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THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

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Green light for hydraulic fracturing

Energy and Climate Change Secretary Edward Davey announced on 13 December that exploratory hydraulic fracturing for shale gas can resume in the UK, subject to new controls to mitigate the risks of seismic activity.

To date there has been no commercial shale gas production in the UK. Exploratory drilling has been suspended since May 2011 after two small seismic tremors were detected near the country's only operations in Lancashire.

Following a detailed study and further analysis by an independent panel of experts commissioned by the Department of Energy and Climate Change, with feedback from a wide public consultation, and the benefit of the report by the Royal Society and Royal Academy of Engineering, the Government has concluded that the seismic risks associated with hydraulic fracturing can be managed effectively with controls.

New controls to mitigate seismic risks include:

- a prior review must be carried out to assess seismic risk and the existence of faults before fracturing operations begin;
- a plan must be submitted to DECC showing how seismic risks will be addressed;
- seismic monitoring must be carried out before, during and after fracturing;
- there will be a new traffic light system to categorise seismic activity and direct appropriate responses. A trigger mechanism will stop hydraulic fracturing operations in certain conditions.

These controls, along with the rest of the recommendations in the independent report into seismic activity and fracturing, commissioned by the Government and published in March this year, have been accepted by the Secretary of State.

The Secretary of State has also accepted all the recommendations of the report from the Royal Society and Royal Academy of Engineering which are relevant to Government. One further recommendation is being considered by the Research Councils.

A study of the possible impacts of shale gas development on greenhouse gas emissions and climate change will consider the available evidence on the lifecycle of greenhouse gas emissions from shale gas exploitation and the need for further research.

www.decc.gov.uk/en/content/cms/meeting_energy/oil_gas/shale_gas/shale_gas.aspx

Challenges for postgraduate education

A vibrant system of postgraduate education is vital if Britain is to achieve its ambition to be 'the leading knowledge-based economy of the world', yet postgraduates are almost entirely absent from the debate about the future of our higher education system, says a report from the Higher Education Commission.

Postgraduate Education, published at the end of October, argues that "a perfect storm is on the horizon for prospective postgraduates". They face higher tuition fees than any generation before them, coupled with financial institutions which are reluctant to lend money. Simultaneously, globalisation and changes in the UK's industrial base mean that postgraduate degrees are more important than ever before in getting ahead in the labour market.

The report is the product of an eight-month inquiry, chaired by Dr Graham Spittle, a member of the Prime Minister's Council for Science and Technology. The Higher Education Commission is an independent body made up of leaders from the education sector, the business community and the three major political parties.

The report calls for the postgraduate sector to be brought in from the cold and fully embraced as part of an integrated education system. It identifies policy shifts which will be needed to ensure that Britain remains a competitive place to do research and do business. It also explores access to postgraduate education, "the next frontier of widening participation", and argues that an emphasis is needed on the up-skilling of the UK population, ensuring that British students are able to compete in the global labour market. High numbers of international students cannot compensate for poor take-up of postgraduate education amongst home-domiciled students, it notes. The report also makes recommendations on how postgraduate provision should be funded in future.

www.policyconnect.org.uk/hec/sites/pol1-006/files/he_commission_-_post-graduate_education_2012.pdf

Green Investment Bank funds released

The Government declared the UK Green Investment Bank plc (UK GIB) officially open for business at the end of November and announced two new investments. UK GIB has been funded with £3 billion of Government money and will mobilise additional private capital.

Speaking in Edinburgh where the new bank is headquartered, Business Secretary Vince Cable revealed that UK GIB had made its first investment since becoming operational, committing an initial £8 million to a project in the North East of England that will generate energy from waste. This will attract a further £8 million of matching private sector funding. The investment, made through fund manager Greensphere Capital, is part of a £80 million investment programme by UK GIB in small waste projects. The Business Secretary also announced that UK GIB will invest £5 million to retrofit Kingspan's UK industrial facilities with systems and services that will reduce its energy consumption by as much as 15 per cent. This investment, through Sustainable Development Capital, is UK GIB's first project supported in its £100 million non-domestic energy efficiency investment programme.

Funding for SME healthcare research

Grants from the government-backed Biomedical Catalyst totalling £39 million have been awarded to 32 projects led by small and medium-sized businesses (SMEs) and universities to accelerate the development of innovative solutions to healthcare challenges.

These are the first substantial awards made from the £180 million Biomedical Catalyst, a programme of public funding jointly managed by the Technology Strategy Board and the Medical Research Council. The Biomedical Catalyst – announced by the Prime Minister David Cameron in December last year – is designed to deliver effective support for the best life science opportunities arising in the UK, enabling businesses and academics to speed-up the translation of scientific ideas into commercial propositions, for the greater benefit of patients.

A digital healthcare system that will provide early diagnosis of dementia, a universal flu vaccine that could protect against all known strains of the illness and a targeted therapy for the treatment of prostate cancer are just three of the planned innovations that will be evaluated, developed or demonstrated using the funding provided by the Biomedical Catalyst.

The Finch Report: where now?

John Enderby

Professor Sir John Enderby CBE FRS is the Editor of *FST Journal*. He was Professor of Physics at Bristol University from 1976 to 1996. He was elected a Fellow of the Royal Society in 1985 for his pioneering studies into the structure and properties of liquids and amorphous materials. He served as a Vice-President of the Royal Society from 1999-2004. One of his responsibilities was the Society's publishing activities. Sir John was President of the Institute of Physics in 2004. He was the Chief Scientist at IOP Publishing.

This issue's Editorial aims to identify some of the issues raised in the Finch Report on expanding access to research publications. It is certainly not the intention to take any particular stance but rather, by identifying the crucial decisions to be made, to encourage discussion among all those engaged in scholarly publishing, whether academics, publishers, funders, opinion formers or legislators.

Background

Although the beginnings of the Open Access (OA) movement can be traced back to the 1970s, the impetus for the present debate springs from a variety of developments in the period 1998-2006.

The *New Journal of Physics* (NJOP) was launched in 1998 as an online-only, open-access, peer-reviewed scientific journal covering research in all aspects of physics, as well as interdisciplinary topics where physics forms the central theme. NJOP is a joint publication of the Institute of Physics and the Deutsche Physikalische Gesellschaft.

In 2000, Harold Varmus, Patrick Brown and Michael Eisen launched an OA journal under the title *The Public Library of Science* (PLoS). In an open letter to the scientific community they wrote: "We support the establishment of an online public library that would provide the full contents of the published record of research and scholarly discourse in medicine and the life sciences in a freely accessible, fully searchable, interlinked form."

Further impetus towards the implementation of an OA policy arose from the Budapest (2002), Bethesda (2003), and Berlin (2003) declarations. The Berlin Declaration, for example, claims to build on the widely accepted Budapest Open Access Initiative, which called for the results of research produced by authors, without expectation of payment, to be made widely available on the Internet, and to carry permissions necessary for users to use and re-use results in a way that accelerates the pace of scholarship and research. The Declaration was signed by nearly 300 research institutions, libraries, archives, museums, funding agencies, and governments from around the world.

Major funders of research began to mandate grant recipients to publish their work in journals which were compliant with OA policies. Examples include the UK's Wellcome Trust and the USA-based Institutes of Health.

Shortly after the Berlin Declaration, the House of Commons Science and Technology Select Committee began its own inquiry, taking evidence from academics, funders and publishers. The general feeling emerged that the UK, as a leading player in research, should develop a clear policy on OA. Accordingly, in 2011 the Minister of State for Universities and Science, David Willetts, initiated a study chaired by Dame Janet Finch.

The report, published on 18 June 2012, recommended a programme of action to enable more people to read and use publications arising from research. According to the report, better and faster communication of research results will bring benefits for public services and for economic growth. It will also bring improved efficiency for researchers, and opportunities for more public engagement. The report goes on to say that the principle whereby the results of publicly-funded research should be freely accessible in the public domain is a compelling one, and fundamentally unanswerable.

Points of agreement

There is a general consensus among all those involved in scientific enterprise that:

a. the results of research should be put in the public domain so that its reliability and relevance to further developments and insights can be assessed;
b. there must be some form of quality control in order to avoid unnecessary diversion of effort by other researchers, as well as protecting the general public from misleading and in some cases life-threatening conclusions. With all its faults, most scientists accept that peer (or expert) review is the most effective method we have of quality control;
c. Open Access is not the same as free access because somewhere in the system, time and money must be found to satisfy (a) and (b) above;
d. any change in the business model away from the conventional one based on subscriptions must be robust and sustainable.

It is the detailed way in which these generally accepted principles are implemented that is at the root of ongoing discussion.

The issues

The first question is whether there is actually any need to change from the tried and tested model based on subscriptions. After all, as critics of OA point out, this model has demonstrated its sustainability ever since 1665 when Henry Oldenburg introduced to the world the first scientific journal, *Philosophical Transactions of the Royal Society*.

Surveys carried out focussing on authors seem to give mixed messages. When asked by Coonin and Younce about publications that required author fees, a majority of the respondents (56.1 per cent) said that they would not publish in journals that required a publication fee.

Russell and Kent from the University of Birmingham explored the motivations for researchers to choose OA and have concluded that researchers are not concerned about the business model but are solely interested in publishing their work in high-profile journals. From the authors' perspective, the ability to send papers to the journal of choice is hugely valued.

On the other hand, librarians, faced with decreasing budgets and ever-increasing journal prices (in fairness to publishers, price rises have moderated recently), believe there is a need to change from the present subscription-based model. Likewise, funders of research would like to see the results become widely accessible without the need for readers to pay anything.

Governments worldwide are broadly in favour of some sort of OA policy. For example, David Willetts welcomed the Finch Report, saying: "Removing paywalls that surround taxpayer-funded research will have real economic and social benefits. It will allow academics and businesses to develop and commercialise their research more easily and herald a new era of academic discovery."

The costs of publishing

The second issue is how to meet publication costs if the subscription base is removed. Finch recommends a clear policy direction in the UK towards 'Gold' OA publishing, where publishers receive revenues from authors rather than readers; research articles then become freely accessible to everyone *immediately* upon publication. This model involves Article Processing Charges (APCs). Research Councils UK (RCUK) supports this view, but does not rule out 'Green' OA whereby the final refereed version is placed in a repository which can be organised by discipline (e.g. *arXiv* for physics) or institution (e.g. *DASH* for Harvard). However, this would often involve a period where the publications were not generally available. The advantage, though, would be that when universities host OA repositories, they usually take steps to ensure long-term preservation.

The Finch Report recommended a programme of action to enable more people to read and use publications arising from research. According to the report, better and faster communication of research results will bring benefits for public services and for economic growth.

Mark Thorley, Convenor of the RCUK Research Outputs Network, points out that RCUK is not anti-Green but has a strong preference for Gold on the grounds that research papers become available immediately and avoid the embargo period usually associated with Green.

Some academics embrace neither Gold nor Green. Professor Tom Wilson, for example, wonders why Finch did not consider a collaborative, subsidised model which involves neither subscription nor author charges. The costs of production are borne either by voluntary labour or by the academic institution subsidising the work of editors and copy-editors.

If Gold becomes the standard model, a third issue relates to its funding. For research-intensive universities this is a critical issue. Professor Ian Walmsley, Pro-Vice Chancellor for Research at the University of Oxford, has estimated that the University's expenditure on publishing could rise by 350 per cent. RCUK has announced that from 1April 2013, a new OA policy will come into effect and that block grants will be paid to universities to support charges associated with Gold OA. The details of this funding arrangement will be made public later this year. Presumably, it will be cash limited so that universities have to manage a finite resource.

Academic freedom

This raises a fourth issue. Can the traditional freedom of academics to submit their work to any journal, irrespective of the APC, be maintained? It is difficult to see how this can be guaranteed, given the huge variation in APCs. In Physics, for example, *Physical Review Letters*, which is particularly well thought of by the community, has set its APC at $2,700. The justification offered by the publisher, the American Physical Society (APS), is that the rejection rate is high so that those papers which are published must cover the processing costs of those that are not. The APS also publishes *Physical Review X* which has a significantly higher acceptance rate than PRL and charges $1,500 per paper published. Likewise, *PLoS* (a non-profit organisation) charges $2,900 for *PLoS Biology*. For higher acceptance rate journals such as *PLoS One*, the APC is $1,350.

In short, the luxury of allowing authors to use high-cost journals as vehicles for their research papers might (depending precisely on how funders deal with Gold OA) have to be sacrificed. Is this acceptable?

Finally, there is the issue of costs involved in the transition to Gold OA. The Finch report recognises that there will be significant costs, but to quantify them is difficult as they depend on factors outside the control of the UK. The best estimate made by Finch is that there needs to be an additional expenditure of between £50-60 million a year.

