Prime Minister. CST's membership is drawn widely from higher education, science, engineering and business. It is co-chaired by the GCSA and by Professor Dame Janet Finch (Former Vice-Chancellor, Keele University). Its Secretariat is based in GO-Science.

Private Office



The Private Office directly supports the Government Chief Scientific Advisor. It liaises with policy teams and key stakeholders to ensure the GCSA has accurate, relevant and timely advice and information for him to act effectively with Ministers, senior Government officials and other key stakeholders.

2010 - 2011 Highlights

2010 lived up to its titles of 'International Year of Biodiversity' and 'Year of Science'. GO-Science played a key role by responding promptly to major national and international events and successfully raising the profile of science across the UK and beyond.

January 2010

- GCSA launched the cross-Government [Strategy for Food Research and Innovation](#).
- Second [Government Science and Engineering \(GSE\) Annual Conference](#) took place in London.
- GCSA led a review of the science, engineering and other evidence underpinning the development of the DECC [2050 calculator](#) – a new tool for policy makers to explore pathways for meeting the Government's target to reduce greenhouse gas emissions.

February 2010

- Foresight project on [Land Use Futures](#) launched.
- GCSA moderated the [biennial UK-India Science and Innovation Committee](#) with his Indian counterpart in New Delhi.

March 2010

- Food Research Partnership published a [report examining the issues around high-level skills](#) in the agriculture and food sectors.
- Council for Science and Technology published its report ['A Vision for UK Research'](#) suggesting new strategies for research, investment, skills and innovation.
- GCSA chaired two seminars on forecasting weather and global financial risks during National Science and Engineering Week (NSEW).
- Government published the ['Principles of Scientific Advice to Government'](#) setting out the principles of engagement between Government and those providing independent scientific and engineering advice.

April 2010

- Royal Academy of Engineering (RAEng) launched a [pilot development programme](#) for twenty-six members of Government Science and Engineering (GSE).
- Scientific Advisory Group for Emergencies (SAGE) was activated to support Cabinet Office Briefing Rooms (COBR) following the eruption of the [Eyjafjallajökull volcano in Iceland](#) which caused significant disruption to UK airspace.

May 2010

- Sixty Government Science and Engineering (GSE) members visited the state-of-the-art [Health and Safety Laboratories in Buxton](#) in Derbyshire.

June 2010

- GCSA provided evidence to the Hine Review on the UK response to Swine Flu.

July 2010

- GO-Science held a workshop for 200 [Government Science and Engineering \(GSE\)](#) members on past and future career strategies within the Civil Service.
- GCSA published the third edition of the [Guidelines on the use of science and engineering advice in policy making](#).

August 2010

- Science and Engineering Assurance (SEA) programme reports for the Department for Transport (DfT) and the Department for Education (DfE) were published.
- The [Government Science & Engineering \(GSE\) Intranet pages](#) were relaunched on the cross-government collaboration website Civil Pages.

September 2010

- GCSA initiated [a review](#) of cyber security and of high impact low probability risks.
- A new section on the GO-Science [website was launched](#) to help people seeking a better understanding of the scientific evidence and principles behind climate change.
- The [Consultation on the Code of Practice](#) that sets out good practice on the function and working of Government's Scientific Advisory Committees (SACs) was launched by the Science Minister and the GCSA at the annual British Science Festival.

October 2010

- SEA programme report for BIS was published.
- GO-Science contributed to the House of Commons [Science and Technology Select Committee inquiry](#) into the use of scientific advice and evidence in emergencies.
- The GCSA gave keynote speeches at the Royal Society's [Tokyo celebration of their 350th anniversary](#) and the Science and Technology in Society conference in Kyoto.
- GO-Science was closely involved in the production of the [National Security Strategy and Strategic Defence and Security Review](#).

November 2010

- Royal Society, with the support of GO-Science, hosted the 2010 [pairing scheme](#) to help build bridges between Parliamentarians / civil servants and scientific researchers.
- GCSA represented the UK at the annual [Carnegie Group](#) meeting of G8+5 Prime Ministers and Presidents' science advisers in Toronto, Canada.
- GO-Science reported on the Government's [needs for climate science advice](#) over the next 5 to 10 years and how those needs can be met.
- A team of leading UK experts helped assess the impacts of the [Hungarian alkaline waste spill](#). This was welcomed by the Hungarian Government.
- Foresight Horizon Scanning Centre published a [report on Technology Innovation Futures](#).
- A new Foresight project was announced – '[Computer Trading in Financial Markets](#)'.

December 2010

- CST made recommendations to Ministers on a number of steps and ways to improve [capability of the UK's digital infrastructure](#).
- GO-Science and BIS participated in the BBC's Science Buddy Scheme as part of BBC's Year of Science.
- GCSA advised the Secretary of State for Transport on the likelihood of [severe winter weather](#) recurring over the coming 2-3 decades in the UK.

January 2011

- GCSA brought key government, academic and industry bodies and NGOs together in a new Water Research Partnership, to develop [a Water Research and Innovation Framework](#) for the UK by end 2011.
- Foresight project on Global Food and Farming Futures launched.

February 2011

- GCSA visited Washington to discuss the Foresight Global Food and Farming Futures report with organisations such as USAID and the World Bank, and space weather issues with US and other colleagues.

