

Meeting the Low Carbon Skills Challenge



A Consultation on Equipping People with the Skills to take Advantage of Opportunities in the Low Carbon and Resource Efficient Economy

Purpose of this Consultation

This consultation sets out the Government's views on the key skills-related priorities and challenges which must be met if we are successfully to:

- Enable British workers and businesses to take advantage of the opportunities in the sectors key to reducing carbon emissions;
- Embed the necessary skills across all sectors to move the UK to a low carbon and resource efficient economy.

This consultation seeks views on the priorities, challenges and gaps identified; on how businesses can best be incentivised and encouraged to respond so that they have the skills they need at all levels; and on how the education and skills system can respond so that it is strongly focused on the needs articulated by businesses. A full list of the questions we ask are at the end of the document at Annex 2.

Your views matter. Your responses to this consultation will be considered closely, and will inform the continuing development of our strategy to ensure that Britain has the people with the skills needed not simply to respond to but to capitalise on the move to a low carbon economy. Government will report on the outcomes of the consultation in the Autumn.

Issued: 31st March 2010

Respond by: 23rd June 2010

Enquiries to:

Low Carbon Skills Team
Department of Energy & Climate Change,
1st Floor Area B,
3 Whitehall Place,
London, SW1A 2HD
Tel: 0300 068 5323
Email: lowcarbonskills@decc.gsi.gov.uk

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Foreword

Change is a constant force in every economy, but over the next two decades and beyond, Britain and its competitors must respond to some of the greatest issues set to face us this century.

As Britain emerges from the recent global financial crisis and we work to deliver sustainable economic growth, we also urgently need to decarbonise our economies and prevent damaging climate change.

As set out in *New Industry, New Jobs*, the Government is committed to ensuring that British businesses and our people are equipped to take advantage of this change and prosper in an increasingly competitive global age.

The shift to low carbon described in the Low Carbon Transition Plan will revolutionise the way in which we all live and work. Britain needs to be ready to meet that challenge, but also to secure a share of the skilled jobs and global trade it will create.

In our Low Carbon Industrial Strategy, we set out the scale of the opportunities available across global supply chains and launched Government action to help British businesses seize them. Most importantly, we need people with the right knowledge and skills to research, produce and use those technologies and solutions that can make Britain's global low carbon ambitions a reality.

In every region, Government is committed to realising the potential Britain has to make our transition to a low carbon and resource efficient economy effectively and compete in the new and adapted markets it will create. That includes securing jobs and trade in emerging low carbon sectors such as off shore wind energy and zero-carbon homes, as well as increasing the resource efficiency and sustainability of traditional industries across our economy.

We're focused on doing what we can to ensure that the current generation of workers in Britain, and the next, can access, make use of and benefit from low carbon innovation in the future. Government is already working across our education system and with business to strengthen our skills base and capabilities in high-growth, high-value industries that will define our success.

This includes measures to boost science, technology, engineering and mathematics skills across our economy; to enable our skills system to respond effectively to the demands of a global competitive, low-carbon world and resource constrained world; to deliver the skills employers need; and to raise employer and individual investment in skills.

We want to hear your views on potential action across our education and training system and how Government, business, individuals and training providers can work together to deliver the right skills to nurture sustainable growth and build Britain's low carbon future.



David Kidney
DECC
Parliamentary Under
Secretary of State



Pat McFadden
BIS
Minister for Business,
Innovation and Skills

Executive Summary

1. We need to equip people and businesses to return the economy to sustainable growth, increasing employment, raising incomes and supporting an improved quality of life. At the same time the necessary transition to a low carbon and resource efficient world described in the *UK Low Carbon Transition Plan*¹ will transform our whole economy. As *New Industry, New Jobs*² and the *Low Carbon Industrial Strategy*³ made clear, the shift to a low carbon economy offers significant economic opportunities that we must be ready to grasp.
2. In *Skills for Growth*⁴ and *Higher Ambitions*⁵ Government set out an activist approach to stimulating the skills solutions that will be needed, and in this document we describe how the skills system is already responding. But we know more needs to be done more quickly in key sectors, and across the economy, if we are fully to realise the economic benefits, manage the social impacts, and achieve a successful and just transition for all. Three key sectors – Power, Transport and Construction/Built Environment – face specific skills needs. We articulate our current understanding of these needs and consider how they can be met.
3. The five key challenges for employers, the skills system and Government that this document identifies are:
 - Delivering significantly higher volumes of generic STEM skills at all levels;
 - Developing and delivering rapidly the specialist skills solutions that will be needed for emerging sectors and technologies;
 - Getting more young people and adults interested in low carbon careers, skills and qualifications;
 - Stimulating employer demand for and investment in low carbon skills;
 - Replicating good practice rapidly in each of the above, within and between emerging sectors.
4. Many of the skills needed to make the transition to a low carbon economy will not be new. For example, we already know that Science, Technology, Engineering and Mathematics (STEM) skills will be needed at all levels, in key energy and advanced manufacturing sectors and more widely across the economy, to lower carbon emissions and make better use of all resources. This document lays out how we are improving access to and uptake of STEM qualifications through actions such as the national programme to attract students to STEM subjects in higher education and the ‘STEM Ambassadors’ to support pupils and schools.

