Education for Engineering response to the consultation on skills for the low carbon economy

About Education for Engineering

Education for Engineering (E4E) is the mechanism by which the engineering profession offers coordinated and clear advice on education to UK Government and the devolved Assemblies. It deals with all aspects of learning that underpin engineering. It is both proactive and reactive to ensure that the education system continually remains appropriate to meet the challenges facing society. It is hosted by The Royal Academy of Engineering with a wide membership drawn from the professional engineering community.

E4E represents the 36 Professional Engineering Institutions and the Engineering Council, EngineeringUK and the Royal Academy of Engineering. A full list of the organisations which E4E represents is provided as an appendix. We trust that, in assessing responses to this consultation, the government will ascribe importance to E4E's response in line with the wide range of Professional Engineering Institutions and organisations which we represent.

General points

Developing the skills of the workforce must be a key part of efforts to shift towards a low carbon and resource efficient economy (LCREE). Government must take the following into account:

- There must be two inter-related ambitions: firstly, to reduce carbon usage across the whole of the UK economy; secondly, to create a new sector of the economy making low carbon products. Skills issues must be considered in regard to both these ambitions.

- Government must define what it means by "low carbon skills". There is not an adequate definition in the consultation document and this makes it difficult for the government to develop a coherent strategy.

- Understanding of and skills for the low carbon economy should be embedded into the curricula, learning paths and qualifications at the primary, secondary, further and higher levels of the education system. 70% of the 2020 workforce has already completed tertiary education, so wide availability of opportunities for adults to up-skill and re-skill will be essential.[1] Meanwhile, children currently starting primary school will enter the workforce when the shift to the low carbon economy will be well under way, and they will need to be equipped with appropriate skills. Primary education plays a considerable part in forging children's attitudes to science and engineering; the time to make improvements in the primary sector is now.

- The government must increase the number of people training to become engineers and technicians. When the engineering skills are in place, this in turn will help to stimulate development of new low carbon industries and provide existing industries with a workforce capable of reducing carbon output.

- Once trained, engineers and technicians are flexible and able to apply their skills in different circumstances, so for the most part they will be able to adapt to the changing economy, transferring across from high carbon to low carbon sectors. The consultation document discusses "specialist" skills for low carbon sectors (and the role which government should play in meeting specialist skills needs); in fact, for the

[1] *Prosperity for all in the global economy - world class skills* (HM Treasury, 2006), p.13

most part “generic” engineering skills can be applied across both high carbon and low carbon sectors. There are exceptions, where specialist skills will be required, for example in the construction sector new skills will be required in constructing and installing low carbon products and technologies.

- Although engineers and technicians are flexible, the transfer of engineers from high carbon to low carbon sectors will be aided if engineering qualifications are modified to include greater focus on skills for the low carbon economy. In the main, entirely new programmes and qualifications will not be required; rather, existing learning programmes and qualifications should be adapted. Of course, there will be some specific and important exceptions where new qualifications will be required.

- As part of efforts to integrate teaching of skills for the low carbon economy into all levels of education, there must be significant improvements in the way examples of best practice teaching are distilled and disseminated. Teachers and lecturers are not always well-prepared to teach the skills for the low carbon economy, and at present it is unclear where and how they will be given the resources and information they need to deliver on what must become an important aspect of their role.

- There are two elements to LCREE: a low carbon economy and a resource efficient economy. The consultation document focuses mainly on low carbon, which is justified because switching to low carbon is the greatest environmental challenge. However the need to increase resource efficiency should not be ignored. This is particularly the case in regard to the built environment, for which there is little gain from designing low carbon buildings if, once built, facilities staff do not know how to ensure efficient operation.

1. What more can employers, schools and Government do to promote the take up of STEM subjects by young people, and encourage them to consider careers in low carbon sectors?

An integral aspect of STEM education is consideration of society and the environment and, in the case of engineering and D&T, developing students’ capability to implement practical solutions to world problems drawing on design, mathematics and science. These are the skills that will be required for the UK to shift towards a low carbon economy.

While much more progress is needed, in recent years there have been some positive trends in the numbers of students on STEM courses. More students are now choosing to study three separate sciences at GCSE and mathematics and sciences at A-Level. Design and technology (D&T) remains the most popular non-core subject at GCSE and the A-level D&T entry is so far holding up despite the 2004 change in statutory arrangements at Key Stage 4. Government must now build on these positive trends and encourage even more young people to study sciences (particularly physics and chemistry), mathematics and technology subjects (ICT and D&T) post-16.