March 2011

- GCSA convened leading scientists and policy officials to review understanding on [potential climate "tipping points"](#) and early warning signals, and to identify research and monitoring priorities and policy implications.
- GO-Science participated in Exercise Watermark, a national exercise to assess the UK response to flooding.
- SAGE was called in response to [events at the Fukushima nuclear site in Japan](#) following a massive earthquake and tsunami.

Working across government

The GCSA advises the Prime Minister and Cabinet on science and engineering issues.

Civil contingencies

Contingency planning includes monitoring and assessing threats and hazards – for example, terrorism or pandemic disease – planning to mitigate the risk, and carrying out research and evaluation to ensure that plans are robust. Exercises and training are then used to verify suitability of the plans. Two areas with which GCSA and GO-Science have been particularly involved are in developing the safety and security needs of the 2010 Olympic Games and supporting the UK's Counter Terrorism Strategy (CONTEST) programme.

Blackett reviews

A Blackett review panel consists of a small number of academics and industry experts who have a wide range of interests focused around a particular topic, with a few key government attendees such as CSAs.

The GCSA chaired two Blackett review panels in 2010. The group convened in spring 2010 considered cyber security issues from a Government perspective; the group convened in late 2010 explored how best Government could identify and plan for high impact / low probability 'black swan' events. Recommendations from both these review panels are being taken forward by the relevant government departments.

Strategic Defence and Security Review

The GO-Science Civil Contingencies team supported the development of the National Security Strategy and the Strategic Defence and Security Review (SDSR), which the Government published in October 2010. The team continues to support the strategies set out in these documents, particularly those dependent on science and technology capabilities, and works to ensure that individual departments and agencies take account of the needs of Government as a whole and make best use of available resources. Following the commitments made in the SDSR, GO-Science, working with the Cabinet Office, has set up an officials committee to advise the National Security Council on Science and Technology (S&T). The committee is chaired by the GCSA and, drawing from senior members of the policy and science community, provides advice on how the Government can best provide strategic direction S&T capability contributing to national security

Pandemic Influenza

Pandemic flu is a constant and significant threat to the UK. Science was an essential part of the Government's responding to the 2009 pandemic, with the GCSA co-chairing a Scientific Advisory Group for Emergencies (SAGE) with Professor Sir Gordon Duff.

Over the last year, the GCSA has continued to engage with UK pandemic influenza preparedness. In 2010, he gave evidence to the 'Hine Review: Independent review of the UK response to the 2009 influenza pandemic'. The review recommended that the GCSA work with the Department for Health to consider how in future a SAGE might best communicate its advice (and any uncertainties in the science) to Ministers, the wider

scientific community and the public, and to review the way that planning scenarios are calculated. This work is ongoing.

Severe winter weather

December 2010 was the coldest recorded for some years, and the Government's response to this was subject to significant media and Parliamentary scrutiny. To inform resilience planning and investment by the transport sector, the Secretary of State for Transport sought the GCSA's advice on the likelihood of severe winter weather recurring over the coming two to three decades, in the context of a changing climate. This advice was provided within a week, and GO-Science continues to work with the Met Office and leading researchers on further improving UK capabilities for seasonal and decadal forecasting.

Space weather

Severe space weather, such as solar flares, has the power to adversely affect the integrity of the world's power grids, the accuracy and availability of GPS, the reliability of satellite-delivered telecommunications and the utility of radio and over-the-horizon radar. Space weather events can happen at any time but tend to become more severe and more frequent in roughly 11-year cycles. The peak of the current cycle is expected in 2011-12.

During his visit to Washington in February 2011, the GCSA took part in a panel discussion on space weather at the annual meeting of the American Association for the Advancement of Science (AAAS). Scientists, planners and emergency managers from around the globe discussed their concerns and the risks this phenomenon poses to societal and economic well-being and national security. Joint US-UK interests in this area were underlined by the GCSA's attending a meeting at the White House to explore the potential risks of space weather, and consider their mitigation, and by his publishing jointly with President Obama's Scientific Adviser Professor John Holdren an article on this issue in the International Herald Tribune in March 2011.

Natural hazards

Icelandic volcanic ash

In April 2010, the eruption of the Eyjafjallajökull volcano in Iceland caused significant disruption to UK airspace. As a result, a Scientific Advisory Group for Emergencies (SAGE) was activated to support COBR (Cabinet Office Briefing Rooms). The GCSA chaired this group supported by officials from GO-Science and the Cabinet Office.

SAGE members included independent and government experts, CSAs from several government departments and a representative from the Civil Aviation Authority. SAGE met four times between 21 April and 24 June 2010.



Right: Eyjafjallajökull volcanic ash
© The Natural Environment Research Council (NERC)

To strengthen international cooperation in this area, a memorandum of understanding was signed between the UK and Icelandic governments in December 2010. GO-Science continues to work with national and international partners to develop ways to better understand and respond to these types of events.

Alkaline waste spillage in Hungary

Following the spill of alkaline waste after a dam collapsed at an aluminium processing plant in Hungary, the Prime Minister promised his Hungarian counterpart the UK's assistance. The GCSA organised for a delegation of leading experts from the British Geological Survey and Newcastle University to visit the site and help assess the impacts of the spill including how vulnerability to future spills could be reduced. The contribution from UK science to addressing the problem was recognised as extremely valuable by the Hungarian Government.



Damage caused by alkaline waste spill in Hungary, November 2010

Japanese nuclear incident

On 11 March 2011, Japan was hit by a magnitude 9.0 earthquake. The resultant tsunami devastated large areas of the North Eastern Coast of Japan resulting in significant loss of life and causing extensive damage to The Fukushima No 1 nuclear power facility.