Most publishers with established subscription-based journals have moved to a 'hybrid' solution such that those papers for which the APC has been paid will be treated as Gold. This will also involve additional costs as there will be extra administrative effort to record the two income streams. They will also need to consider how best to reduce subscription prices if the total APCs become a significant source of revenue so as to avoid what librarians call 'double dipping'. To what extent do participants regard these costs as (a) unavoidable and (b) reasonable? The debate will continue and I have no doubt that the Foundation for Science and Technology will wish to take part. □

www.researchinfonet.org/wp-content/uploads/2012/06/Finch-Group-report-FINAL-VERSION.pdf

What is the 'right' balance between competing primary energy sources for UK electricity generation? Will the economy or the environment be the deciding factor, or can both be accommodated in the future energy mix? These questions were debated at a meeting of the Foundation for Science and Technology on 7 November 2012.

Choosing the right options for future electricity supply

John Hayes

The Government aims to develop a new energy paradigm, one that has the right energy mix and can match supply with demand. That necessitates building a new generation of power plants, the infrastructure necessary to provide the heat and light we need. In order to achieve this new paradigm, a number of challenges have to be addressed, the objectives of energy policy set and then a suitable generation mix chosen to deliver these objectives.

The first challenge is that around 20GW, one-fifth of our existing power stations, is set to close over the coming decade. However, demand for electricity is set to rise as major sectors such as transport and heat are electrified. One scenario suggests that demand may double by 2050, but these things are immensely difficult to predict. It is clear that there is a real risk of tight capacity margins in the future compared to the relatively ample supply of recent times. So the first objective is to ensure security of supply.

Second, and of equal importance, is to achieve value for money for the taxpayer and the consumer by maintaining security of supply at minimum cost. Energy prices are as salient as ever – especially when, as now, energy costs are a threat to fragile growth and where households are watching their bills with increased vigilance.

The final challenge and objective is to do all this in a way that builds a cleaner energy future of Britain and the world – and indeed we have a statutory target to reduce greenhouse gas emissions by at least 80 per cent by 2050.

Diversity of supply

Diversity of supply is fundamental to delivering the secure, affordable, low-carbon energy sector entailed by those objectives. Diversity delivers security, reducing our reliance on any one technology, and lessens our exposure to international fuel prices. It helps keep bills down as generators compete against one another on price. It will reduce emissions as low-carbon technology plays an increasing role in the mix.

John Hayes MP is Minister of State for Energy at the Department for Energy and Climate Change (DECC). He has been the MP for South Holland and The Deepings since 1997. Before his current post, he was Minister of State for Further Education, Skills and Lifelong Learning. Previously he served as a Shadow Minister for a range of posts in food and farming, transport and education. He has been a member of Select Committees dealing with agriculture, administration and education.

The reforms being introduced in the Energy Bill do not support one specific technology; rather they are designed to encourage innovation and competition, and reward those generators that can provide clean, affordable, secure energy for consumers at the lowest price. Given the difficulty of modelling over many decades, by far the best public policy option is to build a system which is sustainable through not being over-reliant on any single technology. The system envisaged is as responsive to change as possible.

The essence of the Government's approach is to deliver more clarity, more certainty and more confidence, all of which are necessary to bring about investment. Long term contracts will provide clear, stable and predictable revenue streams for investors in low carbon electricity generation. The legislation will introduce a capacity market to provide insurance against future blackouts, with the aim of ensuring that consumers continue to benefit from reliable electricity supplies at an affordable cost.

The Bill's provisions were published in draft on 22 May 2012, providing Parliament and industry with an opportunity to consider the details. The Government recognised the importance of getting this right. There needs to be a cross-party consensus about long term energy strategy. Inevitably governments in democratic politics change from time to time and it is crucial that investors are not confronted with radical policy lurches. This is a Bill for the future, not just for this Parliament.

Renewable energy

What different energy sources will provide our future energy mix? First, renewable energy: it has an important role to play in helping us to reach our initial energy

DISCUSSION

Pay now or later?

The message of the Stern Report, that the cost of doing nothing will eventually be greater than acting now, has been ignored because the bigger cost will fall on future generations, not present voters. Is it possible in a democratic society to overcome this hurdle? China is cited as an example of a country which is pouring vast sums into demand reduction, energy security and environmental improvement. It is doing this now to redress a lack of past investment during a period of high economic growth which has led to unacceptable rises in local air pollution in some cities.

security goals. Last summer's Renewable Energy Roadmap put us on a path to meeting our emissions reduction targets while driving down the costs of these energy sources over time. There was at least £12.7 billion in investment and 20,000 jobs announced in renewables in the UK between April 2011 and July 2012. Renewable energy will become cheaper as it matures. All new technologies in their early stages are costly but as they grow in scale, costs can be expected to fall.

Nuclear energy

Nuclear is central to our emissions ambitions, indeed to the UK's emissions targets. There are currently nine nuclear power stations across the UK providing around 16 per cent of its electricity; yet on current plans all but one will close by 2023. Most of the nuclear stock was built a considerable time ago, with only one power station being constructed in recent times, in 1985. New nuclear is cost-competitive with other technologies and in the future is expected to be the lowest cost, large scale, low carbon source of electricity – so it can help keep bills down while also helping to meet national emissions targets.

Industry has set out a plan to develop up to 16GW of new nuclear power in the UK by 2025. Two consortia are currently taking forward plans to build new capacity, the first being EDF and Centrica, and the other NuGen – made up of GDF Suez and Iberdrola.

A third, Horizon, has been sold to Hitachi who have confirmed their intention to build two or three nuclear power units at Wylfa on Anglesey and the same at Oldbury in Gloucestershire. This is a very exciting development. The sale of Horizon is recognition that the prospects of developing nuclear power in the UK are real and attractive. Each new 3.2GW twin reactor has the potential to provide reliable, baseload electricity to over 5.7 million homes per annum. The Government has taken steps to make the UK one of the most attractive places in Europe for nuclear build.

Carbon Capture & Storage

The Government is firmly committed to the development and deployment of Carbon Capture & Storage (CCS) technology. We want to achieve a world-leading CCS industry that can compete with other low carbon sources to ensure security and diversity of our electricity supply. It can make the UK's energy-intensive industries cleaner, bringing jobs and creating wealth to the country.

DISCUSSION

Security of supply

For a democracy, security of supply must come first: no Government survives if the lights go out. Security of supply will not be delivered without huge investment; so the Government must aim to ensure that investment happens through incentivising the investors and, for some options, accepting the consequent carbon emissions.

The CCS commercialisation programme, with £1 billion in capital funding, was open to a full range of projects – four bids have now gone forward to a short, intensive phase of negotiations. Decisions on which projects will get further support will be taken early in 2013. The Government is also providing £125 million to support Research & Development. Contracts negotiated through the Electricity Market Reform (EMR) will provide the stable returns needed to drive investment and commercial scale CCS in the 2020s.

Gas

Gas, too, is bound to play an important part in this mix. It is a vital and flexible source of generation. In an era where intermittent renewables and inflexible baseload nuclear will play vital roles, the country will need the flexibility of gas generation to ensure that supply can meet demand.

Modern gas power stations are more efficient and much cleaner than their predecessors. Better efficiency means that more power is produced from less fuel with fewer CO_2 emissions. Gas-fired generating plant is not only less polluting than other fossil fuel plant, it is also much less expensive to build and much more efficient in operation.

Gas currently provides a significant proportion of electricity generation (around 40 per cent in 2011). The Government sees unabated gas playing a significant role in electricity generation throughout the 2020s – and as back-up or with CCS through the 2030s and '40s. It is clear that shale gas could have great potential but the regulatory framework must guarantee safety and assuage public fears.

The Government will set out its views on the role of gas in the electricity market in its Gas Generation Strategy. This aims to attract investment in gas generation, ensure security of supply and make best use of our natural resources. It is vital to maximise economic recovery of our indigenous hydrocarbon reserves. UK policies, including licensing, have ensured that the exploitation of the UK Continental Shelf has been an enormous success story – some 41 billion barrels of oil and gas have been produced so far, but up to 20 billion still remain.

The North Sea

The North Sea will remain important for decades to come. UK-produced oil and gas provide around half of the UK's primary energy needs and it must continue to make the most of these assets. The industry is also a strong contributor to the economy, supporting around 350,000 jobs directly and indirectly, plus 100,000 more in the export of goods and services.

The North Sea still attracts global investment. A new offshore round was launched in May this year and attracted the highest number of applications – 244 – since licensing began in 1964. The Government has in place a fiscal regime that encourages investment and innovation while ensuring a fair return for UK taxpayers. The successful exploitation of the UK Continental Shelf demonstrates what can happen when the regulatory and support frameworks are right.

The Electricity Market Reforms will create a new paradigm, one that does not rely on any single technology, rather one that rewards innovation, competition and the delivery of secure, affordable and clean energy. It will make the most of our ability to boost economic growth, make the most of the skills and jobs that will come from private sector investments – it will be a paradigm to deliver a better energy mix for a brighter future. □

In the weeks following the Minister's speech, the Government has published its Energy Bill and further announcements have been made regarding UK energy provision. The Energy Bill and associated documents can be found at: **www.decc.gov.uk/en/content/cms/legislation/energybill2012/energybill2012.aspx**

The role of nuclear power

Andrew Spurr

Since I started my career in engineering in 1975 there have been significant changes in energy policy. While security of supply and affordability have always been fundamental, environmental concerns have achieved the same priority in recent years.

The UK now faces major and far-reaching decisions which must be taken in a difficult economic context. Electricity is fundamental to our society. Yet the way we generate it is changing. North Sea gas is being depleted over the long term and we are increasingly dependent on imports from abroad. While shale gas should be investigated, even its advocates do not believe it will be the game-changer it has been in the USA.

The UK is required to reduce carbon emissions by at least 80 per cent by 2050. That will entail the almost total decarbonisation of electricity generation, yet 40 per cent of the country's generating capacity is due to come offline in the next 15 years and will need to be replaced.

The Department for Energy and Climate Change has estimated that replacement will cost around £110 billion over the next decade and a half, but all of this must be done in an affordable way to ensure fairness for customers and keep business internationally competitive.

The nuclear future

A key element in tomorrow's generating mix will be nuclear energy. Together with Centrica, EDF Energy wants to develop up to four new nuclear power reactors at two sites in the UK with the potential to deliver as much as 6.4GW of low-carbon, secure electricity. The first of these projects, at Hinkley in Somerset, is progressing well. Preparations to ready the site for construction are underway. Before moving ahead, EDF Energy requires a positive recommendation from the Planning Inspectorate – expected before the end of the year – with a subsequent decision by the Secretary of State for approval.

There have been three years of consultation with the local community, ending in an agreement with local councils for a £94 million package of impact mitigation measures. EDF Energy has been working with the regulators for four years to assess the chosen reactor design, the EPR. Negotiations are continuing with DECC to determine the funded decommissioning programme arrangements for decommissioning and long term waste management. Contracts worth nearly £1 billion have been signed with 400 UK companies across the supply chain. A preferred bidder has been selected for the £2.1 billion main civil works contract.

Dr Andrew Spurr is Managing Director, Nuclear Generation at EDF Energy. He has had a lifelong involvement in the nuclear industry. He has worked on the design and operation of nuclear stations and has been a station manager for Dungeness A and B nuclear power stations. In 2006 he was appointed Chief Technical Officer of British Energy and, following the integration with EDF Energy in 2009, was appointed to his current role.

Overall, the Hinkley Point C Project team, consents, contracts, and cost estimates will be ready around the end of the year. It is vital that the Energy Bill has completed its Second Reading in the Commons before Christmas so that we can progress to a final investment decision. Because we plan to make our final investment decision before the Bill receives Royal Assent, legally robust transitional arrangements that provide clarity and certainty for investors will also be essential.

A boost to the economy

The electricity market reforms are important not just in terms of our energy challenges. As the Energy Secretary said recently: "New nuclear build is part of a drive to develop an industrial strategy and will provide a huge boost to the economy."

Research from the Institute of Public Policy Research (IPPR) think tank shows that a programme to build up to 18GW of new nuclear capacity could boost UK GDP by more than £5 billion annually for 15 years. It could also create, on average, more than 30,000 jobs per year at the power stations, in the supply chain and in the supporting economy around the nuclear plants. Hinkley Point C alone will deliver more than £100 million per annum into the local economy during peak construction and see 25,000 people employed over the construction period. Thousands more will be employed in the supply chain and this is already manifesting itself on the ground in Somerset. EDF Energy has invested millions of pounds in local colleges to ensure that we have the right people with the right skills and we intend to leave a legacy of a highly-skilled workforce in the area.