We look to the Government to honour its commitment to support growth in the number of apprenticeships - particularly employed apprentices at Advanced/Modern and Higher levels, but also Young Apprenticeships. Again there have been some positive trends in recent years, with a welcome increase in the number of young people taking engineering-related options from the age of 14, including Young Apprenticeships, BTECs and other vocational qualifications, and the engineering-related 14-19 Diplomas. Post-16, the expansion of Apprenticeships and expansion to the BTEC suite (including level 3 awards, HNC and HND) are very positive developments. The government must now build on these trends.

The new government should retain existing policies where they have been successful. For example, the engineering profession has supported 14-19 Diplomas in engineering, manufacturing and in construction & the built environment and opportunities should be sought to build upon the work done in their development and introduction. Another successful programme is the Digital D&T Programme. This programme provides CPD for D&T teachers, allowing them to develop their ability to teach electronics, systems and control – vital skills if we are to develop low-carbon solutions to world problems. The Digital D&T Programme deserves continued support.

Only through the highest quality teaching will young people be inspired to become the next generation of expert and innovative low-carbon engineers, engineering and ICT technicians. As well as the D&T Programme, we fully support other excellent initiatives supporting STEM teachers: STEMNET, the Stimulating Physics Network, the Further Mathematics Support Programme, the national and regional Science Learning Centres and the National Centre for Excellence in Teaching Mathematics. We urge Government to preserve these. E4E also sees a need for more regular opportunities for teaching and support staff to experience placements in business and industry. This is particularly important for staff working in the secondary and tertiary phases as industrial experiences contribute to more relevant teaching and learning but can also broaden teachers' understanding and help them give better informal careers guidance to students.

Considerable growth in the number of people with practical, intermediate level (technician) skills will be vital for the low carbon economy. Further education colleges and work-based-learning providers are an important source of vocational and occupational training for the engineering and ICT sectors. Learners in all parts of the country need to have access to high quality vocational and occupational engineering learning opportunities within a reasonable travel-to-learn distance – including within workplaces. In addition, joined-up systems of support and quality assurance for the FE sector will be vital, and the introduction of the National Apprenticeship Service (NAS) and the national Specification of Apprenticeship Standards are viewed by E4E as very positive developments, which will encourage entry to the engineering profession at technician level.

The formation of the Technician Council will be an effective way to create a common framework of technician registration standards across health, science, ICT and engineering and to promote the status of technicians. The Council can also work to promote the status of technicians in society, which will help attract a more diverse proportion of the population into engineering, ICT and other careers key to the low-carbon economy. We look to the Government to support the further development of the Council as a vital means to change industrial and business culture in the UK, while widening vocational routes into the professions.

Many young people are still unsure of the career direction to take at the age of 19. Thus the proposal to introduce a single, all-age careers service is one which E4E supports and hopes to see implemented as a matter of priority. Drawing on the considerable and wide ranging experience of its member organisations, E4E is committed to providing advice to careers advice organisations and practitioners on entry to and progression in professional engineering and technology careers. Working with specialist Sector Skills Councils, the engineering professions' substantial expertise in the low-carbon field could usefully be harnessed to accurately but inspirationally inform young people about the careers which will become available as the UK shifts to a low carbon economy.

2. What more can universities, working with businesses, do to help stimulate demand for the high level STEM skills required in the low carbon economy?

There is a need to ensure that the content of engineering degrees provides students with the up-to-date skills required by industry and for the emerging low carbon economy. The problem is that university courses can be slow to reflect changing industry needs. As the Royal Academy of Engineering has stated in a report about developing a low carbon built environment, this is because "university courses take time to design, approve and implement and rely on there being sufficient authoritative reference materials on a subject."[2]

One way of tackling this would be to launch a large scale programme of staff exchanges and placements between university teaching staff and employees of firms and organisations already active in the low carbon economy. Some models and case studies of such staff exchanges and placements are provided in another report by the Royal Academy of Engineering, *Engineering Graduates for industry*, which was published earlier this year.[3] There may be a role for the engineering institutions in any such exchange programme.