SAGE was activated to advise Cabinet on the UK response to the incident and to provide advice on the implications of a potential radioactive release from the Fukushima plant for British Nationals in Japan. GO-Science worked with key government departments, agencies (Health and Safety Executive Nuclear Directorate, Health Protection Agency, Met Office and others), external academics and international partners to understand the situation on the ground, to develop possible scenarios and to assess their impact.

SAGE based its advice on the likelihood and impact of the reasonable worst case scenario, which include possible core meltdowns in the damaged reactors. Its advice was that there was no significant radiation hazard in Tokyo that would lead to the need to evacuate.

In addition to advice to COBR, the GCSA held a number of teleconferences with British Nationals, through the UK Embassy in Tokyo, providing information on the implications of on-going events and answering questions from members of the community. The transcripts of these teleconferences were posted on the Embassy website. This advice attracted significant interest from both National and International press. The SAGE advice was seen as the authoritative source of science information by the broader expat community in Japan and was recommended as an important source of advice by the Japanese authorities.

The advice provided by SAGE, and the GCSA's role in communicating this advice, has been greatly appreciated in Japan. The Japanese Foreign Minister specifically met the GCSA to discuss these issues when visiting London and thanked the UK for providing proportionate

and evidence based advice to its Nationals. The GCSA also visited Japan in May 2011 to discuss a range of issues arising from the events at Fukushima with key Japanese academics and Government Officials.

Health and biotechnology

UK Nanotechnologies Strategy

GO-Science coordinated the production of the UK Nanotechnologies strategy. Published in March 2010, the Strategy was informed by the views of a wide range of interested parties including academia, industry and non-governmental organisations following an evidence gathering exercise in 2009.

It sets out commitments from across government to support the safe development of these technologies to deliver improvements for consumers in the UK, help to sustain continued recovery and growth in the UK manufacturing industry and contribute to our effort to tackle global challenges.³

Food, water and energy

Food research and innovation

In January 2010, the GCSA launched a cross-Government Strategy for Food Research and Innovation.⁴ The Strategy provides an overarching framework for the UK Government and Devolved Administrations to develop and disseminate new knowledge, technologies and skills, and to deliver the evidence to support effective, joined-up policies. A critical element involves strengthening partnerships across organisations, disciplines and sectors to address social, environmental, health and economic challenges.

Achieving the Government's vision for a sustainable, secure food system will require an adequate supply of highly skilled people: to provide the research to support effective, joined-up policies; to develop and disseminate new knowledge and technologies; and to exploit the opportunities for innovation.

In March 2010, the Food Research Partnership, a body chaired by the GCSA and comprising senior representatives from Government, academia, industry and consumer organisations, published a report examining the issues around high-level skills in the agriculture and food sectors, and identifying priorities for action.⁵

Tackling UK and global challenges on water

Science and innovation have a major role to play in addressing UK and global challenges on water; challenges which are only set to increase ahead as the impacts of climate change, population growth and other drivers become more acute in the decades ahead. In January 2011, the GCSA led in establishing a new Water Research Partnership, bringing together key government, research and industry bodies and NGOs to jointly develop a UK Water Research and Innovation Framework by the end of the 2011.

³ <http://www.bis.gov.uk/assets/BISPartners/GoScience/Docs/U/10-825-uk-nanotechnologies-strategy>

⁴ <http://www.bis.gov.uk/assets/bispartners/goscience/docs/c/cross-government-food-research-strategy.pdf>

⁵ <http://www.bis.gov.uk/assets/bispartners/goscience/docs/h/10-929-high-level-skills-for-food.pdf>

New tool for reducing greenhouse gas emissions

The GCSA led a review of the science, engineering and other evidence underpinning the development of the DECC 2050 calculator – an innovative new tool developed to help policy makers explore pathways for meeting the Government's target to reduce greenhouse gas emissions by 80% in 2050. The tool, which is available online, also provides an excellent means for the public to investigate the options and challenges in meeting the UK's climate change goals.⁶



Climate science and the GO-Science website

The scientific evidence that climate change presents a major threat to our societies is clear and compelling. To help people better understand this evidence, together with the principles behind climate change and areas of uncertainty, the GCSA launched a new section of the GO-Science website. This explains the science underlying some of the most important climate change questions.⁷



Meeting HMG's Climate Science Advice Needs

In late November, GO-Science published a report examining the Government's needs for climate science advice over the next 5 to 10 years and how these can most effectively be met, focusing in particular on the role, resourcing and governance of the Met Office Hadley Centre.⁸

A key message was to reinforce the critical importance of climate science advice across a wide range of major policy areas and investments, on issues ranging from infrastructure development, flood risk management and security to supporting the UK's approach to international climate negotiations and helping developing countries to adapt. Recommendations from the report are now being considered by the relevant departments.

Climate "tipping points" event

As greenhouse gas concentrations in the atmosphere increase and global average temperatures rise, the risk of large scale, non-linear effects (sometimes referred to as climate 'tipping points') increases. Effects could include, for example, changes to the Indian or West African monsoons, die back of the Amazon forest, or changes in ocean currents.

In March 2011, the GCSA brought together leading scientists with key government contacts to consider the state of knowledge on 'tipping points' and to review particular areas of risk; the potential for 'early warning signals'; and future research and monitoring priorities. An important area of follow up was whether current policy responses could mitigate potential effects and increase resilience.