New energy skills and construction centres in Somerset confirm the benefits already available. Local companies are already benefitting from contracts worth about £70 million and 1,000 Somerset companies have now signed onto our supply chain register to learn more about the opportunities.

When complete there will be 900 permanent jobs and the station will continue to inject £40 million into the local economy for each of its 60 operational years. If the UK can seize the opportunity now, investment in a low-carbon energy mix could play a key role in getting us back on the path to growth and international competitiveness.

Energy prices

Current energy prices do not take into account the significant new investment

DISCUSSION

Economic and environmental costs

The Government cannot ignore the cost of electricity to industry and householders, or the need to reduce emissions. Properly guided, with sufficient incentives, such investment can be realised while at the same time keeping costs as low as possible, and working towards carbon reduction targets.

in infrastructure which is needed. Demand and, therefore, prices are depressed as a result of the recession and wholesale electricity prices are currently around 50 per cent lower than four years ago in 2008.

The future wholesale price will have to reflect the cost of the new investment that the UK urgently needs in generation technology, transmission lines and distribution system. However, any price rises must be fair. It is vital to find the right balance between economy and environment, between fairness to customers and a rate of return for investors. If prices are not fair, they simply will not be sustainable and that will undermine the new-build programme – with all the impacts that will entail on the supply chain and on skills development.

Although investment will inevitably push prices up, the cost of failing to decarbonise our power supplies, of remaining reliant on imports, of failing to grow our economy and of continuing with aging and outdated infrastructure will ultimately be much higher.

While energy suppliers are facing up to these challenges by investing in new energy infrastructure, that does not mean they are doing nothing to reduce consumption. The nationwide roll-out of smart energy metering will improve the public's understanding of their consumption, revolutionising how we use electricity at home and work. The Government's Green Deal scheme to fund household efficiency measures has now been launched and will help to improve the inadequate energy efficiency of our housing stock. These are important because energy policy must be seen holistically with generation and demand, side-by-side, helping us to deliver a secure, low-carbon future, affordably.

Having the right policy framework to facilitate this transition is vital. Electricity Market Reform (EMR) is needed to unlock investment in nuclear, in renewables, in high-efficiency gas and in Carbon Capture & Storage (CCS). We need to cultivate a diverse, low-carbon and secure energy mix and improve awareness of consumption and efficiency. ☐

Perspectives on the future

John Loughhead

The future in the energy field is subject to considerable uncertainty. However, in 2008 the International Energy Agency tried to paint a picture of world energy supply in 2050. Depending upon the policy measures taken, future energy consumption could be allocated to different sources. The baseline, i.e. if the policy framework remains the same as today, would imply there would still be a lot of coal used, while if certain major policy changes were implemented that would diminish significantly.

The following year, the UK Energy Research Centre (UKERC) published its own view of the future, specifically about electricity generation in the UK. We took two target years in particular: 2035 and 2050. While assumptions made about decarbonisation have quite an impact, one thing is clear: if no policy action is taken, by 2050 there will still be a great deal of coal in the system, accounting for up to 75 per cent of total UK energy supply.

A Royal Academy of Engineering study in 2009, however, showed that while transport and heating are virtually entirely fossil-fuel powered, there is a much greater mix in electricity production (with fossil fuels, nuclear power, wind and biomass all in the mix). Electricity is already one of the most diverse sources of supply that we have in energy (see Figure 1).

Projecting forward to 2050, the drive for decarbonisation would mean that much more primary energy goes through the electricity system because electricity is being used for transport and for various types of heating. The sources of that electricity are in the main nuclear power, technologies with Carbon Capture & Storage (CCS) and, to a smaller degree, intermittent renewables and biomass.

Current IEA thinking (and again this is overall global energy supply) suggests that under most scenarios, oil displaces coal as the predominant influence on supply in 2035. The share of nuclear would actually reduce and renewables would also be lower than currently expected.

Dr John Loughhead OBE FREng is Executive Director of the UK Energy Research Centre based at Imperial College London. He was previously Corporate Vice-President of Technology and Intellectual Property at Alstom's head office in Paris. He is the UK member of the European Energy Research Alliance, a member of the European Advisory Group on Energy, an Advisor to the European Commission Directorate-General Research, an Assessor for the Technology Strategy Board, Non-Executive Director of the Ministry of Defence Research & Development Board, and a member of the UK's Energy Research Partnership.

Modelling the future

UKERC looked at a number of scenarios for 2050 and four in particular. The reference case (REF in Figure 2) assumes the present arrangements continue until 2050. The second (ADD) involves one or two extra measures that could be achieved without too much political pain. The third involves a real commitment – and the requisite actions – to hit the 80 per cent carbon reduction target (LC). Finally, the fourth scenario accepts that these dramatic targets will not be met and in fact the UK will undershoot by 30 per cent between 2015 and 2050 (GAP).

Interestingly, under our modelling there is fundamentally a very similar distribution of the energy sources whichever scenario is followed. The main difference is that in the two that involve significant carbon reduction, there is a lot less coal and a little more nuclear while gas generally tends to diminish as we go into the future.

Nuclear capacity

Modelling the baseline (reference) scenario between now and 2050 shows a clear growth in nuclear capacity. The figures we worked with were not pure

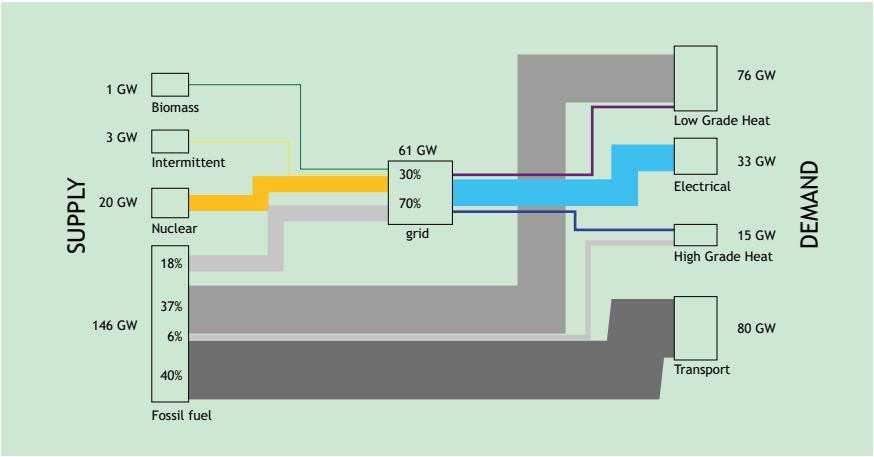

Figure 1. Simplified Sankey diagram of UK energy supply in 2007. Source: Royal Academy of Engineering.

guesses; they were based on an economic analysis of what the industry is likely to do. There would be a substantial amount of nuclear power in 2050, with unmitigated gas steadily decreasing.

Coal is still significant although progressively with carbon capture and storage. Renewables continue to be concentrated on wind until about 2030 when marine technologies start to make an impact. In this future carbon capture and storage also features. Gas continues to be important with a little biomass and bio-waste.

Suppose, though, the UK acts in such a way that it can meet its 80 per cent reduction target. Gas then disappears to almost nothing. Co-firing of biomass with CCS comes into the picture – it provides a means of actually extracting carbon from the air. There is some bio-waste. Nuclear, after a reduction in 2020 due to likely build times, expands but actually ends up representing less of the total. That may seem odd but it this is because biomass is a more effective way of reaching the target. And then there are the renewables and all the others. Strangely, the energy mixes that result from those two scenarios – the reference and low carbon cases – are not very different!

We can tweak the low carbon scenario assumptions. What happens if some measures are abandoned? The modelling suggests, for example, that the nuclear industry can withstand the withdrawal of the renewables obligation but without a carbon price floor it would disappear altogether from the mix by 2050. Instead, coal would make a comeback. In essence, the economic and technical analysis shows a very strong dependence on some form of positive support mechanism for all of these newer technologies.

Plentiful gas

The team also looked at specific changes: one was to look at the consequences of gas became surprisingly cheap and available. Another was to model the impact of greater system resilience by limiting technologies to a maximum of 40 per cent of the mix while assuming at the same time the UK continues to reduce the energy-intensity of economic activity by 3 per cent a year.

The impact of low gas prices, as one might expect, is to substantially increase the share of gas in the market. However, apart from that, there is not much difference in the rest of the mix, according to the modelling. In a scenario where the UK's low-carbon ambitions are met, gas prices and resilience measures have little impact on the likely mix for electricity.

Models of future generation

Looking at nuclear energy, under all the scenarios, very few measures make much impact on the total amount in the mix. If there were no financial constraints, none of the scenarios result in vastly different mixes: the conclusion is that the mix is as much dependent on financing as it is upon technology. On the other hand, the costs of building a resilient, low-carbon system are much higher than of maintaining a totally unconstrained system.

A final point about the IEA's current thinking as expressed in its World Energy Outlook 2011. Each of its three main scenarios for 2035 has a major role for coal, oil, gas, nuclear and renewables. But renewables do not make the predominant contribution to the overall energy system – and that is an issue about the maturity of the technologies. The IEA's message is that we have to engineer a cleaner future using many of those resources that we are moving away from in the longer term. ☐

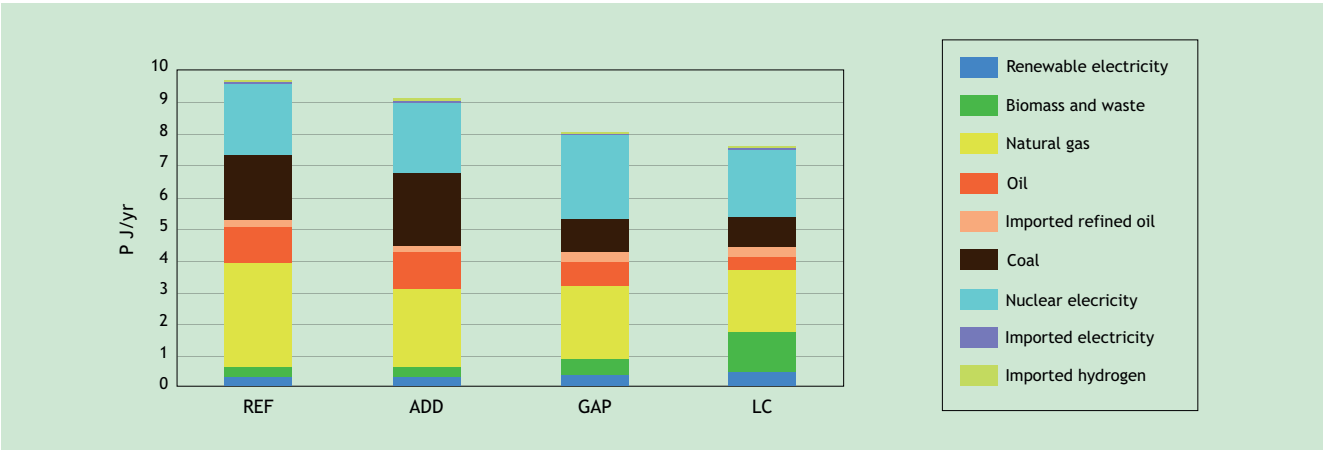

Figure 2. Four scenarios for the UK energy supply mix in 2050. Source: Ikka Keppo, UKERC Energy Systems and UCL. For discussion see text.

The growth of social media is opening many new ways of communicating one-to-one and one-to-many. The repercussions of that explosion in communications are still unfolding. A meeting of the Foundation for Science and Technology on 11 July 2012 debated the implications.

The impact of social media on society and democracy

Mike Lynch

Social media constitute a new communications channel which is different from many in the past in that it is interactive. However, people tend to have a weak understanding of this new reality unless they are immersed in it.

The most telling statistic is not how many users there are or how often they visit a site, but how much time they spend there. I sit on the board of the BBC, which continually analyses how many people watch specific television programmes and for how long, as well as how many people go to the website. One striking finding from all this is just how many minutes of each day people spend on social media. Even the BBC website, with so many different stories and videos to interest people, comes nowhere near Facebook in terms of time spent on the site. So the question is 'what are they doing for all that time?'

In any queue of more than, say, 10 people there is likely to be at least one person on a smartphone. They will be doing one of two things: either checking a message or email, or else flicking through Facebook. The Facebook page carries notifications from their friends. For someone my age, it is very hard to understand why I would want to do this, because the notification (using vast technology and digital processing power that I and many others have spent years working on) tells me that Heather has just bought a doughnut! Yet actually, it is a mark of a constant feeling of 'presence' amongst people, even when they are separated. This is an extremely powerful effect.