The engineering profession has adapted degree registration to encourage teaching of sustainability. For example, degrees accredited by the Joint Board of Moderators (JBM) must include teaching of sustainable development as a pervasive element throughout the degree programme.[4] The JBM is a grouping of the Institution of Civil Engineers, Institution of Structural Engineers, the Institute of Incorporated Highway Engineers, and the Institution of Highways and Transportation. It accredits civil engineering courses in 55 Higher Education Institutions, a number set to rise, which together train around 3500 HNCs, HNDs, undergraduates and postgraduates per annum.

Levels of funding are a key issue for engineering departments at universitites. The consultation document refers to government programmes which aim to increase the extent to which universities deliver learning in engineering and other areas which will be crucial to the low carbon economy. Such programmes are welcome, and in particular we commend HEFCE's £350 million support programme for strategic and vulnerable subjects, from which engineering has benefited substantially.

However, much as such programmes are important, their impact will be limited whilst strategic subjects are under-funded through mainstream funding routes. Prior to 2003/04, engineering departments received double the basic unit of resource for teaching, in recognition of the fact that equipment and other costs make engineering degrees more expensive to deliver than other degrees. In 2003/04, the extra funding for engineering was cut to 1.7 times the basic unit of resource. The Royal Academy of Engineering has recently published a report analysing the state of engineering in universities. The report finds that universities are facing funding shortfalls for teaching of around 15%, resulting in:

- increased student to staff ratios;
- reduced opportunities for tailored, individual support for students;
- and serious pressures on routine expenditure (equipment, maintenance etc).[5]

If the UK is to meet the skills needs of the low carbon economy, the funding engineering departments receive from HEFCE for teaching must be raised to meet the costs of providing high quality provision. Of course, universities receive tuition fees from students as well as funding from HEFCE. The levels at which tuition fees are set is currently under review. Given

[2] *Engineering a low carbon built environment: the discipline of Building Engineering Physics* (RAEng, 2010)
[3] *Engineering graduates for industry* (RAEng, 2010)
[4] http://www.jbm.org.uk/uploads/JBM123_AnnexCSustainability.doc
[5] *Engineering graduates for industry* (Royal Academy of Engineering, 2010), p.4

the need to increase the number of students applying to subjects like engineering, there are strong arguments for the government meeting the shortfall in funding rather than students.

3. How can more colleges and universities be encouraged to respond to the need for specialist skills in emerging low carbon sectors?

Once trained, engineers and technicians are flexible and able to apply their skills in different circumstances, so for the most part they will be able to adapt to the changing economy, transferring across from high carbon to low carbon sectors. In other words, many of the "specialist" skills referred to in the question are, in fact, generic engineering skills. Given this, the priority of government must be increasing the number of people opting to become engineers and technicians in the first instance.

This said, the process by which engineers adapt to the low carbon economy will be aided if engineering qualifications are modified to include greater focus on minimising carbon usage and greater focus on low carbon technologies. For the higher education sector, ways of achieving this are covered in answer to question two. For the further education sector, an important part of the solution must be finding better ways to disseminate best practice teaching.

There will be some specific and important exceptions where the demands of the low carbon economy will require new specialist skills, for example in the construction sector new skills will be required in constructing and installing low carbon products and technologies.

4. Is our overall analysis of the skills challenges, as outlined in this document, correct?

Research by Pro Enviro provides the most comprehensive study of the skills which will be required for the low carbon economy. However, Pro Enviro stress that they found there to be only a small evidence base, and that addressing this lack of evidence must be an immediate priority for government.[6]

Broadly, the consultation document makes a reasonable appraisal of the skills challenges facing the UK, within the confines of the evidence available. However, E4E does not agree that the skills to decarbonise buildings and construction "will be mainly at Graduate level."[7] Of course more high level engineering skills will be required, but many of the technologies that are key to achieving the targets already exist, for example solar water heating, combined heat and power (CHP) and microgeneration. There is an urgent need for more technicians who can install, repair, maintain and operate these systems, especially given that retrofitting existing buildings forms such a major part of the agenda.

E4E would also highlight that a significant skills challenge may be ensuring understanding and commitment to green issues at management levels in the private sector, as discussed at length in the report *Lean and Green: Leadership for a low-carbon future* (Chartered Management Institute, 2009).

Finally, the consultation document fails to adequately acknowledge one of the significant problems faced by the education and skills system: confusion amongst employers about the very many different qualifications, bodies and initiatives. Government must continue to support the simplification agenda being led by the UK Commission for Employment and Skills (UKCES).