1 http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx

2 <http://www.berr.gov.uk/files/file51023.pdf>

3 <http://www.bis.gov.uk/files/file52002.pdf>

4 <http://www.bis.gov.uk/assets/biscore/corporate/docs/s/09-1467-skills-strategy-command-paper.pdf>

5 <http://bis.gov.uk/policies/higher-education/shape-and-structure/higher-ambitions>

5. In some sectors, much of what needs to be done will be building upon existing STEM-based skill sets. However, there will be sectors in which completely new skills are needed, some in new combinations, and for which new qualifications will need to be developed. Our skills system needs to be able to respond rapidly and flexibly to these demands. Action will need to be taken at local, regional and national levels, not just by our schools, colleges and universities, but by our industry-led skills partners and most importantly by individuals and by businesses.
6. Decarbonising the power industry will require a major cross-sector effort to meet escalating demand for skills. The industry will need to recruit apprentices and graduates in large numbers, particularly those with STEM skills. We have already supported key measures such as the National Skills Academies for Nuclear and for Power, and there are already good examples of industry bodies working together to develop new qualifications such as the Wind Turbine Service Technician Apprenticeship. This consultation seeks to identify the best ways to further accelerate skills development in the power sector to meet our targets and identify where successful programmes can be replicated.
7. In the wind and nuclear energy sectors, we have a clearly identified need for technician level skills. Subject to employers coming forward with Apprenticeship places in sufficient numbers, and as part of our plans to deliver an additional 35,000 advanced and higher Apprenticeships to young adults aged 19 to 30 over 2 years from September 2010, Government will:
 - Co-fund the delivery of up to 1,000 apprenticeships per year to support decommissioning and new-build in the nuclear energy sector;
 - Co-fund the delivery of up to 2,500 apprenticeships in the emerging wind energy sector, in line with the sector's ambition for the size of its workforce in 2017.
8. Decarbonising buildings and construction will create strong demand for skills to adapt existing housing stock, for renewable building methods and for the construction of zero carbon homes. The required skills will be mainly at graduate level to develop, manufacture and implement new technologies, and to enhance existing practical construction skills for installing new adaptation and mitigation technologies. The skills system is starting to address this, for example through updating National Occupational Standards. We need to understand whether good models from other industries, such as the Nuclear Skills Passport, or the Wind Energy Skills Accord, can be applied to low carbon construction, or other low carbon sectors. The major challenge is to identify precisely skills needs in this emerging and diverse sector. Through this consultation we want to know whether existing initiatives will be sufficient to realise Government ambitions.