The new media are also ways of engaging with very hard-to-reach groups: Birmingham City Council has 70,000 followers on Twitter. For the health of our democracy, it is important that social media is embraced by the political process. In the USA, President Obama has used it to raise money, but politicians are also realising that they have to listen and talk through social media. The big advantage is that there is feedback. The danger is that responses are disproportionately weighted, but that has always been an issue with politicians and lobbying.

Dr Mike Lynch OBE FREng was the co-founder of Autonomy and is a member of the Council for Science and Technology which advises the Prime Minister. He has been instrumental in creating a number of highly successful high-growth software companies. He served as CEO of Autonomy up to May of this year. During this time Autonomy acquired Verity, Zantaz and Interwoven and in October 2011 was sold to Hewlett Packard for $11 billion. In December 2006, he was appointed a non-executive director to the board of the BBC.

The new media and the law

There are also issues about law and regulation. We have the well-established concept of law that applies to public spaces; now, social media is a virtual public space where people interact. The law is very confused in this area, though. There are a number of contradictory rulings about what is private and what is public. The law is almost impotent when it comes to dealing with Twitter, as can be seen from recent injunctions about celebrities. The old model of keeping information 'under control' is becoming increasingly problematic. It is possible to make statements untraceable and so accountability disappears.

There is a whole series of regulatory issues. These channels are being used by businesses to interact with members of the public. So, for example, financial services can be marketed over social media. There have already been concerns about drug companies promoting off-label use of products but the volumes involved mean that traditional regulation becomes very difficult. Inappropriate advertisements on traditional television can be dealt with much more easily.

Social media are communication tools that criminals or terrorists could use – incredibly efficient ones because they communicate one-to-many at speed, encompassing different types of information some of which are particularly difficult to decode. The Nika riots in the year 500 AD occurred when everyone was at the Hippodrome and they did not like the show: so there was a riot and public buildings were attacked. With social media there is no longer any need for people to be in one place in advance of the event; the message can be disseminated very rapidly and widely as it was during the London riots of 2011. That makes immediate police or Government response very difficult.

DISCUSSION

Risks of social media

There is a need to educate the public on how best to manage the risks of the new technologies. It is essential to set appropriate privacy settings and to teach users to check that their financial and other sensitive transactions were being conducted via an https// encrypted site. It is too easy for parody accounts to be set up to mimic real sites, or for criminals, who are effectively untraceable, to impersonate others online.

That speed can have both advantages and disadvantages. Many people would look at the Arab Spring and regard it as a very good thing. However, decisions were being made very quickly, without the ability to debate them or even see the whole picture. We are also starting to see political debate affected by real-time feedback from Twitter.

The future

Where is all of this going? People get very excited and positive about social media – transparency is cited and the potential effect on democracy, as well as the overthrow of dictators. However, there is another side to it as well. The civil liberties movement has long been concerned about the ability of 'Big Brother', i.e. Government, to infringe privacy, listen in and prepare personal files about individuals. Up till now, only governments had the resources to do that. Yet social media and our computer age are making it possible for an army of 'Little Brothers' to do this sort of thing as well. So groups like the English Defence League, for example, can organise through social media.

In addition, there is a new wave of technologies coming which will allow information to be assembled and analysed in new ways. Combined with social media, that will really change what groups can do. A very simple example is a new iPhone app that will read the licence plates of cars going past on the street. That in itself is quite alarming. But connect that to Facebook and a group of like-minded individuals could track all the vehicles moving around a city. This becomes a surveillance activity: potentially any group, with any motivation, could carry out this kind of activity.

Smart devices are starting to achieve facial recognition. Imagine if anyone in a street or building can take out a smart phone and be told the identity of someone near them. How could clandestine meetings ever be held? Secrecy can sometimes be essential: could the Good Friday Agreement ever have been concluded if the relevant sides had known who was involved in behind-the-scenes discussions? Yet soon it will be very difficult to hold such meetings, just because of the power of social media to connect information together.

So, while as a society we should focus on the advantages of being able to interact in large groups, we should not forget the negative side that also has to be tackled. The Government will have to decide how to respond to the rapid pace of the social media-enabled world with all its potential risks. At the same time, these technologies bring a phenomenal opportunity to communicate with the electorate, to hear their views and to get feedback. Perhaps, if social media is used with a little more care, it can also be used to educate people and give them facts; that would help democracy function in a more efficient manner.

The appearance of social media marks a fundamental change in how people access and use information, and as today's 25-year olds become 35-year olds and 45-year olds, so these new practices will move through the population and become part of everyday life. □

Engaging with constituencies and communities

Julian Huppert

A very long time ago, transferring information between people could only be done on a very direct, one-to-one basis. One-to-many communications were impossible until there were gatherings where people could meet for large scale discussions. Paper allowed wider connections, but communication was fundamentally limited by the time taken. The printing press helped, but first creating something and then distributing it still took a long time. The advent of the telephone changed the dynamic: networks became non-geographic and long-distance. Now with social media there are much more complicated and faster networks.

It is interesting just how different the different social media networks are and the effects this has. Facebook fundamentally consists of a 1:1 relationship that you can have with people; if I am interested in what you are doing, you are interested in what I do. So it is based around friendship groups as a model.

If you hear something from me via Twitter, it does not necessarily mean that I ever want to hear anything from you – it is an asymmetric relationship. My own preference, given my role as an MP, is for Twitter because there are a number of people, apparently, who want to hear what I am saying, whereas I do not necessarily want to hear everything that everybody does in Cambridge all of the time – fascinating though it might be.

Dr Julian Huppert is MP for Cambridge and co-Chair of the Liberal Democrat Parliamentary Party Committee on Transport. He has a PhD in biological chemistry, and has held research fellowships at a number of Cambridge institutions. He was elected as MP for Cambridge in 2010. He has campaigned in Parliament on many issues, including civil liberties, sustainable transport and the need for science and evidence-based policies. He has reviewed science policy for the Liberal Democrats.

By coincidence I was the first of the current MPs to join Twitter. I had gone to a conference where, I was told, this thing called 'Twitter' would tell me what people were saying about the talks. It was actually fascinating to get that live feedback. Politicians are now increasingly turning to Facebook and Twitter and a large majority of politicians are on Twitter, trying to communicate with their electorates.

Engaging with constituents

Some 150 years ago, many Members of Parliament would make an annual trip to their constituency in order to see that it was still there and being governed properly in their absence. It was very hard in those days to contact a politician, it was very rare to talk to them. We have now moved to a system where it is possible for me to communicate with a number of my constituents, the ones who

DISCUSSION

Empowerment

The new technologies can be very empowering. In emergencies, social media provides an unparalleled means for the public and the authorities to remain in contact, as can be seen in relief efforts that took place in Japan and in Haiti. Social media can be used to detect the early signs of public health problems, as well as for personal medical monitoring. Care is nevertheless needed in social media analysis, where responses cannot easily be weighted for the quality of data or inadvertent bias in sampling.

wish to be involved, on a fairly constant basis. Not only do they hear from me, but I have the chance to hear very regularly from many of them.

I often use social media to ask people for their opinions in a way which could never have been done before. Recently I had the opportunity to propose a Bill in the House of Commons and it was possible to ask those constituents who were on Twitter 'what subject do you think this should be about?' There were a huge number of responses very quickly.

Social media has also changed the roles of others in the political world. The lobby journalist is in a very privileged position being inside Parliament, but that degree of privilege has changed with the rise of the citizen journalist – people who can have that level of engagement without having to be inside, or indeed be bound by some of the same rules.

There is an organisation called '38 degrees', which carries out political campaigning. It has over a million members who contact their MPs about the issues that 38 degrees suggests to them. It achieves a powerful lobbying effect and the organisation has become an important, powerful force in just a few years.

Contacting communities

One of the ways in which Twitter works is through the 're-Tweet' – a message from one person is passed onto the next rather more reliably than Chinese Whispers. While that is a very simple concept, it is very effective in getting messages to people who are interested in a subject. So for example, one of my interests is cycling. I recently had a meeting with someone who used to ride in the Tour de France. I sent out a comment that he had made. Out of the 7,500 people who follow me, those who were interested in cycling would have passed that message onto their friends.

Politicians try to target messages at the right people and Twitter is a channel where people can choose to receive the messages that reflect their interests. The next general election will probably be the first in this country where social media is an important vehicle for getting messages out. As an MP, I will then need volunteers to deliver leaflets and knock on doors and I will need money to pay for election communications. Will social media prove an effective way of pulling people in to help or contribute in other ways – including the cycling campaigners and scientists who have been interested in what I will have done over the preceding five years? That will be tested in just a few short years.

Business has been far better at taking up the opportunities provided by social media than the Government. For example, a number of rail companies use it to provide very up-to-date information about service delays.

Government messaging, on the other hand, is very bland and very corporate. One of the reasons is a real confusion over whether people are commenting in their personal capacity or as an official. This is a real concern for many people throughout Government. The Cabinet Office has issued guidance for civil servants, but it is still unclear exactly how to achieve that separation of roles consistently in a way that the public can understand.

The London riots

There is no doubt that the way the 2011 riots evolved and developed was linked to the use of social media, Blackberry Messenger and various other tools. One of the immediate responses from the Prime Minister was to talk about how we could ban social media and somehow 'turn these things off' (a week later there was an announcement that such an idea was never even considered!).

Of course, social media is also extremely useful for the Police as well. If a member of the public can find out about events taking place at short notice, then so can the Police. They can also get information to the public in ways that previously were not possible in real time.

On a positive note, while it is possible to use social media to organise a riot, it is also possible to use it in the aftermath. There was a strong social media campaign which resulted in people washing down the streets and clearing everything up.

Legal issues

There are a number of aspects of social media that pose new questions for policy makers and legislators. Take the issue of defamation. How do you allow for free speech while also ensuring a right to privacy? What is the legal position of somebody who merely passes on a message which is defamatory of somebody else? Can you effectively legislate for what happens online?

For example, recently there was an issue involving a footballer who took out a super injunction. No-one was allowed even to mention his name. Yet many millions of people knew it via Twitter and at one football game his name was actually chanted. Ultimately one of my colleagues named him in the House of Commons and that broke part of the injunction.

Is there any way of keeping things private in a world where information can spread so quickly? Do people have the right to be anonymous online and does that apply even if they start to defame or harass other people? Can they be tracked down if they do?

A draft Bill has been presented to Parliament which considers what information the state could require record holders to keep. For example, should the state be able to ascertain that you sent a Facebook message to somebody else at a particular time? How much information should be kept?

Given the amount of private information routinely posted on social media, identity theft becomes much easier. People supply others with photos of themselves, information about what they like, their birthday, their friends and everything they have been doing recently – there is a real danger that people simply do not understand the value of that information and what the risks are.

Because it is difficult to tell where social media will lead us as a society there is a tendency to become worried and to over-regulate. When the printing press was invented it was equally difficult to foretell what sort of effect it would have. Ultimately, I think, the printing press has been a force for good. It has been a force for education and freedom. I expect social media to have a similar impact. □

Change and continuity in a digital age

The meeting was also addressed by Kathryn Corrick, an expert on the growth and use of social media. Sir Geoffrey Chipperfield summarises her talk.

Kathryn Corrick illustrated her remarks with a practical demonstration of the power of social media. She showed how some members of the audience had already used their mobile phones to tweet their opinions on Mike Lynch's opening talk, thus connecting those present at the Foundation for Science and Technology meeting with a potentially global audience in near-real time. No permissions were now needed to communicate in this new world.

A deluge of data

Citing Peter Kafka, that one upside of the web is that everyone has a printing press but one downside is that everyone has a printing press, she drew attention to the growth in ownership of mobile devices (such as cameras and tablets) with the ability to capture and transmit video as well as pictures. This produces a deluge of data with the problem of too much rather than too little information. This effect would increase as more services moved onto the cloud.

The communications speed is near-real time, and she quoted Terry Pratchett's remark that 'a lie can be round the world before the truth has got its trousers on'. The cost of recording and storing all this data had steadily fallen, in line with the rise in processing power predicted by Moore's Law.

Communications are now (with only a few exceptions in repressive states) not limited by national borders and the use of proxy servers was helping to circumvent the restrictions some governments still tried to impose on what their populations were allowed to know.

Comprehension

Nevertheless, it is not the case that near-universal access brings a similar level of comprehension. A straw poll of those present at the meeting revealed that very few were accessing information in languages other than English and French, although she recognised that software such as that provided by Google could produce automated rough translations of text accessed on the web.

Kathryn Corrick pointed to the increasing dependence of public and private sectors on a few big ICT and software companies such as Google, Amazon, Apple and Facebook. Their oligarchic market position provided these companies with great power to restrict, exclude, censor or shut down services, without there being any corresponding public accountability.