⁶ http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx

⁷ <http://www.bis.gov.uk/go-science/climatescience>

⁸ <http://www.bis.gov.uk/go-science/science-in-government/global-issues/climate-change>

Resources for science

2010 Spending Review

Throughout the 2010 Spending Review, the GCSA worked closely with colleagues in HM Treasury, the network of analytical professions and departmental CSAs.

The GCSA and departmental CSAs provided advice to Sir Adrian Smith, Director General Knowledge and Innovation in BIS, on public science spending ahead of the Autumn Spending Review.⁹

The Government reaffirmed the agreement that the GCSA and HM Treasury should be consulted in advance of any potential cuts to departmental research spend, and this has been enhanced to include professional analysis generally. The GCSA has worked with the Heads of Analysis Group in Government - which includes the heads of all the analytical professions in government (economics, social research, operational research, statistics, and science and engineering) - to look across the piece and to ensure decisions in relation to spending review outcomes are being taken in a strategic way.

⁹ <http://www.bis.gov.uk/assets/bispartners/goscience/docs/c/csa-advice-on-the-science-and-research-budget-11-june-2010.pdf>

Science in Government

GO-Science works to ensure that all levels of Government have access to the best scientific and engineering advice.

Guidance and advice

Principles of Scientific Advice to Government published

The dismissal of Professor David Nutt as Chair of the Advisory Council on the Misuse of Drugs (ACMD) by the then Home Secretary in November 2009 provoked debate across the UK scientific community on the relationship between the Government and its independent scientific advisers. The GCSA and the then Science Minister worked with the science and engineering community and the network of Scientific Advisory Committees (SACs) and Councils, of which ACMD is one, to develop a set of principles on the 'rules of engagement' between Government and those who provide independent scientific and engineering advice.

Following the General Election, in May 2010 the new Government affirmed its commitment to ensuring the provision, and proper consideration, of independent scientific advice. This was demonstrated by the inclusion of a reference to the Principles in the revised Ministerial Code issued by the Cabinet Office in May 2010.

GCSA's Guidelines published

The Guidelines on the Use of Science and Engineering Advice in Policy Making were first published in 1997 by the then GCSA Professor Robert May (now Lord May of Oxford). They were developed following notable instances of problems in the use of science by Government, for example during the BSE crisis. The Guidelines were revised for a third time in 2010 following a public consultation. This ensured that they remain up to date and relevant for departments and other users. The revised Guidelines continue to form a cornerstone of the GCSA's engagement with departments.

Code of Practice for Scientific Advisory Committees

In developing the 'Principles of Scientific Advice to Government' a number of issues were raised around the working of SACs, such as how SAC Chairs engage with the media. Good practice on such issues is set out in the Code of Practice for Scientific Advisory Committees (CoPSAC), which had last been revised in 2007.

In the light of the publication of the Principles and the updated Guidelines (above), the GCSA decided to consult on updating CoPSAC.¹⁰ In addition to a public consultation, discussions were held with SAC Chairs and secretariats. These engagement activities concluded that CoPSAC provided clear and valued guidance, but that some additional information and updating was warranted (for example on handling disagreements). The Government's response to the consultation and the revised Code of Practice will be published in 2011.

¹⁰ <http://www.bis.gov.uk/consultations/code-of-practice-for-scientific-advisory-committees-consultation-document>

Science and Engineering Assurance

Purpose

The GCSA's Science and Engineering Assurance (SEA) programme has been developed to provide departments and their stakeholders with credible, externally verified assurance that their policies reflect the best evidence available.

Approach

The programme is:

- tailored to help departments maintain and exploit their science and engineering evidence base;
- targeted to help departments integrate science and engineering evidence into their policy development and delivery; and
- designed to minimise the administrative burden on departments during the review.



Completed reviews

Three reports were published in autumn 2010.¹¹ These covered DfT, DfE and BIS.

Department for Transport

The DfT review identified a strong commitment to evidence-based policy making. However, practice in using science and engineering was found to vary across the department.

The report made 10 recommendations to help the department get all areas up to the best possible standards. Some key ones were to:

- develop better links between business planning and research;
- take a more 'systems based' approach to issues;
- put in place processes to ensure that science and engineering evidence is considered in relevant policy decisions;
- ensure stronger evaluation of available research; and
- develop a plan for sustainable science and engineering skills.

Department for Education

The DfE review made a strong positive assessment of the use of science and analysis by the department, and highlighted its properly using all analytical evidence to inform policy-making. The report described several areas of good practice and made twelve strategic recommendations, some examples were:

¹¹ <http://www.bis.gov.uk/go-science/science-in-government/reviewing-science-and-engineering/completed-reviews>

- to embed fully the department's evidence-based framework for policy making and delivery;
- the early involvement of analysts in policy making;
- to encourage evidence-based policy delivery among frontline delivery partners;
- the periodic review of the evidence base during policy development;
- to identify how to transfer best practice from international initiatives and evidence; and
- strengthen multi-disciplinary working.

Department for Business, Innovation & Skills

The BIS report highlighted a number of positive steps that the department had taken to improve its use of science and engineering. However, the review also identified that, with successive machinery of government changes, the resourcing and organisation of science and engineering evidence and advice have not always been given the priority that was needed. The report made six recommendations:

- ensure that science and engineering evidence is consistently, and routinely, used as a core part of strategy, policy development and decision-making;
- increase the resources allocated to the Chief Science Adviser (CSA) role to enable effective, sustainable delivery against the role's objectives;
- continue rolling out the Science and Technology, Technology, Engineering and Mathematics (STEM) Assurance Scheme across the department;
- develop plans for effective use of departmental science and engineering skills and expertise;
- ensure robust and systematic identification and utilisation of high-quality advice from a range of sources; and
- improve communications with stakeholders to ensure that the level of advice and use is transparent and well-documented.