9. Decarbonising the transport sector is a key part of the *UK Low Carbon Transition Plan*. Transition to ultra low carbon vehicles and the development of new fuel efficient aircraft will require the manufacturing and maintenance workforces to adapt their skill sets to the demands of changing technology. STEM graduates will again be in high demand. We need to better understand how the transport sector should work with the skills system to anticipate and respond to these demands, to optimise the UK's share of these expanding domestic and world markets.
10. Beyond the three key sectors, this consultation reviews the skills needed to decarbonise our entire manufacturing and process industry supply chains and make the most efficient use of resources. We also lay out the opportunities for growth and carbon savings in the food and advanced manufacturing sectors and the skills needed there. A wide range of cross-cutting skills will be needed, many of which will combine traditional professional disciplines with emerging industrial applications, such as composites. STEM qualifications will again be pivotal, as will specialist skills. We need to understand these skills needs better, especially where we need to equip people with a different combination of skills, rather than specific new skills.
11. Even in a decarbonised society, we will need to continue to adapt to a changing climate, and embed the knowledge and skills to do so across the economy. The need for adaptation will provide opportunities for businesses, both in terms of providing solutions and services in the UK and in exporting their expertise abroad.
12. We need young people and existing employees to be aware of and take an interest in the career opportunities emerging from the low carbon transition, and provide clear pathways into those careers. We are already taking action in this area, such as the *Government Science: [so what? so everything]*⁶ campaign to encourage young people to consider STEM related careers. The new adult advancement and careers service, which will launch in August 2010, will also help make adults aware of the opportunities offered across the low carbon economy, and the skills and qualifications needed to progress in those jobs.
13. For businesses to succeed in the low carbon economy they will need people with the technical and managerial skills to develop and exploit both existing and new markets. Government is helping to stimulate the market and ensure that low carbon businesses are equipped with the skills needed for high productivity and strong economic growth. In summary, we are:
 - Ensuring that employer skills needs in areas key to economic growth are clearly identified and articulated, and are prioritised within the skills funding system;
 - Developing new funding incentives to enable Universities to respond to the needs of areas key to future economic growth;
 - Co-investing in collective employer action to tackle skills needs in new and emerging markets;
 - Speeding up the development of new and updated qualifications to reflect new and changing jobs;

6 <http://sciencesowhat.direct.gov.uk/>

- Stimulating joint action between business and skills partners regionally and locally on new skills needs; and replicating the good practice emerging in specific areas and industries;
 - Exploiting the power of public procurement to drive up demand for skills and Apprenticeships through the supply chain;
 - Promoting a dialogue between regulators, regulated industries and Sector Skills Councils to drive up demand for skills;
 - Working with national, regional and local bodies, trade unions, business organisations, and third sector bodies to ensure that the transition to a low carbon economy does not unduly penalise those working in high carbon sectors.
15. The document highlights as case studies the range of innovative measures which have already brought together employers, sector skills councils and the wider skills system to articulate low carbon skills needs and develop prototype skills solutions. We need to understand how this good practice can be replicated in other sectors and regions, and across the wider skills system.

We are seeking your views on these key issues through this consultation.

Territorial Extent

This document covers England only. We will work closely with the Devolved Administrations in Northern Ireland, Scotland and Wales, recognising their particular and varying responsibilities. While some of the policies in this paper are specific to England, the challenges are common across the four countries of the United Kingdom. Each will consider the most appropriate arrangements in those areas for which they have devolved responsibility, to address the issues in ways that meet their own circumstances and needs.

How to Respond

Your response will most useful it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

The closing date for responses is 23rd June 2010.

When responding please state whether you are responding as an individual or representing the views of an organisation. If responding on behalf of an organisation, please make it clear who the organisation represents and, where applicable, how the views of members were assembled.

Email responses should be submitted to: lowcarbonskills@decc.gsi.gov.uk.

Hard copy responses can be sent by post to:
Low Carbon Skills Team
Department of Energy and Climate Change
Area B, 1st Floor, 3 Whitehall Place
London SW1A 2HD
Telephone: 0300 068 5323

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Low Carbon Skills Team,
Department of Energy and Climate Change
Area B, 1st Floor
3 Whitehall Place
London SW1A 2HD
Telephone: 0300 068 5323

An electronic version can be found at www.decc.gov.uk and www.bis.gov.uk Other versions of the document in Braille, other languages or audio-cassette are available on request.

Confidentiality and Data Protection

Individual responses and information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information regimes (these are primarily the Freedom of Information Act 2000 (FOIA), the Data Protection Act 1998 (DPA) and the Environmental Information Regulations 2004. If you want other information that you provide to be treated as confidential, please be aware that, under the FOIA, there is a statutory Code of Practice with which public authorities must comply and which deals, amongst other things, with obligations of confidence.