Unchanging certainties

She suggested that, nevertheless, behind the newness of the technology some human certainties had not changed. We too readily disregard the history of previous technological changes that have created new patterns of human communication. The drivers of social upheavals are often the essentials of economic life, such as the divide between rich and poor. A number of today's issues would be better understood if we had a more complete appreciation of the past.

Basic human judgment was still needed to assess what was really relevant and what was merely 'noise in the system'. The validation of machine results, for example from analysing huge data sets, still required human comprehension and common sense.

Even more fundamentally, human emotions have not changed: the desire to be loved, to keep in touch, to be secure and protected, to live and have fun all remain vital parts of what it means to be human.

Another fundamental characteristic of the human animal to be seen today through social media use is the desire to be part of something bigger and to be a social being. For many, there is also a desire to change the world mostly for the better. However, the desire for power and, for some people, for absolute power will still exert an attraction through control of social media today as through other ways in the past.

Concluding, Ms Corrick suggested that in the UK many institutions – Parliament, the banks, the police, the media – have lost moral authority. The public need to have a new narrative of what these institutions represent in the digital world. The story is more about the struggle between libertarian and authoritarian tendencies than those of the traditional Left and Right.

Inclusive

New media provide the opportunity for a more inclusive politics. The activities of hackers and 'hacktivists' have to be understood in terms of their wish to change the world from their point of view, especially in trying to achieve the original utopian vision of the Internet as a space where everyone would have the freedom to be what they wanted to be.

There is a debate about how we understand capital, both economic and human. In addition, intellectual 'property' is not regarded as being purely owned by corporations. In this context, some are advocating a re-evaluation of Marx.

Our use of technologies such as social media is a reflection of our humanity and our society, so we should be asking ourselves as we examine social media, what sort of society do we want to see? ☐

DISCUSSION

A tool for the elderly

Some of the problems of a growing elderly population could be mitigated by encouraging social media use. Indeed, as the current younger generation ages, the use of social media for this purpose will seem quite natural. There may be less reliance on the printed word and more on visual representations, including virtual and layered reality. After all, for much of human history the primary means of communication has been through visual imagery, whether cave paintings or Renaissance works of art.

On 11 September 2012, the Foundation for Science and Technology held a meeting to review the state of mental health provision in the NHS.

Mental health and the NHS

At the end of a dinner/discussion on the subject in May 2011, it had been agreed the topic should be revisited when a study into it had reported. The report, led by Lord Layard FBA with a team of distinguished experts, was published in June 2012. The study formed the basis of the discussions at this meeting.

Lord Layard outlined some of the findings in the report prepared by the Mental Health Policy Group of the LSE's Centre for Economic Performance. He described how mental health issues account for 40 per cent of all diseases; that their effects are more debilitating than many physical diseases and that they are responsible for substantially increased costs in treating physical diseases. Half of all patients referred to consultants for physical illness have medically-unexplained symptoms, such as back pain, chest pain or headache. These patients cost the National Health Service some £3 billion every year.

He noted that there were cost-effective treatments available, yet the NHS only treats one-third of patients who suffered from mental illness. Mental health morbidity rates are the highest of all diseases (38 per cent) and, including premature death, amounts to 23 per cent of the total burden of disease. Yet Cognitive Behavioural Therapy (CBT) is a proven therapy costing only £900 for 10 sessions, with a 32 per cent recovery rate. Evidence from the USA shows that CBT costs can be fully recovered from the savings made in physical care.

The Improved Access to Psychological Treatment Programme (IAPT) was launched in 2008. This aimed to provide therapies recommended by the National Institute for Health and Clinical Excellence (NICE). The programme went extremely well during its first three years, with an effective training programme and good recovery rates. Yet although funds are allocated in the Comprehensive Spending Review, they are currently not being fully deployed by regions and Primary Care Trusts (PCTs). In addition, insufficient trainees are coming forward, so overall there is a significant risk that the programme will not be delivered.

Lord Layard argued that the NHS needs to change the vision many of its staff have of mental illness. The NHS Commissioning Board should make the continuation and, indeed, expansion of IAPT a high priority and it should be included in the mandate to Commissioning Boards. In particular, child mental health services should be expanded, not cut, and GPs should be better trained in diagnosing mental illness. Furthermore, he urged that more students be encouraged to become psychologists.

Wide disparities

Professor Wessely questioned why, despite the fact that mental illness accounts for 40 per cent of all disease, and despite the existence of effective therapies, there remain wide disparities in the availability of treatment as well as discrimination in the allocation of resources.

He acknowledged that stigma is an important element and also popular culture does not acknowledge mental suffering to the degree it does for physical ailments (Great Ormond Street has much greater appeal than the Maudsley, for example). This was not entirely irrational - in extreme

DISCUSSION

The legacy of Descartes

Within the medical profession itself, 40 per cent of GPs do not have mental health training and medical directors in Trusts often have little psychological awareness. The continuing 'Cartesian divide' of body and mind means that there is no consensus between clinicians about how mental and physical healthcare can be brought together. Indeed, there is a danger that they are drifting further apart. It is crucial that psychiatry remains part of medicine and is not seen as a disconnected field.

The speakers

The Lord Layard FBA is Director of the Wellbeing Programme at the Centre for Economic Performance at the London School of Economics and Political Science (LSE). Since 2000 he has been a member of the House of Lords. He is a labour economist who has made contributions on unemployment, inflation, inequality and post-Communist reform. His influential book *Happiness – Lessons from a New Science* was published in 2005 and appears in 20 languages. He also advises the Government on mental health policy and is the architect of the policy of Improving Access to Psychological Therapy (IAPT).

Professor Simon Wessely FRCP FRCPsych FMedSci is Vice Dean and Professor of Psychological Medicine at the Institute of Psychiatry and Honorary Consultant Psychiatrist at King's and Maudsley Hospitals. His research interests are in the areas between medicine and psychiatry, clinical epidemiology, psychiatric injury and military health. In the first part of his career his main areas of research focused around clinical epidemiology, with special emphasis on unexplained symptoms and syndromes, most particularly chronic fatigue syndrome. For the past 10 years his research has shifted towards aspects of military health.

Professor Sir Bruce Keogh KBE DSc FRCS FRCP is NHS Medical Director for England. He is responsible for clinical quality, policy and strategy and postgraduate education of doctors, dentists, pharmacists and clinical scientists. He oversees the work programme of the National Patient Safety Agency (NPSA) and has been the sponsor for the work programme of the National Institute for Health and Clinical Excellence (NICE). He has been appointed National Medical Director on the NHS Commissioning Board.

DISCUSSION

Public and private

Mental health is a public good as well as a private one. It is linked with the commitment of society to help its most troubled members, and that compassion towards the individual is the only way to build a healthy society. Yet such compassion can only be effective if: it is recognised that the mind/body division is false and that individuals need to be treated as a unity; that professionals understand their responsibilities and have the training to undertake them; and that institutional structures do not stand in the way. However, there is a long way to go before the public accepts the importance of mental health and the associated stigma is reduced. People must also understand that the NHS cannot deal with the results of stresses imposed by modern society.

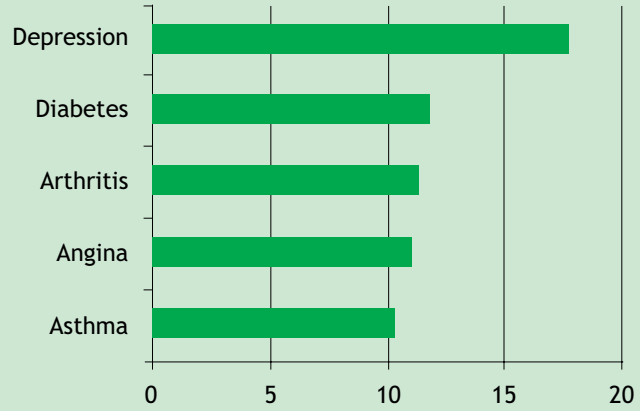

Figure 1. The effects of mental illness: loss in health-related quality of life – difference from 'no chronic condition', % points. Source: Moussavi S, *et al* (2007) Depression, chronic diseases, and decrements in health: results from the World Health Surveys. *The Lancet* **Vol 370**: 9590.

	% of all morbidity	% of all QALYs* lost
Mental illness	38	23
Cardiovascular	6	16
Cancer	3	16
Respiratory	11	8
Sense organs	13	7
Diabetes	2	2
Other	27	28
TOTAL	100	100

* Quality Adjusted Life Years

Table 1: The burden of disease. Source: WHO 2008

situations (such as military operations) where mutual interdependence was crucial, mental health would be ignored.

There was also fear of 'overstretch' or the medicalising of problems which might arise from the normal stresses of life, such as grief, or exceptional intelligence. Yet the philosophical Cartesian ethos in the NHS – that mind and body are two separate entities (as exemplified in the division of the two Maudsley hospitals) plays a major part too. To take an analogy, life deals individuals a hand of cards. Some can play their hand successfully, but others cannot and these are the ones who need help. They can often think they have physical problems, although diagnosis and treatment, after huge expenditure, does not reveal any. Yet mental health issues are not considered.

If a psychologist had been consulted at the start, and effective remedies such as CBT instituted, the patient might recover and the NHS save money. The institutional problems are due to a failure to accept that physical care cannot be separated from mental care. However, GPs find it difficult to know to whom they should refer cases where they believe that a physical complaint may well have a mental health basis.

A feeling of compassion

Professor Keogh said that, as Medical Director of the NHS, he would assume responsibility for both mental and physical health in 2013. He also said that he recognised the problems of the Cartesian divide.

His aim was to restore the feeling of compassion for those suffering which had animated the founders of the National Health Service in 1948. Since that time, although funds had increased and the science had been excellent, there had been a focus on technological improvement, bureaucratic and clinical structures, as well as setting performance targets. By contrast, individual suffering had received much less focus. Lengthy delays for appointments and operations were one sign of this.

The aims of the reorganised NHS – to focus on clinical outcomes, put more responsibility and accountability on clinicians and give patients more choice – should help. A high level framework is to be structured around fundamental NHS tasks - to prevent death where possible; look after patients in long term care; deal effectively and speedily with short term cases; be vigilant on safety; and provide good patient experience. Yet he acknowledged that the service could occasionally benefit from outside pressure when clinical views had become too complacent – as for example in the drive by Ministers to reduce MRSA figures.

The new commissioning boards will have the difficult task of allocating funds for both physical and mental health problems. To do so effectively, they will need to understand the business case for funding projects. Lord Layard's paper, with its emphasis on cost effectiveness and recovery rates, will be very valuable but if mental health is to achieve its proper position within the NHS, there must be robust clinical leadership, as in other fields. Only then could the NHS become more responsive to patients' needs. □

How Mental Illness Loses Out in the NHS: http://cep.lse.ac.uk/pubs/download/special/cepsp26.pdf

The increasing number of people with dementia poses many challenges to the Government and the Health Service over the coming decades. A meeting of the Foundation for Science and Technology on 3 October 2012 considered how those challenges could be met.

Caring for the rising number of dementia patients

Sally Davies

At the moment we have 670,000 people in England living with dementia. This figure will rise to 1 million in less than 10 years. One in three of us will have dementia by the time we die. We have no cure. In a recent study, three quarters of people living with dementia said they feel society is not geared up to deal with people with it[1]. All too many of our health and care workers do not understand what dementia is or what it means: indeed, many of the 'gatekeepers' to the system – General Practitioners – do not. That, of course, makes it much worse for the sufferers and the carers.

While 50 per cent of cases are Alzheimer's, the rest are not. Some are rare diseases, but many are vascular in origin. It is important to know which is which, in order to see if progression can be arrested.

If we have no cure today, why make people unhappy by giving an early diagnosis? There is ample evidence and experience now that, if picked up early, there are drugs that can improve the quality of life for many people. Many will then be less bewildered and able to use the good-quality time in a way they want. Their carers can plan so they can have the care they want, the care they need from diagnosis until the end of life. If the diagnosis is not made early, then patients do not have those opportunities and that, I think, is unacceptable.

In 2009, the Department of Health, after a great deal of work with others, published the National Dementia Strategy[2]. While it has already achieved a great deal, diagnosis levels are low. Currently only 42 per cent of people with dementia in England have a formal diagnosis and often that comes too late.

The Prime Minister's Challenge

The Prime Minister's Challenge on Dementia[3] asks people to go further and faster, building on the progress so far. His ambition is to make this country a world leader in dementia care and research. At the moment we do not have a good early bio-marker for Alzheimer's, we do not have an effective prevention or cure and reports suggest that drugs tried in late-stage disease are not having an impact. Maybe they would have an impact if tried earlier – but that relies on effective early diagnosis.