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[6] *Skills for a low carbon and resource efficient economy* (ProEnviro, 2009)
[7] Consultation document, p.5

5. What are the best ways to replicate the examples of good practice provided throughout this document quickly and effectively?

The consultation document provides details about examples of best practice led by employer associations, Sector Skills Councils and others. Such examples of best practice are welcome and should be replicated; promulgating details about successful schemes, as through this consultation document, is one useful approach.

E4E has particular concerns that teaching of STEM in the secondary, further and higher education sectors does not reflect the changing needs of industry as the UK shifts to a low carbon economy. There is a particular need to replicate instances of best practice where teachers and lectures are successfully teaching up-to-date skills.

6. Is stimulating innovation in skills development and delivery the best way forward?

Yes, Government should encourage innovation in the way courses are run and the approaches taken by teachers and lecturers. However, for the most part what is required will be innovation *within* courses, rather than the creation of entirely new learning routes. Of course, there are some exceptions where new technologies and policy imperatives will require new training routes. For example, there will be a need to continue developing the new Building Engineering Physics discipline, as discussed in the recent report by the Royal Academy of Engineering.[8]

7. How should employers and Government plan for the future re-deployment of skilled workers from high carbon industries to low carbon industries, and ensure a just transition?

Significant government intervention should not be required for the successful re-deployment of engineers from high carbon to low carbon sectors - many, probably most, of the engineering skills in question are generic and hence readily transferable with some training. As regards education and skills policy, the main aim of government must be to increase the number of people training to be engineers and technicians in the first instance. Of course, there will be some exceptions where new technologies will require substantial new skills and in such cases government should play a role.

8. For the power sector skills we have identified, what is the best way to accelerate skills development beyond what is planned?

Low carbon power generation will require more people opting to enter the engineering profession at graduate and technician level. However, importantly, addressing skills issues cannot in itself bring about a shift to low carbon power generation: government must use other levers at its disposal to bring about a shift from high carbon to low carbon power generation. Once this happens, the engineering workforce will migrate accordingly. However, there will be specific instances in which special training may be required.

The consultation document only briefly mentions smart grids, and government should be aware that these have a high demand for new skills and services; intelligent networks and customer energy engagement are fundamentally more complex than the current system and will require new skills in R&D, system design and planning, commissioning, operation and front line support.

The consultation document lists existing government activities which aim to increase the number of people developing skills to enter the power sector. Of these, we particularly

[8] *Engineering a low carbon built environment*

welcome the introduction of the National Skills Academy for Power, which has benefited from wide support from industry and academia. The Academy is wide-ranging in its scope, operates at a range of levels of the education system and will help address many of the issues identified in this consultation response.

Any discussion about introducing still more new programmes must be informed by knowledge of the existing programmes run by non-government organisations, such as the E3 Academy and the Institution of Engineering and Technology Power Academy and the IET Power Networks Research Academy (PNRA).

9. What more can be done, both within the power industry, and through Government energy policy, to promote energy-related careers to young people?

As stated in answer to question one, better careers advice at the right age will enable more young people to find out about engineering careers. The proposal to introduce a single, all-age careers service is welcome and E4E hopes to see this implemented as a matter of priority.

In designing the new careers service, the government must consider different and novel approaches to delivery of careers guidance. In the past, careers guidance systems have been based around the expertise of careers advisors. As it is difficult for careers advisors to maintain up-to-date knowledge on the wide range of careers available in engineering, the new careers service could additionally put users in contact with engineers in industry. Users would then be able to learn from those with first hand experience. There are number of existing organisations which could facilitate this, including STEMNET and possibly the engineering institutions.

The introduction of the National Apprenticeship Service (NAS) and the new Specification of Apprenticeship Standards are also viewed by E4E as very positive steps towards encouraging entry to the engineering profession at technician level.

10. How can we stimulate the demand for the skills required to meet the CCS market opportunity, including a range of skills; from advanced R&D skills, to crafts and technical skills?