In view of this, it would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding on the Department. The Department will process your personal data in accordance with the DPA. In the majority of circumstances, this will mean that your personal data will not be disclosed to third parties

Help with Queries

Questions about this document can be addressed to:

Low Carbon Skills Team,
Department of Energy and Climate Change
Area B, 1st Floor
3 Whitehall Place
London SW1A 2HD
Telephone: 0300 068 5323
E-mail: lowcarbonskills@decc.gsi.gov.uk

If you have comments or complaints about the way this consultation has been conducted, these should be sent to:

Consultation Co-ordinator
Department of Energy and Climate Change
3 Whitehall Place
London SW1A 2HD
Email: consultation.coordinator@decc.gsi.gov.uk

Meeting the Low Carbon Skills Challenge

1. The transition to a low carbon and resource efficient world that has been described in the *UK Low Carbon Transition Plan* will transform our whole economy. It will change our industrial landscape, the supply chains of our businesses and the way we all live and work. The vast majority, if not all, economic activity in the UK will have to reduce its carbon impact significantly.
2. This rapid and unprecedented transition will require action right across the economy. It will demand action by all the key stakeholders with an interest in ensuring that individuals and businesses have the skills for the low carbon economy of the future. That means action by businesses to ensure they have access to those skills, action by all those in the education and skills system – in schools, colleges, universities, sector skills bodies, regional development agencies, local authorities, and others; and action by Government.
3. We must ensure that UK businesses and workers in all sectors are equipped to maximise the economic opportunities and minimise the costs of the transition, and to face the challenges and opportunities that adapting to climate change brings. They will do this both by catering to growing British and global markets for low carbon goods and services, and also by using energy and other resources more efficiently to reduce costs. One part of being equipped is to have a skilled workforce.
4. The *Low Carbon Industrial Strategy* set out both the scale of these potential opportunities and a programme of government action for assisting British based firms in seizing them. At the heart of this strategy are three basic principles for a positive environment for low carbon and resource efficient business:
 - A long term strategic approach from Government that sets stable frameworks for businesses and consumers;
 - A pragmatic approach to the role of both markets and Government in making the transition to the new economy quickly and effectively;
 - Recognition that Government has a responsibility to support British-based companies and people to compete for the new markets.
5. The strategy makes clear that the global market for environmental goods and services (LCEGS) was already worth £3.2 trillion in 2008/09, a £150 billion increase on the previous year's estimates. As international action on climate change gathers momentum, this market is forecast to grow to over £4 trillion by the middle of the decade.

6. Britain already has a strong base. The UK LCEGS market is worth £112 billion and employed 910,000 people directly or through the supply chain in 2008/09. It is estimated that over 1 million people will be employed in the LCEGS sector by the middle of the decade. These are skilled jobs, with the average



market value per employee well above the national average. At the same time, all businesses must move to operate in ways that minimise their carbon emissions and that are more resource efficient, to the benefit of the business and its employees.

7. In July 2009, *New Industry, New Jobs* set out Government's drive for growth and long-term prosperity, in response to the economic downturn. It argued that the UK needed to take a more strategic approach to identifying and meeting its skills needs. In January 2010, *Going for Growth*⁷ confirmed that the drive for sustainable economic growth will remain at the heart of the Government's agenda. Together, these documents set the framework for a more active Government approach to industry and an active strategy to help deliver the skills that the economy needs to grow, both now and in the future.
8. There are uncertainties and risks in making the transition to a low carbon economy, and Government will have a key role to play in accelerating the skills solutions we need. As with previous structural changes to the economy, the shift to a low carbon economy will affect each business, worker and family differently. This will depend on the sector a person works in, the type of job they are doing and where they are geographically located. Previous structural shifts have had huge social and economic impacts, with some workers and communities being left behind as industries are restructured by change. The Government is committed to minimising such impacts in this transition.
9. While many jobs in a low carbon economy will be new, the tasks that workers and businesses will undertake are likely to be familiar and will build on existing areas of UK strength. The vast majority of all of our jobs will become increasingly green. The Government is committed to doing all it can to ensure this is a just transition, and to avoid unduly penalising high carbon job roles. For this reason, we have created a forum for considering these issues and advising government. The Forum for a Just Transition includes representatives from Central Government, national, regional and local bodies, Trade Unions, business organisations, and third sector bodies.

7 <http://www.bis.gov.uk/assets/biscore/corporate/docs/b/bis-pro-bus-serv-2020-vision-8666.pdf>

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10. This consultation document sets out how we are transforming the skills system to allow British people to take advantage of these jobs in low carbon sectors, as well as the need to embed skills to decarbonise and use resources more efficiently across the economy. We have come a long way in ensuring the education and skills system is positioned to meet the new challenges, but this is a fast moving transition which demands a highly innovative and forward looking response. We want your help in identifying the best ways that employers, the skills system and Government can work together in the future to secure that transition.