So the Prime Minister's Challenge focuses on three key areas: driving improvements in health and care; creating dementia-friendly communities which understand how to help; and then there is the research agenda. Three 'champion groups' were set up, bringing key leaders and organisations together in order to drive this forward. Jeremy Hughes and Angela Rippon are raising awareness and creating the dementia-friendly communities. Sir Ian Carruthers and Sarah Pickup are focussing on improving health and care, while Sir Mark Walport and I are the 'better research' champions.

There is no doubt that the challenges life holds for people with dementia go well beyond the battle for diagnosis and support. The Alzheimer's Society found as many as 67 per cent of people with dementia do not feel part of their community. They suffer loneliness, isolation, anxiety and depression.

Using public transport can be difficult, as can remembering the PIN to access a bank account – things that we take for granted. Dementia makes it difficult to be active in the community unless the community are active in their support and engagement. Clearly, our health and care system has a vital role to play, but a much broader range of organisations need to be engaged: housing, transport, leisure, welfare, as well families and carers.

Exciting opportunities

Under reforms starting in April 2013, new Health & Wellbeing boards will provide an important opportunity to prioritise the needs of local people with dementia, championing joint health and social care improvement outcomes, pushing for better quality.

Diagnoses need to be made early. People with vascular dementia must be supported in order to try and halt its progression. Better care is needed in hospitals: a quarter of all hospital beds are occupied by someone with dementia. People in hospitals have not been picking up the cases of dementia and giving the support needed. So in the Prime Minister's Challenge there is an incentive payment to hospitals – called a CQUIN (Commissioning for Quality and Innovation) – offering risk assessments to all over 75s. As more people in hospital are having their risk assessed, they will be better able to manage the condition and its symptoms and should receive better care in hospital.

Residential care is patchy, from superb through to not so good. However, most people – over two thirds – live at home. So patient-centred support that comes into help those patients is needed from health, social care and other agencies.

The NHS has been setting up memory

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services: there is good provision now, but is the service good enough? The first audit found that more than half were satisfactory, but the rest needed to improve. There is variability in all areas of healthcare, but this is a particularly important sector. Only 31 per cent of GPs believe they have sufficient training in this subject.

Work on dementia-friendly communities is pressing ahead. One million people are being educated to become 'dementia friends' by 2015; these people are being trained by volunteer 'dementia community champions'. There are dementia awareness campaigns. Financial institutions are working to develop programmes based on the concept of 'recognise, understand and respond'. Some 21 schools have come together to form a group developing children's confidence and insight into these issues and removing stigma. Once the training packages have been finalised, these could be extended to many other schools.

The fire service has identified that half of the people who die in accidental house fires are over the age of 65. They have made a pledge on dementia, committing themselves to take action to increase the safety of sufferers. Energy providers, such as E.ON, are committed to providing dementia champions within their specialist customer service teams. First Group is giving 17,000 bus drivers training on dementia awareness. Tesco are looking at ways of increasing dementia awareness.

The NHS Institute has issued a call to action, urging that every hospital commit to being dementia-friendly by April. The NHS Commissioning Board Authority has created a strategic clinical network as a way of bringing clinical specialists in mental health, dementia and neurological conditions together.

Research

It is not yet known how to prevent or stop dementia. Current disease-modifying treatments have very limited efficacy and work better when given early. Yet as a nation the UK has real strength in neuroscience and specialist research facilities. There is a good deal of hope as well: there are over 200 medicines in production or in the pipeline.

I am working with Mark Walport on the research agenda. A Clinical Practice Research Data Link service has been established which allows scientists to link datasets, totally anonymised, to study and research. The Medical Research Council (MRC) is pressing ahead with funding brain scanning of patients: eventually there will be 100,000 volunteers involved. Some dementia biomedical research units, which have come together in a translational research collaboration, have been established. Social science research to help people with dementia lead healthy, independent lives for longer is underway. We are engaging with industry to move the research forward. We are doubling the research spend in this area.

When the Prime Minister launched the Challenge, he said: "In less than 10 years, as we all live longer lives, the number of people with dementia will reach a million, so my argument today is we have to treat this like the national crisis it is. We need an all-out fightback against this disease, one that cuts across society." □

1. Dementia 2012: A National Challenge, Alzheimer's Society 2012: www.alzheimers.org.uk/site/scripts/download_info.php?downloadID=821

2. National Dementia Strategy: www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_094058

3. Prime Minister's Challenge on Dementia: www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_133176.pdf

A challenge to everyone

Julienne Meyer

There are 400,000 older people in care homes: that is more than three times the number of hospital beds in the NHS. Some 66 per cent have some form of cognitive impairment, while 40 per cent have depression. This is a very frail group indeed.

In terms of dementia, 60 per cent of people with dementia actually die in care homes; but they often come into care homes at a point of crisis, where the families are unprepared. The opening-up of care homes to volunteers would be good, not only for the residents but also to help the public reflect on their own frailty, their own end of life and at the same time learn more about dementia – it is potentially a good place to learn, the care home.

Care homes typically receive very negative media coverage. Yet in reality there have been steady improvements over the past decade. In the White Paper on social care reform[1], the Government says it will support the work being led by My Home Life and national care provider organisations to work with their members in order to connect care homes to their local community. In many ways care homes are like hospices, they balance the living and dying.

Older people policy focuses on person-centred care, independence and choice. Care homes need to look at, in addition, interdependence and the maintenance of good relationships. If relationships are to be good then consideration has to be given not just to the needs of the older person, but also those of the visitors and the relatives – as well as the staff who work there (and who are often forgotten).

My Home Life[2] began as a small project pulling together best practice and is now seen as a social movement. What is important is the way the sector has come together to work in partnership. The project is supported by the Relatives and Residents Association and every national

Professor Julienne Meyer is Professor of Nursing: Care for Older People, at City University London and is Executive Director for the My Home Life programme. The My Home Life Programme (MHL) is a UK-wide initiative to promote quality of life for those living, dying, visiting and working in care homes for older people. Professor Meyer is also Co-convenor of the National Care Homes R&D Forum and its linked international network (International Care Homes R&D Forum).

DISCUSSION

Prejudice and discrimination

An important issue is the social isolation that carers and sufferers alike have to endure. There is both prejudice and discrimination. Dementia carries a powerful stigma; people do not wish to know about it or be associated with it. Then, how often is a young disabled person given care, which stimulates and encourages them, while a dementia patient is not supported in this way? Such discrimination raises issues about Human Rights. To tackle this, there is an urgent need for better education of the public about dementia.

provider organisation that represents care homes across the UK.

My Home Life is a movement which is evidence-based, relationship-centred, appreciative, and seeks to make a difference. Research that purely reports on poor practice and then blames practitioners does not help remedy the deficiencies. It is far better to look at what residents, relatives and staff want, to see where that works and then focus on sharing that practice more widely.

For too long, health and social care have been operating in their own 'silos'. Among the cross-cutting themes of the movement is 'personalisation'. It is the sort of thing that social care staff and social workers emphasise – the concept of 'see who I am, involve me, connect with me'. Interestingly, a recent literature review on older people's and relatives' experiences in hospital contained little about the need for clinical care (older people expected that to be in place) but they were concerned with the importance of 'see who I am, include me and connect with me'.

For healthcare professionals, rather than personalisation, the focus has been more on managing transitions: all the emotional upheaval of going into a care home, managing the losses of connections with the past and also the losses bound up with 'frail in body, frail in mind'. Healthcare people are also concerned with improving health and healthcare, as well as supporting a good end of life. What is really interesting is how often social care people say 'if only the nurses in care homes would stop treating this as a clinic, residents would have a better quality of life'. Nurses on the other hand say 'if only those social care people would push fluids a little bit more, then actually the residents would wake up and enjoy a better quality of life'. There needs to be a shared respect and value of each other's knowledge as well as a shared vision if we are to achieve the best results for the residents and relatives.

Underpinning My Home Life is the concept of relationship-centred care. Ask older people (and relatives and staff) what is important to them and the results are clear – and not unexpected. Research has shown they want to feel safe, to feel that they belong, that they are part of things. If they can experience links and connections between what has gone before, what is happening now and what is to come; if we can help them to feel they have goals, that they are reaching those goals and that they matter as individuals – then it does not matter whether they have dementia or not, these are the things that matter. Fulfilling a sense of security, belonging, continuity, purpose, achievement and significance is not important just to older people; these senses are important also for the wellbeing of relatives and staff as well.

My Home Life has undertaken a great deal of work with care homes; in particular a Leadership Support and Community Development programme within 21 local authorities. Many care home managers have been involved in quality improvement initiatives, but this research has shown that they are under a lot of stress and they really need support. Care home managers feel that they are feeding the system rather than feeding their residents. A report detailing the research findings from My Home Life has been published by the Joseph Rowntree Foundation[3].

The care home sector is really serving our dementia community well, but we need to do much more to help them do this work. What we have discovered through the programme's Leadership Support and Community Development programme is how much we need to trust, enable, network, support and empower care home managers in order to get the best results – for everyone. □

1. www.dh.gov.uk/health/2012/07/careand-supportwhitepaper

2. www.myhomelife.org.uk

3. www.jrf.org.uk/publications/my-home-life

Making progress on Alzheimer's

James Goodwin

There are approximately 820,000 people in the UK living with dementia. About 40 per cent of them have been diagnosed, while 60 per cent remain undiagnosed. It is clearly age-related; the risk increases from 1-in-20 for people who are 65 or more, to 1-in-3 for those aged 90. The current figure is forecast to increase to 1.7 million by 2051.

Many more people have Mild Cognitive Impairment (MCI). This is cognitive decline in the absence of diagnosis of dementia. It can involve an inability to concentrate, an inability to initiate or complete activities of daily living, trouble in managing number-related tasks and so on. A very high number of people have MCI – estimates vary but up to 16 per cent of the population over 65 of age are believed to have it. That is 1.65 million people. More importantly, it is highly associated with an increased risk of dementia.

About 1-in-6 of that 1.65 million is expected to develop full-blown dementia. So, many people who are susceptible to Alzheimer's could be diagnosed early through testing for MCI if we could do so. That would help to improve our preventative measures.

Now, the cost of Alzheimer's to the UK economy is £23 billion annually, comprised of health and social care, informal care, and the decline in productivity. The vision of AgeUK and the dedicated Alzheimer's charities is to reduce that number of sufferers considerably.

Research results

What can research tell us about MCI and dementia? The Disconnected Mind Project (which AgeUK part funds at the University of Edinburgh under Professor Ian Deary) is a multi-million pound, longitudinal study based on the 1936 Lothian Birth Cohort. There have been substantial advances in our understanding of cognitive decline with age as a result of this. The

project has found longitudinal (not cross-sectional) genetic factors accounting for approximately 24 per cent of the variation in changes in cognitive ability. This is important news for everyone involved in health and social care because it means it will be possible to intervene across the course of a life, mitigating these modifiable risk factors which affect cognitive ability.

In Alzheimer's, inherited genes account for only 1 per cent of all cases. There are also modifiable non-genetic risk factors and genetically-determined risk factors such as the much-publicised ApoE4. However, there are also a number of postulated, non-genetic risk factors. For example, sex hormone deficiency actually contributes, we know, to the development of Alzheimer's. Other less obvious factors are low social activity and low education. Not only are there modifiable risk factors and genetic risk factors, there are also interactions between these. This leads on towards the personalisation of medicine as some may constitute a risk factor for people with a genetic predisposition but not for others.

In midlife there is a critical period, during which:

- if you are hypertensive the risk of developing dementia is doubled;
- if you are hyper-cholesterolemic the risk is again doubled;
- if you are obese, greater than BMI 30, the risk for dementia post-65 is doubled.

The most astounding feature is that they are cumulative, so if a person has all three conditions (about 1 million people in the UK) then they are six times at much at risk. This is a clear indication that we are able, through healthcare and intervention, to do something about the prevalence of dementia.

Transition

The relationship between research, policy and practice could be termed 'transition'. The universities are involved in a research impact exercise to assess what research has generated benefits to society. The processes by which we can move research into tangible benefits are now understood. First, it is a matter of knowing what knowledge transfer is. The Canadian Institute of Health Research defines it as: "the exchange, synthesis and ethically sound application of knowledge – within a complex system of interactions among researchers and users – to accelerate the capture of the benefits of research". The key feature of that definition is the 'complex system of interaction amongst researchers and users': this is the rate-limiting step for obtaining traction from high quality research.

Professor James Goodwin is Head of Research at AgeUK. He represents AgeUK on expert bodies including a Ministerial Advisory Group on Research, a UN Research Agenda for Aging panel, the UN Digital Health Group, a WHO Advisory Group, and leads the user involvement element of the EC-funded FUTURAGE project. He is also Chair of the Halcyon (NDA) Knowledge Transfer Steering Committee.