Carbon Capture, Transportation and Storage (CCS) will grow over the coming decades and will provide significant employment opportunities, especially in geological storage, where the UK is particularly well endowed with suitable geology that may serve both the UK and wider Europe. CCS mainly requires the combination of skills from existing sectors and therefore the key priority will be to efficiently draw these together and provide limited CCS specific additional skills. The relevant skills from existing sectors include process engineering, power engineering, chemical engineering, control engineering, gas engineering, pipeline engineering, systems engineering, safety engineering, offshore engineering and geology. The extent to which people trained in these areas will be ready to transfer to CCS would be enhanced by encouraging the courses in these areas to include CCS related learning, modules or options. There may be a need for some limited courses and training with a prime focus on CCS, to provide essential co-ordination skills, but in the main, skills adapted from existing sectors will suffice. This also means that there will be a need for “top-up” training to allow people with relevant existing skills and experience to adapt them for use in the emerging CCS area.

Whilst some of the existing sectors may be declining and so be able to provide transferable skills (e.g. oil and gas), other sectors will also be growing (power systems engineering) and so the CCS skills requirements may exacerbate future shortages in these areas. This should

be recognised in planning the measures and quantities needed to provide future skills in specific topics.

11. Can the Zero Carbon Hub approach be used as a model for identifying skills needs, and stimulating demand for those skills, across the construction sector?

The published objectives of the Zero Carbon Hub appear to chime exactly with the aims set out in the consultation document. There are numerous different organisations, agencies and sub sectors involved in delivering low carbon solutions in construction and the built environment. Also, the sector is largely made up of SMEs and microbusinesses, and "working practices within it have been competitive and adversarial" which "inhibits the dissemination of building performance information."[9] If the Hub operates as intended, it should facilitate the joined up thinking which will be so necessary for the sector to achieve its targets. The Hub will need to achieve buy in from the universities, employers, professional bodies and trade associations, SSCs and other relevant agencies. E4E's perception is that it does not currently enjoy a high profile and this will need to change.

12. What more could it do to deliver low carbon and resource efficient skills in all parts of the construction industry?

The construction industry would benefit from more young people studying STEM (see answer to question one).

The pressure government can bring to bear through its own procurement policies are perhaps overstated in the consultation document, given that public spending cuts may be deeper than was expected when the document was drafted. More direct government action, through rewarding carbon friendly business practices and penalising others, may be necessary.

The government may wish to commission research to identify the extent to which firms spearheading the move to a low carbon economy have been hit by the recession, relative to the economy as a whole.

13. What more should Government and industry do to ensure that those retrofitting existing buildings have the necessary skills?

E4E welcomes the creation of the National Skills Academy for Environmental Technologies under the direction of Summitskills. In this instance, new qualifications are required, and they are now being developed accordingly. The new qualifications will need to be well publicised and explained to members of the public and householders who will be employing these contractors.

Crucially, the skill set which these technicians and tradesmen will need must include communication with the customer and the ability to explain how the new, very different, technologies work. Experience shows that, in commercial and public buildings, the actual performance in practice of properties which were designed to be low carbon is sometimes very poor. This is because building users and facilities managers do not know how to operate the systems (such as building management systems) which have been installed. Monitoring, maintenance, follow-up and support will be crucial, and should be built into the skills training.

[9] *Engineering a low carbon built environment*

The achievement of personal professional registered status for learners (EngTech) should be an integral part of the skills programmes. The requirements for achievement of EngTech include communication and interpersonal skills, and a commitment to CPD.

14. What more could be done to improve awareness of low and zero carbon regulations along construction industry supply chains to enable them to take advantage of new low carbon markets?

Recent years have seen unprecedented advances in laws and regulations governing carbon emissions of buildings, and their energy efficiency (Part L). However, we do not see these provisions being enforced, and no penalties are being exacted for non-compliance. It therefore appears that the impetus which should drive carbon friendly innovation in the supply chain is lacking. We recommend that government reviews the way in which compliance is organised as a matter of urgency.

15. How should we capture and respond to the key skills demand and supply issues in the eco-towns projects and share lessons learnt more widely?

The engineering profession has expressed strong concern about the eco-towns projects. In particular, we are concerned that the eco-towns initiative will be used to support the development of large numbers of low cost houses on green-field land, creating a strong likelihood of additional use of private cars for commuting purposes. Overall there will be little real improvement in environmental performance.[10]

Nonetheless, the building of the first wave of eco-towns has been confirmed and, as much as is possible, the government must use the opportunity this creates to increase public interest and levels of engagement in environmental issues.

Historically, there is a dearth of accurate evidence about actual performance of new buildings because of reluctance to share commercially sensitive data.[11] The results of post-occupancy evaluations, if they take place at all, are not disseminated. The discipline of building physics has therefore been slow to develop. In instances where eco-town projects will proceed, this should be used as an opportunity for transparency, and the planning permissions granted could accelerate a move towards more openness, for example by imposing conditions on those involved to share information for the purposes of research and development.