Government Science & Engineering (GSE)

GSE Annual Conference

2010 and 2011 saw the second and third Government Science & Engineering (GSE) Annual Conferences take place. The overarching themes of these events were infrastructure and international collaboration in science and engineering, respectively.

On each occasion, scientists and engineers from across government departments gathered to hear presentations from the GCSA, Government Ministers and high-profile speakers from industry, academia and across the Civil Service. They also took part in breakout sessions covering, in 2010 for example, issues such as the impact of the Oyster card on



Sir John delivering his opening speech at 2010 GSE Annual Conference

London's transport infrastructure.

Building on the success of 2009's inaugural event, the 2010 and 2011 conferences didn't disappoint. Indeed, 95% of people said that the second annual conference was both enjoyable and useful.

Health and Safety Laboratories Field Trip – The Science of Safety

In a departure from the usual conference format, a GSE event entitled the 'Science of Safety', took 60 members to the state-of-the-art Health and Safety Laboratories (HSL) in Buxton, Derbyshire.

Delegates toured the indoor laboratories as well as the 550 acre outdoor facility where larger scale 'energetic' experiments take place. In particular HSL staged a demonstration of a hydrogen burn, which requires special thermal imaging equipment to observe.

Planning for our Future Careers Event

In July 2010, the GCSA hosted a workshop for 200 GSE members on science and engineering careers in the Civil Service. A document was produced that set out various facts and figures based on the data provided by the GSE's 3000+ members. The list of the various occupations identified in the GSE membership identified over 700 different areas of expertise, from 'bivalve hygiene specialist' to 'stealth technologist' and provides a useful source of information on the types of careers that are available.

GO-Science promotes joined-up working

GSE Intranet relaunched

Networking and knowledge exchange are some of the most valued aspects of GSE membership. As such, over August 2010, work took place to develop a GSE intranet page on 'Civil Pages'; a secure online space for cross-government collaboration. GSE members can now visit the site to find news stories concerning science and engineering across government, job postings, relevant documents, and discussion threads. The site is accessible to everyone on the Government Secure Intranet.¹²

Royal Society Pairing Scheme

The Royal Society has since 2001 run a pairing scheme between MPs and scientists. The aim of the scheme is to help build bridges between Parliamentarians and some of the best scientific researchers in the UK. Through a partnership with the GSE community, in 2009 it expanded to pair Civil Servants with scientists and the scheme was repeated in 2010.

As well as giving Civil Servants the opportunity to understand, or re-engage with, the research process and explore methods of sharing knowledge with scientists, the scheme also helps scientists recognise the potential methods and structures through which they can feed their scientific knowledge to Parliament and government.

¹² <http://www.civilpages.gsi.gov.uk/display/gseopen/Home>



Above: delegates at Royal Society Pairing Scheme launch

Royal Academy of Engineering Development Programme established

Over 1000 members of GSE identify themselves as having a background in engineering. To build on this, work with the Royal Academy of Engineering (RAEng) on a pilot development programme for GSE members has put in train. Twenty-six GSE members were selected following a short application process, and those members gained access to the full suite of RAEng development activities including lectures, events, training courses and work placements.

The participants met the GCSA and the Chief Executive of the Royal Academy (Philip Greenish), at a special reception in October. This first programme has only recently completed, and lessons learned will be used to inform future initiatives.



Left: RAEng flyer

Council for Science and Technology

CST responds to questions raised by the Prime Minister and Cabinet colleagues and proactively provides advice on strategic issues.

A Vision for UK Research

In 2010, the Prime Minister asked the CST to examine:

- how to ensure the UK research base maintains its high level of performance and productivity and the outputs are maximised in terms of economic and social impacts;
- how we continue to maintain our global position;
- how to optimise business pull and research push; and
- how to recruit, train, reward and retain the best talent.

CST published its findings in 'A Vision for UK Research' ahead of the Spending Review. It concluded that the UK must continue to be a confident global player in research, knowing our strengths, punching above our weight and acting as a magnet for global investment.

Digital Infrastructure



Late last year, CST wrote to Ministers with recommendations for improving the UK digital infrastructure. In particular, the Council was concerned that current infrastructure may not be adequate in terms of both speed and penetration. It also identified a need to better understand the 'people dimension', and for the full use of research evidence. It was also recommended that the Government more clearly signal its intention to deliver public services electronically in order to stimulate take-up of superfast broadband.

How Academia and Government Can Work Together

The 2008 CST report "How Academia and Government Can Work Together" challenged the Government to improve the way it draws on the knowledge base in the UK's world-class academic institutions.¹³ A 10-point plan was published in 2009, and during 2010 GO-Science continued to take this forward. For example, the GCSA hosted a seminar at the Royal Society to raise the awareness among senior academics of the work of departmental CSAs and the opportunities for working with Government.

CST for the future

The Council is being reconfigured during 2011 to include five re-appointed members, four ex-officios appointments including the Presidents of the Royal Society, The Royal Academy of Engineering, the Academy of Medical Sciences and the British Academy as well as eleven new members who are currently being recruited. The refreshed membership of the CST will be announced by the Prime Minister in June 2011.