AgeUK has produced a knowledge transfer model for the World Health Organisation which identifies a number of elements contributing to the overall impact of research. It was one of the five sources of evidence which the UN used to generate their research agenda for aging over the coming 15 years.

It is the only knowledge transfer model for aging and health which is empirically based – there is evidence for each of the factors. Take 'climate and context for research use' as an example – if the users of research are not amenable to the use of evidence in changing practice and policy, then there will be no traction. That might sound completely intuitive but in my own experience in parliamentary circles in the UK and in Europe, the attitude towards research, as opposed to assumptions made in policy, has been ambivalent.

Now, the climate and context for research use on dementia look good in the UK. There is a National Strategy on Dementia, a Ministerial Summit on Dementia Research and a Ministerial Advisory Group on Dementia Research (one of the most effective Government bodies with which I have been involved).

The programme of government from the Coalition only had one dedicated reference to research and it was on dementia research. There have been funding calls for research on dementia and now, of course, there is the Prime Minister's Dementia Challenge.

Regarding 'linkage and exchange efforts', the Ministerial Advisory Group identified five sub-groups. Two were distinctly related to linkage and exchange efforts, specifically raising public awareness of dementia research and improving the translation of research.

On 'knowledge creation', the figures make interesting reading. Current spend on all sectors of R&D (that is both private and public sectors) came to £26,000 million in the UK in 2010. Health research is part of that and within that smaller sector is cancer research at £590 million, heart research at £169 million and then dementia research at just £50 million – it is very much the poor relation. Not only the poor relation in absolute terms, though: divide the number of sufferers by the amount of money and that results in cancer getting £295 of research money spent per patient, heart disease £75 per patient and dementia £61 per patient.

Emphases

The Ministerial Advisory Group decided that the three emphases for research should be 'care, cause and cure'. Of their five priorities, four are concerned with care, two on cause and two on cure – because these are inter-related.

There are five themes under the title of 'Push Efforts' with two focussing on getting the research out so that it can be effective. 'Pull efforts' on the other hand are concerned with how users absorb that research through public involvement and engagement. Here there is immense charitable involvement as well as intermediate organisations which link the researchers to the user community.

So knowledge transfer progress is steady but slow. The causes of dementia are understood quite well. There is an increased volume of research but a more systematic focus is needed on the factors which will generate traction and transition. ☐

DISCUSSION

A tool for the elderly

Some of the problems of a growing elderly population could be mitigated by encouraging social media use. Indeed, as the current younger generation ages, the use of social media for this purpose will seem quite natural. There may be less reliance on the printed word and more on visual representations, including virtual and layered reality. After all, for much of human history the primary means of communication has been through visual imagery, whether cave paintings or Renaissance works of art.

Alzheimer's - a personal perspective

Jan Hall

My mother died of Alzheimer's and I found, like many people, that when something touches your life then you often get involved in something that you would never have imagined.

I set two balls rolling: one was to capture lessons from carers about how to help care for loved ones better which I hope will be published next year.

The second was to result in the Evington Initiative, a group of business people who have had parents die of vascular dementia, Alzheimer's and the like, or who really cared about making a difference. We tried to make a business case to raise money because there is proportionately very little money raised and spent on research into dementia. What we learnt was that this is a complex area. The current drug trials are failing and it is not clear whether scientists really know what causes dementia.

The world is probably 10 to 20 (but possibly 30) years away from a cure. So it is imperative to seek that cure now because every day of delay means an even longer wait for all those people currently in their 50s who are going to have some form of dementia – perhaps one in three of us.

I am going to give the perspectives of family members, partly my father, partly my brother, partly me, my son and his cousins.

My father had to face the issue when my mother was asked to become the Ladies Captain at the Golf Club. He had to persuade her not to because he knew she would not cope with the complexity of running the club. He then started to watch his wife enter a daydream where he began to lose her as a presence in his life.

They could never go on holiday, or come and stay with us, because my mother could not cope with an environment that she did not know. So he did not stay away from home for several years. They lost many of their friends. People crossed the street so as not to talk to them because people could not cope with it. My mother's best friend stopped coming to see her.

My mother was not a very aggressive Alzheimer's person, but she was cross with my father a lot of the time. She thought he was not telling her things, that he was cheating or lying, because life did not make sense. So the person he adored was cross with him quite often.

For the last two years he never slept through the night and in the last year he was up two to three times every night.

Jan Hall is a Founder Member of the Evington Initiative. The Evington Initiative is a group of business leaders, all of whom have personal experience of dementia, working together to support research into this area. The Evington Initiative is being actively supported by the Wellcome Trust and Bupa. By profession Jan is a headhunter and a founding partner of the JCA Group which specialises in board-level searches.

Then, when she was finally taken into hospital, he watched her battle the ambulance men for half an hour because she was terrified: she did not understand what was happening to her and was being taken away by people she did not know; she thought she was in great danger.

These are just some of the things that dementia means.

For me – I lost my best friend. She used to be the person I told everything to: she always had brilliant advice. When I went to visit her over the last three months, she would still recognise me, she would beam and then her first words were always "Hello, how's your mother?" So, I lost my friend.

I found it really hard in the early stages. She could not say that she had Alzheimer's. For a lot of people it is just too hard, so denial is the way that they cope. But that means you lose your friend early because you cannot talk to them: they will not tell you what is going on, so you cannot help. With somebody in pain you can be sympathetic, but when somebody will not engage with you about what is happening, it is really, really tough.

After my mother went into hospital, my father went to see a doctor who said: "Oh my God, is nobody doing anything about this? Is nobody helping this man?" And social services then appeared. My father finally said "I can't cope" after telling himself for so long that he could.

My brother was upset that my mother was keeping my father prisoner; she would not let him go out of her sight. A doctor explained: "Think toddler. A small child won't let go of their mother's skirt and that is what somebody with dementia thinks about their principal carer. Don't be cross with her, she is not keeping him prisoner, she needs him, just like a tiny child needs their mother."

And then, finally, my son. Her grandchildren adored their grandmother but gradually she slipped away because that engagement could no longer happen. One day, aged 10 or 11, he turned to me, and her nieces could have said the same thing, and said: "Mummy, I don't think I want to see Nana anymore because I'm losing all my good memories of her."

Everybody who has been through this will have those kinds of vignettes. It is grim. The carers and the help that comes make it manageable, but it is so important to do the research because ultimately we have to find a way to help people avoid this disease.

In the short term, we need to help staff in care homes provide the best care for people. But it is also vital that when people are in the early stages and they go to the doctor for diagnosis, that there is help available for the carers and families.

Another man whose wife had Alzheimer's said the very worst thing about the whole journey was the time they went to see the doctor who told them, "Yes, I can confirm the diagnosis as Alzheimer's." So the man asked: "So, what happens now?" The doctor replied: "We'll see you in six months." The man said that was the cruellest thing anybody ever said to him. ☐

www.theevingtoninitiative.org/

DISCUSSION

Support for carers

There is an urgent need to help the carers of those living at home. The pressures on them can be almost intolerable. Assistance from social care is very limited and the difficulties of getting the patient accepted in a hospital or a care home are insufficiently recognised. Moreover, the cost to the state of people going into either a hospital or care home is much greater than when they are cared for in their own homes.

In tough economic conditions, how can Scotland find new ways to stimulate enterprise and innovation which will lead to economic success and prosperity? This topic was addressed in a joint meeting of The Foundation for Science and Technology and The Royal Society of Edinburgh on 25 October 2012.

Enterprise and innovation in Scotland

Ian Ritchie

Some months ago, the Business Innovation Forum at the Royal Society of Edinburgh decided to investigate the financing of technological innovation in Scotland[1]. Google and Facebook did not exist 10-12 years ago, yet they are now massive, global, powerful companies based in Silicon Valley. Scotland has the basic raw materials, as well as a very strong science and technology base. So can it create its own Silicon Valley?

The problem lies in securing funding – money has to be found to research a new product, develop it and manufacture it. In the late 1990s, before the 'dotcom' collapse, venture capitalists would invest heavily in projects at a very rudimentary stage but that is no longer the case. In the five years following that crash, seed money became much more difficult to find and investors were reluctant to involve themselves in the early stages of a project. The situation has become even worse since then.

The dotcom boom and then bust in 2001 wiped out a great deal of supposed wealth that did not really exist. When everything collapsed, value was destroyed as were any returns from that sector. Post-2001, the companies that were started would have been expected to exit by about 2008, but then the 2008 financial crisis wiped out many exit sales and a lot of Initial Public Offerings.

So for the last 12 years or so, risk capital in early stage technology businesses has not been making the required returns. Without those returns, people will not invest in this investment class; people with corporate funds to invest have steered away from early-stage risk capital when investing in technology.

Looking at Internal Rate of Return (IRR) figures since 2001, venture capital – which is really the investment in 'risk' – was initially very healthy but it quickly disappeared in the aftermath of the dotcom episode. Most returns these days come from management buy-outs and larger, later stage, deals. Investment companies find it much easier to turn around an under-performing family-managed company or, at the top end, a public sector organisation that is being privatised.

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Fortunately, in the technology sector in particular, business angels have come to the rescue and taken the strain (helped by the fact that the UK offers them a very good tax break system). This year the Seed Enterprise Scheme provides 50 per cent relief (normally 30 per cent) on income tax when investing in an early stage company. Also, after three years when the companies are sold the gains are tax-free. That is very attractive and has resulted in a favourable environment for angel investors in the UK. The scheme has survived through a number of changes of government, so it seems to have become a fixed point in the investment landscape.

In Scotland, there is also the Co-Investment Fund. This does not look at individual companies but rather at the angel groups themselves, approves them and then invests with them. That means that an angel group that can raise say £400,000 can immediately invest £800,000. This is crucial because this level of funding – between £500,000 and £1.5 million – is what most technology companies need. The Fund has been very useful in Scotland.

When the Fund began in 2003, there were three angel groups in Scotland: now there are 19. So it has been very successful in encouraging seed investment in Scotland. There are downsides, though: angels are usually limited to deals worth less than £2 million. So this system is not ideal for larger, more ambitious or longer-term companies. New businesses in life sciences or green energy, for example – which will need a lot more money over a longer period – are very difficult to finance with angel money.

Also Angels do not mix very well with subsequent venture capital – the UK's Enterprise Investment Scheme only allows holdings in common stock, i.e. ordinary shares. However, venture capitalists almost always require preference shares. For this reason, many angel groups just do not want to move companies onto venture capital where they will become 'second class shareholders'. The end result is that companies get sold too young, too early and often too cheap.

Where then is the larger scale financing to come from for technology companies? The report by the Business Innovation Forum came up with several possibilities. In 1979, the USA changed its regulations, making it possible for pension funds to invest in risk capital for the first time. This has since driven a great deal of venture capital funding in the States. By and large, pension funds do not invest in venture capital or risk capital in the UK, because their actuaries tell them it is not a good category. Yet there are ways of constructing a fund, I am convinced, which can give a guaranteed return to a pension fund, one that they would be quite happy with. These types of models should be looked at more closely.

New personal investment vehicles might unleash more funding resources. There could be a Scottish Innovation Fund based on Venture Capital Trust (VCT) models which also provide good tax breaks.

Then there are crowd-funding methods. These are at a very early stage and currently tend to support theatre groups and similar social and charitable projects, but they could be developed and turn into bigger, more effective instruments.

Scottish Enterprise used to have a division called Scottish Development Finance (SDF) which operated as a venture

capitalist. It co-invested with real venture capitalists, but never took more than 50 per cent of a deal. It was a very straightforward operation, but it brought in a good number of partners from overseas.

My own company received investment from SDF and my other three investors were all London-based. Because SDF was here in Scotland, it invested in the company, came to Board meetings and involved itself in the company. SDF was 'privatised' into Scottish Equity Partners in about 2004; although the right thing to do, this was a sad loss because SDF invested only in Scotland and only in technology, whereas SEP invests throughout the UK. It may be a good time to invent new SDFs, particularly in areas such as life sciences or green energy. □

1. www.rse.org.uk/cms/files/advice-papers/2012/AP12_10.pdf

How universities can catalyse innovation

Pete Downes

It is very important to understand why universities carry out research, especially given the current economic climate. Essentially, there are three reasons: it provides a legacy of new knowledge, so there is a responsibility, in fact, to provide for future generations; as a species, humanity is curious by nature – the creation of new knowledge is intrinsically rewarding, it is motivating and it is inspiring; and quoting Einstein, "We are curious for a reason" – knowledge of even the most fundamental and esoteric kind will eventually be put to good use.