16. What are the key technical disciplines involved in the transition to ultra-low carbon vehicles? How can we ensure the new skills required are met?

A broad range of scientific and technical skills will be required if the UK is to develop a road transport system based around ultra-low carbon vehicles and if the UK is to gain a significant slice of the worldwide market in ultra-low carbon vehicles. These include:

- Electricity distribution system engineers, capable of building on today's skill base to develop the innovative systems that will be needed in a world with "unusual" load patterns, as required by electric vehicles.
- Battery technologists, primarily physicists and physical chemists. Battery technology is a key limiting factor in electric vehicles and over the next few decades there is likely to be a continual push to improve the cost capacity and weight parameters
- Electric powertrain engineers. Much electric vehicle design and manufacture is similar to that for internal combustion engine (ICE) powered vehicles, although

[10] http://www.raeng.org.uk/societygov/policy/responses/pdf/Eco-towns_Planning_Policy_Statement.pdf
[11] *Engineering a low carbon built environment*

pressures to reduce the weight of vehicles will place significant demands on material scientists, mechanical engineers and production engineers – there is likely to be a limited market for a future electric vehicle which is less robust or less safe in a collision than the vehicles of today. However the major change is in the powertrain – a broad range of electronic and electrical system engineers will be needed to ensure that the efficiency of powertrains steadily improves in future decades.

- Skills for low carbon power generation (see answers to questions 8, 9 and 10).

Without these skills, the shift to ultra-low carbon vehicles will either not occur or, more likely, the shift will happen but the technology and products will be made outside the UK.

17. What more do we need to do to ensure that UK companies have the skills they need to capitalise on the transition to lower carbon aviation?

Areas for further improvement of carbon emissions from aircrafts will come from: improved operations through better air traffic management; reducing aircraft weight; increasing propulsion efficiency; increasing lift-to-drag ratio in cruise and introduction of biofuels.

Improvements in all these areas will require relevant engineering skills. Over the next 20 years, close to 60% of the workforce in the aerospace & defence industry is set to retire, and many of those retiring will have STEM skills which will need to be replaced.[12] Semta have estimated that the aerospace industries are already suffering skills shortages of 28% for associate professional and technical occupations, and skills shortages of 24% for skilled trades.[13]

18. Are the skills priorities identified for the freight and logistics sector correct? What more do we need to do to ensure employers in the freight sector have the skills they require?

The Logistics sector employs 1.7 million people across 194,000 businesses. Key workers include: transport and distribution managers, storage and warehouse managers; importers, exporters; transport and distribution clerks; HGV and van drivers; warehouse operatives, postal workers and couriers. 40% or more in each major occupational group are not qualified to the minimum skill level and 46% of the sector workforce does not hold a level 2 qualification.[14]

E-commerce could have a significant impact on the environmental footprint by optimising transport logistics, reducing overproduction and warehouse space. Just-in-time delivery has been found to reduce the material inventory by 28%.[15] U.S. companies have found that they were able to significantly cut logistics expenditure by introducing ICT in their purchasing system.[16] Key ICT skills to facilitate greater use of e-commerce include electronics, wireless communications, embedded systems and communication networks.

19. What more should Government and employers do to ensure UK companies have the skills they need to capitalise on the electrification of rail and future rail projects?

The railways industry needs to strengthen its engineering capability to achieve the efficient delivery of the changes required for future railways infrastructure projects. To achieve this, it needs both to up-skill the current workforce and to recruit more highly skilled people. The

[12] *EngineeringUK 2009/2010* (EngineeringUK, 2009)
[13] *2006 Labour Market Survey of the GB Engineering Sectors* (Semta, 2007)
[14] *Sector Skills Assessments for the Freight Logistics and Wholesale Sector UK Summary Report* (Skills for logistics, 2009)
[15] Romm, J., Rosenfield, A., Hermann, S., *The internet economy and global warming* (1999)
[16] Downey, M., *Workshop on implications of the new digital economy on transport: developing research and data needs* (National Academy of Sciences, 2000)

National Skills Academy Railways Engineering (NASRE) points out that the last large electrification programme was completed over 20 years ago and the electrification skills base is believed to have been substantially eroded since then.[17]

NSARE research has also identified a substantial requirement for up-skilling of the workforce across much of the industry to meet the challenges of new technology being introduced and the need to improve efficiency.