¹³ <http://www.bis.gov.uk/assets/bispartners/cst/docs/files/whats-new/08-1556-academia-government.pdf>

Science in Parliament

The Science and Technology Select Committees in both the House of Commons and the House of Lords play an important role in holding Government's policies on science and on its use of science and engineering to account.

House of Commons Science and Technology Select Committee

Over the last eighteen months, the GCSA has given oral evidence to the House of Commons Committee as part of particular inquiries (for example on the use of scientific advice and evidence in emergencies), and in a session that drew on the 2009 GO-Science Annual Review to explore the Office's performance, effectiveness and achievements

In addition to supporting the GCSA's oral evidence to the Select Committee, GO-Science led in developing the Government's response to the Committee's report 'The Reviews into the University of East Anglia Climatic Change Research Unit's emails'. This response addressed, amongst other things, the key principles and complexities related to transparency and data sharing as part of the scientific process and the application of the Freedom of Information Act to scientific research.

House of Lords Science and Technology Select Committee

During the 2010-11 Parliamentary session, the GCSA appeared before the House of Lords Committee to provide oral evidence on the implications of the Spending Review for scientific research. This followed the GCSA and GO-Science officials being involved in the preparation of the Government response to the Committee's inquiry 'Setting priorities for publicly funded research'.

A strategic approach to the future

Since its creation in 1994 the Foresight Programme has helped Government to think systematically about the future.

Foresight programme

Foresight's strength lies in its ability to influence and inform policy, through evidence-based, peer reviewed strategic insights.



Foresight does this in three ways:

- Foresight projects are in-depth studies looking at major issues up to 100 years in the future;
- The Foresight Horizon Scanning Centre does short projects looking at more discrete issues 10-15 years in the future;
- Foresight Toolkits and Networks strengthen futures thinking capacity and share best practice within and across government.

Highlights from the Foresight Programme

Land Use Futures

The Foresight report on Land Use Futures, published in February 2010, argued for strategic objectives for land to guide future land use change as the UK's land system comes under new pressures in the 21st century.

The project identified land as a precious and uniquely versatile national resource – it provides natural resources, such as minerals, fertile soils and services which people value such as acting as a catchment for water, regulating flood waters, supporting biodiversity and locking away carbon.

The final report concluded that the present way the land system is managed in the UK will need to change: 'business as usual' is not an option for the long term. Since the Second World War, there have been major changes to how land use is managed, for example, in preventing urban sprawl and protecting the most valued landscapes. However, the project has shown that the next 50 years will bring new challenges and new demands from a combination of factors including:

- climate change;
- an ageing and growing population with more people living alone;
- the rise of the low carbon agenda; and
- society's rising expectations associated with growing incomes, for example, more space for living and better transport.

The report argued that policy makers need to be much smarter about how land use is managed in the future to protect what people value whilst managing new pressures on land. Future decisions will be needed on crucial issues such as how to balance local and national interests; what is the appropriate mix of market incentives and regulation to guide future land use change, and how government can improve the strategic use of space and assets when land is mostly under private ownership.

Since the report's publication, the Foresight Follow-up Team has worked with government departments and other stakeholders to explore how the evidence base from the report might be used to inform policy and strategic thinking. For example, Defra has used the report in developing the consultation exercise for the Natural Environment White Paper and in taking forward the National Ecosystem Assessment.

Global Food and Farming Futures

The Foresight project Global Food and Farming Futures report, published in February 2011, explored how a future global population of 9 billion people could all be fed healthily and sustainably.

The report emphasises that we are at a unique moment in history as diverse factors such as changes in the climate; competition for resources, for example water supply and energy; and changing consumption patterns converge and provide considerable challenges to sustaining the world's food supply. Whilst the global food system currently delivers for many, it is failing in two critical ways; consuming the world's natural resources at an unsustainable rate; and failing the very poorest, with almost one billion of the least advantaged and most vulnerable people still suffering from hunger and malnutrition.

Key messages from the report were:

- Waste must be minimised in all areas of the food chain: An amount of food equivalent to about a quarter of today's annual production could potentially be saved by 2050 if the current estimate of global food waste is halved.
- Focus on sustainability: The application of existing knowledge and technology could increase average yields two- to threefold in many parts of Africa, and twofold in the Russian Federation. Similarly, global productivity in aquaculture could, with limited changes to inputs, be raised by around 40%.
- Improving governance of the global food system: It is important to reduce subsidies and trade barriers that disadvantage poor countries. The project's economic modelling shows how trade restrictions can amplify shocks in the food system, raising prices further.
- Knowledge is power: Investment in new science and technology could raise the limits of sustainable production and address new threats. No one technology or type of research will be a silver bullet for addressing sustainable production (all can contribute something). We will need to increase our understanding of animals to improve yields while still increasing water, nutrient and other efficiencies. Also, we will need to prioritise research on climate change adaptation and mitigation in the food system, for example, producing crops that are drought and flood resistant.

The project report attracted the immediate attention of multiple UK and international stakeholders, and has already begun to make an impact on the international policy and research community. The UK Government is working closely with Foresight and the lead

experts to facilitate the report's impact on several areas of policy development; for example, in trade reform and markets, sustainable intensification, biodiversity, and ending hunger.

Computer Trading in Financial Markets



Foresight's latest project, announced in November 2010 is investigating the challenges and opportunities presented by technological advances in financial markets worldwide.