Now, in the report by the Council for Industry and Higher Education (CIHE) on Enhancing Impact[1], Ric Parker of Rolls Royce very simply stated that it is "the role of universities to top-up the hopper of research" – I think it is more complex than that. The report also argued that university research is designed to achieve a new understanding of natural phenomena and technologies, while the role of business is to make innovation its central goal. Again, I think it is more complex than that and it is critically important to get the relationship between these two sectors right.

One critical element is the way in which universities catalyse interchange between those components. An analysis of research funding in UK universities shows that a large proportion falls under the category of user-inspired research. This can be thought of as a transition state between pure-basic and pure-applied research.

In a world where governments and taxpayers invest heavily in universities, these institutions cannot abdicate responsibility for ensuring that research has utility for society. Universities are not merely 'filling the hopper', but ensuring the hopper and the knowledge within it are delivered in a form which can be understood, utilised and developed by user communities.

How can universities act as catalysts for this process? They must deploy their intellectual property, the product of their research activity, wisely. Also important is IP's lesser-known cousin – the 'know-how' that exists within research groups and research teams. That know-how, and the intellectual property that it generates, should be used primarily to drive productive partnerships with innovative businesses.

Professor Pete Downes OBE FRSE is Principal and Vice-Chancellor at the University of Dundee. He is a distinguished biochemist who has played a key role in developing life sciences at the University of Dundee to its current status as a global player and which contributes around 16 per cent of the region's economy. He is also the Convener for Universities Scotland which brings together 19 higher education institutions from across the country.

As a model of business/university partnership, take the Division of Signal Transduction Therapy at Dundee. This was set up nearly 15 years ago and is one of the first examples in Scotland, possibly in the UK, of a genuinely open innovation model. It took a year to get six pharmaceutical companies and their lawyers together under a single agreement with the university! It must have been a good deal, though, because it has been renewed four times and has raised around £50 million of inward investment into Dundee.

Both Pfizer and GSK, at different times, have named it their most valuable academic collaboration worldwide. It is certainly one of the largest and longest-running. Not many large pharmaceutical companies engage in collaborative work that lasts (with the current agreement) for 18 years.

Another example uses a slightly different approach and is concerned with lowering the risk of novel university research to business. Over the last few years Dundee has been developing its own industry-standard drug discovery unit, funded primarily by The Wellcome Trust but with involvement from a number of pharmaceutical companies who fund particular projects. By creating what I call a 'translational engine', individual bioscientists have the opportunity to develop an assay that can be used to find prototype drugs. This facility is available to all of Scotland's academic life sciences researchers through the Scottish Universities Life Science Alliance. That might not sound like a great deal, but in the world of drug discovery, being able to 'de-risk' the project in this way is a very important step to triggering investment.

The first job of any academic scientist, though, when they start their careers, is to find a way to become the best in the world in their subject. University leaders and managers should stop hounding them to get knowledge-exchange numbers up; their job is just to get started. In the right environment, the rest will follow.

It is very clear in the UK and especially so in Scotland that investment in R&D in our businesses is low compared to international standards and it is especially low amongst the small to medium sized enterprises that form the majority of the developing businesses in Scotland. It is surely right, then, that the Scottish Funding Council favours SMEs through its knowledge exchange funding formula; big companies should actually be paying for the research. SFC also supports 'Interface', an organisation which is also making real inroads in bringing universities and SMEs together in Scotland.

Finally, the most important product of a university is its graduates. In order to create more innovation, Scotland needs to produce graduates who understand innovation and want to participate. At the Massachusetts Institute of Technology (MIT), 35 per cent of graduates start a business within a few years. If something similar could be achieved at Dundee and elsewhere, that would go a long way to producing a sustainable pipeline of innovative business. □

1. www.cihe.co.uk/category/knowledge/publications

Investing to achieve results

Phil Smith

It is important to recognise that we already have a culture of enterprise and innovation in Scotland and, indeed, throughout the UK. There is no shortage of excellence in skills, in research, in business acumen and in enterprise and innovation.

There are many stories to tell that demonstrate we have best-in-the-world businesses and research, absolute gold-medal standard. And we must exploit our strengths. Even when the UK is second- or third-best in the world in business we are still excellent. If businesses were to accept defeat for not being first, many top-notch, extremely profitable Scottish and UK businesses would not exist.

The investment climate has been dreich. However, it is never a viable business option to hide below deck to wait out bad weather. The American William Ward expressed this Darwinian necessity by saying: "The pessimist complains about the wind; the optimist expects it to change; the realist adjusts the sails." There are many business opportunities even in very difficult situations. The question is how to find the silver linings.

It is vital to find new ways to deliver sustained economic growth if Scotland is to get past the current problems and restore its economy to strength. As recessions end and economies start to grow, nations whose knowledge-based businesses are most innovative are the ones that recover the fastest and grow the most.

Without serious investment to support innovation now, the UK and Scotland may have a small amount of short-term growth but could lose the ability to compete in the future. A well-coordinated industrial policy is needed but this has to be very different from industrial policies of the past which backed losers rather than focusing on picking races and capitalising on our strengths. Today, the game has changed. Technology is driving change like never before, creating completely new businesses, markets and sectors almost overnight. No business in any sector is exempt. TSB's role is to:

- bring together the right resources to create excellent new technologies;
- quickly identify and capitalise on technological opportunities;
- avoid 'fad' tech investments that end in destructive market bubbles (although some failure is a key characteristic of entrepreneurship and risk-taking).

Phil Smith is Chairman of the Technology Strategy Board (TSB) and Chief Executive Officer UK & Ireland for Cisco. He was appointed Chairman of the UK Technology Strategy Board in December 2011. He has a 30-year track record within the ICT industry, advising leading global organisations in the private and public sector on how to drive transformation, productivity and sustainable growth.

The other big force in future markets will be the challenge-led opportunities caused by global seismic changes in population and the environment. TSB is addressing the challenges – energy supply, climate change, congestion, ageing population and so on – that will shape future market opportunities. Piecemeal pushes into silos of skills, regional aid, R&D and infrastructure will not be sufficient. Instead, the country needs to build highly competitive knowledge-based sectors, markets and value chains through integrated strategies that can bring together all of these things. These challenges need focus and orchestration to bring together the right people and resources with intelligent oversight and project management.

The innovation ecosystem is very complex; a few deficiencies anywhere in the innovation landscape can skew the whole balance, creating destructive bottlenecks in the pipeline for businesses. Now more than ever, businesses need a connected landscape when working with Government. Businesses, after all, do not recognise Government Department boundaries.

In Scotland, a range of partners, including Lotus, Nissan and Jaguar, Scottish Power, the University of Strathclyde and Glasgow City Council are participants in big Demonstrator projects like Reevolution (a £20 million public-private programme). Demonstrators are large-scale validators of consumer confidence and markets and this one is entitled the Ultra Low Carbon Vehicle Demonstrator. Dundee's Axeon has also been part of the programme. It is Europe's largest independent designer and manufacturer of lithium-ion battery systems for electric and hybrid vehicles, and in addition produces high volumes of batteries for e-bikes, power tools and mobile technologies.

The Dallas programme (delivering assisted living lifestyles at scale) will help hundreds of thousands of older people to live more independently by using innovative products, systems and services. The programme has been developed by TSB and joint funded by the National Institute for Health Research and the Scottish Government. £10.4 million has been invested in Scotland, helping 55,000 elderly people here. The health sector offers huge scope for innovation.

The Offshore Renewable Energy Catapult will capitalise on Scotland's strong renewable energy market. Catapults are centres of innovation excellence and there are currently seven, focussed on different technologies. This centre will concentrate on technologies and components for offshore wind, wave and tidal power.

Skills placement is being fostered through Knowledge Transfer Partnerships (KTPs). TSB is helping SMEs with Proof of Market, Proof of Concept and Prototype Development through the UK Smart Awards. In addition, it is helping small businesses win Government business though pre-commercial R&D contracts as well as helping Government deliver more effectively and save money with the innovative ideas that SMEs can provide through its Small Business Research Initiative (SBRI).

TSB has worked closely with colleagues in Scottish Government, Scottish Enterprise, Highlands and Islands Enterprise and other partners to increase awareness and engagement of Scottish business in our programmes, to align our activities and to identify opportunities for joint working, collaboration and as well as (increasingly) co-funding. Scotland's six identified priority sectors of Energy, Life Sciences, Creative Industries, Financial Services, Food and Drink and Tourism all align strongly with the TSB's key sectors. ☐

Recent dinner/discussions organised by the Foundation for Science and Technology are listed below. Summaries of these and other events – as well as the presentations and recordings of the speakers – can be found on the Foundation website at: www.foundation.org.uk

Lecture (Science, Innovation and International Development) and Christmas Reception

5 December 2012

Professor Chris Whitty FMedSci FRCP FFPH, Chief Scientific Adviser, Department for International Development
Mme Geneviève Fioraso, Secretary of State for Higher Education and Research, Government of France (Professor Cyrille van Effenterre from the French Embassy spoke on behalf of the Minister)

The contribution of mid-sized companies to the growth of the economy

26 November 2012

Dame Nancy Rothwell DBE FRS FMedSci, President and Vice-Chancellor, University of Manchester
Tera Allas, Director General for Economics, Strategy and Better Regulation, Department for Business, Innovation and Skills
Professor Luke Georghiou, Vice-President for Research and Innovation, University of Manchester
Richard Burslem, Site Director, Wallwork Heat Treatment Ltd

Delivering the industrial strategy - how can government promote growth?

14 November 2012

Sir John Parker GBE FREng, President, The Royal Academy of Engineering
Professor Alan Hughes, Director, Centre for Business Research, Judge Business School, University of Cambridge
The Rt Hon David Willetts MP, Minister of State for Universities and Science, Department for Business, Innovation and Skills

Energy policy: selecting the right options for future electricity supply

7 November 2012

John Hayes, MP for South Holland and The Deepings, Minister of State for Energy, Department of Energy and Climate Change
Dr Andrew Spurr, Managing Director, Nuclear Generation, EDF Energy
Dr John Loughhead OBE FREng, Executive Director, UK Energy Research Centre
Dr Paul Golby CBE FREng, Former Chairman and Chief Executive, E.ON UK (*panellist*)

What are the best ways to promote a culture of enterprise and innovation in Scotland?

25 October 2012

Ian Ritchie CBE FREng FRSE FBCS, Vice President, Business, Royal Society of Edinburgh
Professor Peter Downes OBE FRSE, Principal and Vice-Chancellor, University of Dundee
Phil Smith, Chairman, Technology Strategy Board, and Chief Executive Officer, UK & Ireland, Cisco

An ageing population: meeting the challenge of caring for the rising number of dementia patients

3 October 2012

Dame Sally Davies DBE FMedSci, Chief Medical Officer, Director General Research and Development, and Chief Scientific Adviser, Department of Health
Professor Julienne Meyer, Professor of Nursing: Care for Older People and Director of the My Home Life Programme, City University
Professor James Goodwin, Head of Research, Age UK
Jan Hall, Founder Member, The Evington Initiative

The future strategy for the management of mental health in the UK

11 September 2012

Lord Layard FBA, Director, Wellbeing Programme, Centre for Economic Performance, London School of Economics and Political Science
Professor Simon Wessely FRCP FRCPsych FMedSci, Chair and Head of Department of Psychological Medicine, and Vice Dean, Institute of Psychiatry, King's College London, and Consultant Liaison Psychiatrist, Maudsley and King's College Hospital, King's College London
Professor Sir Bruce Keogh KBE DSc FRCS FRCP, Medical Director, National Health Service in England
Dr Andy Richards, Chairman, Abcodia

The impact of the use of social media on society and democracy

11 July 2012

Dr Mike Lynch OBE FREng, Founder of Autonomy Corporation plc
Julian Huppert, MP for Cambridge
Kathryn Corrick, digital media consultant.
Candace Kuss, Director of Planning and Interactive Strategy at Hill & Knowlton Strategies (*panellist*}.

Making science work

20 June 2012

Sir Paul Nurse PRS FMedSci, President, the Royal Society
David Eyton, Head of Technology, BP
Dr Andy Richards, Chairman, Abcodia
Professor Rick Rylance, Chief Executive, Arts and Humanities Research Council, and Chairman of the Committee of the Chief Executives of the Research Councils

Achieving food security in the face of climate change - the Climate Change, Agriculture and Food Security (CCAFS) Commission Report

23 May 2012

Sir John Beddington CMG FRS FRSE, Government Chief Scientific Adviser, Government Office for Science
Dr Peter Holmgren, Director, Environment, Climate Change and Bioenergy Division, Food and Agricultural Organisation of the UN
Professor Tim Wheeler, Deputy Chief Scientific Adviser, Department for International Development
Sir Robert Watson CMG FRS, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs (*panellist*)

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