The Project Brunel study was carried out in 2007, before the recession, so its figures must be treated cautiously. Nonetheless, the study does serve as a general indicator:[18]

	Demand	Available Resource	Estimated Shortage (%)	Shortage
Railway Engineering	13,200	12,100	8%	1,100
Permanent Way	6550	6000	8%	550
EMC	360	340	6%	20
Power	1460	1260	14%	200
Rail Signalling + Train and Traffic Control	3600	3350	7%	250
Rolling Stock	1250	1200	4%	50
Overall: Generic Skills for Rail Engineering: Project Management, Civil, Technical, M&E / Comms, Audit, HSE	45740	40860	11%	4880

21. What actions should be taken to ensure that individuals working in carbon intensive industries have the skills to make the transition to a low carbon, resource efficient economy?

Please refer to the answer to question 7.

22. Is our understanding of the skills needs in advanced manufacturing correct? How can these needs best be met in the short, medium and longer terms?

For those already in the workforce, it is striking the extent to which the engineering and technology community have embraced Adult Apprenticeships since their introduction a few years ago. Research conducted by EngineeringUK has found that Adult Apprenticeship starts rose by 88% between 2007/08 and 2008/09. Adult Apprenticeships are a relatively new addition to the training infrastructure, so the total numbers of learners remains low - 3,831 in 2008/09 - but nevertheless the rate of growth is impressive. This suggests that Adult Apprenticeships could provide an effective way of re-skilling and up-skilling the workforce for the low carbon economy. The new government's commitment to Apprenticeships is welcome, but it is essential that the government invests in Adult Apprenticeships as well as Apprenticeships for individuals aged under 25.[19] In addition to adult training, the government must continue to encourage more young people to study STEM to fill future gaps in the manufacturing workforce (see answer to question one).

24. What will the key skills needed be, to build adaptive capacity for climate change, enabling organisations to minimise risks, and capitalise on the opportunities that climate change will bring?

Climate change adaptation will not require much in the way of new skills. The issue is more one of strategy – considering the problem and its likely impact and then devising an organisational response to address it on the required timescale. The response will likely

[17] *Skills Academy in Business Planning* Stage (National Skills Academy Railway Engineering, 2010)
[18] *Transport Industry Resources Study* (Project Brunel, 2008)
[19] *The Apprenticeship Renaissance* (EngineeringUK, 2010)

need to be joined up within and across sectors. Arguably the most important skill in this area is therefore to develop people who can look within and across many sectors of infrastructure and both find the solutions and broker the deal making that will be needed to ensure implementation.

The engineering institutions have been asked by the Department for Environment, Food and Rural Affairs to produce a report on adapting to climate change. The report will be published in November 2010.

Appendix: E4E Members

British Computer Society

British Institute of Non-Destructive Testing

Chartered Institution of Building Services Engineers

Chartered Institution of Highways & Transportation

Chartered Institute of Plumbing and Heating Engineering

Chartered Institution of Water and Environmental Management

Energy Institute

Institution of Agricultural Engineers

Institution of Civil Engineers

Institution of Chemical Engineers

Institute of Cast Metals Engineers

The Institution of Diesel and Gas Turbine Engineers

Institution of Engineering Designers

Institution of Engineering and Technology

Institution of Fire Engineers

Institution of Gas Engineers and Managers

Institute of Highway Engineers

Institute of Healthcare Engineering and Estate Management

Institution of Lighting Engineers

Institute of Marine Engineering, Science and Technology

Institution of Mechanical Engineers

Institute of Measurement and Control

Institution of Royal Engineers

Institute of Acoustics

Institute of Materials, Minerals and Mining

Institute of Physics

Institute of Physics and Engineering in Medicine

Institution of Railway Signal Engineers

Institution of Structural Engineers

Institute of Water

Nuclear Institute

Royal Aeronautical Society

Royal Institution of Naval Architects

Society of Environmental Engineers

Society of Operations Engineers

The Welding Institute

Engineering Council

EngineeringUK

The Royal Academy of Engineering

E4E is supported by an Expert Panel whose members include:

Design and Technology Association, Engineering Professors' Council, SEMTA, Specialist Schools and Academies Trust, STEMNET, and Women Into Science, Engineering and Construction (WISE)

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