In recent years the ways in which financial markets operate have been transformed by fast-paced technological progress. For example, the volume of financial products traded through computer automated trading - taking place at high speed and with little human involvement - has increased substantially in the past few years.

Today, over one-third of the UK's equity trading volume is generated through high frequency automated computer trading while in the US this figure is closer to three-quarters.

This project, sponsored by HMT and led by the GCSA, aims to make a significant contribution to the efficiency, integrity and resilience of financial markets, by identifying options for policy makers in the UK and internationally. It will explore how computer generated trading in financial markets might evolve over the next decade or more, and how this will affect:

- financial stability;
- integrity of financial markets, including price information and liquidity;
- competition;
- market efficiency in allocating capital;
- transaction costs on access to finance; and
- future role and location of capital markets.

It will also assess options for addressing the challenges ahead, and consider how the opportunities offered by advancements in computer technologies could be capitalised upon by the financial sector.

The project is due to be published in autumn 2012.

Foresight Horizon Scanning Centre

Technology Innovation Futures (TIF) is a forward look at a range of developments which have the potential over the next 20 years to support sustained economic growth in the UK. As the UK comes out of the economic downturn, it seems likely that future economic prosperity will derive in large part from seizing opportunities offered by technologies such as these.

Published in November 2010, the report concluded that there are strong opportunities for growth in the UK economy through the 2020s if businesses can harness scientific and industrial capabilities to take advantage of technology developments. It identified three potential



areas of growth which could be transformative: manufacturing, infrastructure and the internet.

Other areas highlighted by the report are the energy transition which the UK will undergo during the next 10-20 years, the UK's research and development efforts in new materials which could help realise the move to a low carbon economy, the potential of the market for regenerative medicine and the increasing importance of intellectual property - all of which offer opportunities for UK companies.

International Dimensions of Climate Change

The Foresight project on International Dimensions of Climate Change aims to improve our understanding of how climate change in other parts of the world could affect the UK.

The Climate Change Act requires the government to undertake a Climate Change Risk Assessment (CCRA) for the UK, the first of which will be laid in Parliament by January 2012. The Climate Change Act also requires Defra to create a national adaptation policy programme: the CCRA is the central evidence source that will prioritise this policy programme. This project, co-funded by Defra and DECC, will enhance the evidence base of the CCRA to ensure that the government's policy on adaptation to climate change takes appropriate account of international impacts.

The project is now reaching completion. It has identified a broad range of impacts that climate change could have on the UK, including possible opportunities and threats. These cover global governance and institutions; security; behaviour and movement; physical resources and commodities; overseas infrastructure; financial services; and health.

The project will publish its findings in summer 2011.

Foresight's impact

Foresight has a dedicated team that works across government to catalyse action and to help departments to take up the findings from the projects. In 2010, Foresight published the one-year review of impact from the Mental Capital and Wellbeing project which set out where the report has played a significant part in helping shape several key government policies reflecting the growing recognition and importance of positive mental health and wellbeing. The report has also had an important role in the development of Research Councils' five-year strategic plans; for example, in the areas of skills development and the resilience to disease.

The review of the Sustainable Energy Management and Built Environment report, also published in 2010, highlights how the project provided valuable analysis to inform the actions government might take in meeting the Climate Change Act's target of 80% decarbonisation by 2050. The study has also been used to inform the development of local scale initiatives in building and retrofitting technologies and energy systems which will make important contributions to greening the built environment.

International engagement

The GCSA and GO-Science engages with international issues and events.

Representing the UK internationally

The GCSA and members of GO-Science participated in a number of international events including a Foresight presentation in South Korea, and strategic discussions in Brussels with a number of Commissioners and Directors General, and a visit by the GCSA to both Paris and the Netherlands to discuss opportunities for scientific collaboration. Four high profile events are described below.

The Kyoto Science and Technology in Society Forum

The GCSA travelled to Japan in October 2010. He gave keynote speeches at the Royal Society's Tokyo celebration of their 350th anniversary and at the Science and Technology in Society Forum.

The Kyoto Science and Technology in Society (STS) Forum is an international science symposium which takes place every October in Kyoto, Japan. Inaugurated in 2004, the Forum brings together policy makers, business leaders, scientists and opinion formers from around the world to discuss science and technology issues and potential problems involving science and its application in society.

In addition to his keynote speech on future energy challenges, the GCSA also spoke with the Japanese media about climate science and chaired a discussion on sustainable agriculture and climate change. In the margins of the conference he also held bilateral meetings with Ministers, advisers and other senior figures from countries including the US, Thailand, Vietnam and Germany to take forward the UK's agenda on international science collaboration.

Right: The GCSA, Sir John Beddington, delivering his keynote speech to STS Forum



The Carnegie Group - Toronto

In November the Canadian Government hosted the 2010 Carnegie Group meeting, an annual congregation of Science Ministers and Advisers from G8+5 countries. The GCSA represented the UK.

Established in 1990, the Carnegie Group meets informally each autumn. At the 2010 gathering, participants discussed a number of scientific issues including global research infrastructure, carbon capture and storage, the digital economy and innovation for growth.

The GCSA used the forum to raise awareness of the damaging effects on health that substandard and counterfeit medicines can have, particularly in the developing world.

Biennial UK-India Science and Innovation Council

The GCSA moderated the biennial UK-India Science and Innovation Council with his Indian counterpart in New Delhi. This Ministerial-level meeting provided an opportunity for the UK and India to agree the direction of bilateral science and innovation collaboration for the next two years. Highlights of the 2010 Council included the agreement of jointly funded research projects worth £70 million in areas including energy, food security, water and health, as well as increased engagement on innovation, a renewed focus on basic science including mathematics and computer science, and improving the mobility of young scientists.



Above: Signing of the Civil Nuclear Co-operation Declaration, 11/2/2010, New Delhi

From left to right: Chris Darby, Head of Science and Innovation Network India; Richard Buttrey, Science and Innovation Adviser; Dr Banerjee, Chairman and Secretary of the Indian Department of Atomic Energy; Sir John Beddington, Government Chief Scientific Adviser; Sir Richard Stagg, British High Commissioner; Rebecca Fairbairn, Head of Science and Innovation, Bangalore; Mr. R. N. Prasad, Joint Secretary (Europe West) Ministry of External Affairs (no longer in position)

Washington

In February 2011, the GCSA travelled to Washington to participate in the annual meeting of the AAAS. During the meeting, he gave a keynote lecture on the recently launched Foresight Food and Farming Futures report and participated in a panel discussion on space weather (see earlier).

In addition to attending the AAAS meeting, the GCSA met with senior officials from organisations such as the World Bank, USAID and the National Academy of Sciences to discuss opportunities for UK-US collaboration and cooperation, and held bilateral meetings with, for example the President's science adviser, John Holdren, and the Energy Secretary, Professor Steven Chu.

Global Science and Innovation Forum (GSIF)

Twice a year the GCSA chairs the Global Science and Innovation Forum which brings together those involved in international aspects of science and innovation, both across Government and its key stakeholders.

The Forum aims to improve coordination of UK engagement internationally and during 2010 it provided strategic input into the development of the UK's position on the European 'Research and Development Framework Programme 8'. The group also worked with the Home Office to ensure the needs of scientists, researchers and innovators were fully considered in the development of migration and visa policy. GSIF members gave high level advice on where the UK should place diplomats in its 'Science and Innovation Network' around the world and also completed a project that will deliver closer working between UK partners in China.

Annex: Key publications

- Climate Change Committee's report
- <http://www.theccc.org.uk/reports/low-carbon-innovation>
- Consultation on the Code of Practice for Scientific Advisory Committees
- <http://www.bis.gov.uk/consultations/code-of-practice-for-scientific-advisory-committees-consultation-document>
- Cross-Government Strategy for Food Research and Innovation
- <http://www.bis.gov.uk/assets/bispartners/goscience/docs/c/cross-government-food-research-strategy.pdf>
- CST report on 'How Academia and Government Can Work Together'
- <http://www.bis.gov.uk/assets/bispartners/cst/docs/files/whats-new/08-1556-academia-government.pdf>
- DECC (Department for Environment and Climate Change) 2050 calculator to assess greenhouse gas emissions
- http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/2050/2050.aspx
- Food Research Partnership's report on issues around high-level skills in the agriculture and food sectors
- <http://www.bis.gov.uk/assets/bispartners/goscience/docs/h/10-929-high-level-skills-for-food.pdf>
- Foresight
- <http://www.bis.gov.uk/foresight/our-work/projects>
- Foresight Horizon Scanning Centre
- <http://www.bis.gov.uk/foresight/our-work/horizon-scanning-centre>
- GO-Science's new website on climate change
- <http://www.bis.gov.uk/go-science/climatescience>
- GO-Science's report on the Government's needs for climate science advice
- <http://www.bis.gov.uk/go-science/science-in-government/global-issues/climate-change>
- Government Science and Engineering Civil Pages
- <http://www.civilpages.gsi.gov.uk/display/gseopen/Home>
- Science and Engineering Assurance Review
- <http://www.bis.gov.uk/go-science/science-in-government/reviewing-science-and-engineering/completed-reviews>
- Spending Review 2010 – GCSA's advice to Government on public science spending
- <http://www.bis.gov.uk/assets/bispartners/goscience/docs/c/csa-advice-on-the-science-and-research-budget-11-june-2010.pdf>
- The British Science Festival held in Birmingham in September

- <http://www.bis.gov.uk/news/topstories/2010/Sep/british-science-festival>
- The Council for Science and Technology (CST)
- www.bis.gov.uk/cst
- UK Nanotechnology Strategy
<http://www.bis.gov.uk/assets/BISPartners/GoScience/Docs/U/10-825-uk-nanotechnologies-strategy>

Annex: Acronyms

BIS – Department for Business, Innovation and Skills

COBR – Cabinet Office Briefing Rooms

CoPSAC – Code of Practice for Scientific Advisory Committees

CONTEST – Counter Terrorism Strategy

CSA – Chief Scientific Adviser

CSAC – Chief Scientific Advisers Committee

CST – Council for Science and Technology

DEFRA – Department for Environment, Food and Rural Affairs

GCSA – Government Chief Scientific Adviser

GO-Science – Government Office for Science

GSE – Government Science and Engineering

SAC – Scientific Advisory Committee or Council

SAGE – Scientific Advisory Group in Emergencies

SEA – Science and Engineering Assurance

SiG – Science in Government

STEM – Science, Technology, Engineering and Mathematics

Further information

Further information on the work of GO-Science is available at:

<http://www.bis.gov.uk/go-science>

Requests for information on the work of GO-Science should be sent to:

GO-Science@bis.gsi.gov.uk

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