Demand for and supply of low carbon skills

11. The transition to a low carbon economy is unprecedented and rapid. Much of the detail about the exact types of skill required to develop this new economy, and the demand for these skills, is still unclear. But some things are apparent. Many of the skills needed are not new, although some may need to be combined in new ways, and some specialist skills will be new. In some areas a major cross-sector effort will be needed to develop new or updated qualifications and the capacity to deliver them. The skills system will need to focus strongly on being able to meet this potential demand, particularly as much of the higher level skills delivery will need to take place at work.
12. Work by the Commission for Environmental Markets and Economic Performance in 2007 showed that reliable forecasts of future job prospects and skill needs in low carbon markets were not available⁸. In 2009 a Defra report: *Skills for a Low Carbon and Resource Efficient Economy a Review of Evidence*, found there was latent demand for low carbon and resource efficiency skills, but that this demand was not being articulated by employers⁹. The *Review* also found that existing low carbon skills research had tended to focus on high level analysis rather than on specific job and skill requirements.
13. This evidence base is now improving. In particular, through the work done by a cluster of Sector Skills Councils¹⁰ to inform the national Skills Audit recently published by the UK Commission for Employment and Skills (UK Commission)¹¹. This has identified a need for professional and technical skills in a wide range of sectors. Higher level STEM skills will be in particular demand, and there will be competition between sectors for specialist skills. Many low carbon industries are faced with an ageing workforce, with large numbers due to retire over the next 10 – 15 years in some sectors. A key issue will be how we handle the growth in demand for skilled people in all sectors, by attracting young entrants and re-skilling existing employees.

⁸ <http://www.defra.gov.uk/environment/business/innovation/commission/documents/cemep-report.pdf>

⁹ <http://skills4lowcarboneconomy.co.uk/uploaded/documents/Reports/LCREE-Report-Final.pdf>

¹⁰ Low Carbon Cluster – Sector Skills Assessment Report, December 2009 <http://www.sscalliance.org/nmsruntime/saveasdialog.aspx?IID=974&SID=1858>

¹¹ The primary role of the UK Commission for Employment and Skills is to advise the UK Governments on how employment and skills services could be improved, and to report progress towards world class standards. UKCES also has an executive role, in funding and performance managing the Sector Skills Councils (SSCs), <http://www.ukces.org.uk/>

14. Many low carbon and resource efficient technologies are new, and we do not yet have a full suite of qualifications for these. Collective action will be needed on both the supply and demand sides to develop these qualifications, and the occupational standards underpinning them, quickly. New skill sets will be needed for cross-cutting applications, including combined electrical and mechanical skills, new practical and vocational qualifications for the new industrial processes being developed, multi-disciplinary skills for professionals, and skills in the application of electronic systems and chemistry to new technologies.
15. Skills will be needed in all sectors to maximise the positive impacts of decarbonisation, including through the use of intelligent controls for analysing the full life cycle of production processes to ensure carbon savings do not displace emissions elsewhere. Managers and industry leaders will need to develop skills in business analysis for new industries, leading to the deployment of innovative and resource efficient products, and so generating market opportunities for UK firms. Businesses will also need understanding of environmental regulations and their implications.
16. We will need to step up the provision and quality of generic management skills, including in sustainable procurement, lifecycle analysis, monitoring and measuring skills, carbon accounting, performance reporting, environmental management systems and risk management. The need for an increasing supply of high level skills, and especially a strong platform of people with generic STEM skills, is a recurring theme in our analysis.

The 5 Low Carbon skills challenges

17. This document summarises our best current understanding of the skills that will be needed in the low carbon economy. Detailed future skills needs will only become clear as new products and markets are developed. That puts a very high premium on ensuring the skills system can react rapidly and flexibly to changing and emerging demand. We have good examples of leading edge skills innovation, with the potential to deliver more of the skills solutions we need. This document provides some encouraging case study material showing what is already being done.



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18. We need your help to learn from and find ways to replicate this early work. We need this low carbon skills consultation to help us set out the priority actions needing to be taken. Our schools, colleges and universities are already taking action, but we are seeking your help to see how much further or faster they may need to go. As we see it there are five main challenges:
- The first challenge is delivering significantly higher volumes of generic STEM skills at all levels;
 - The second challenge is developing and delivering rapidly the specialist skills solutions that will be needed for emerging sectors and technologies;
 - The third challenge is getting more young people and adults interested in low carbon careers, skills and qualifications;
 - The fourth challenge is stimulating employer investment in and demand for low carbon skills;
 - The final challenge is replicating good practice within and between emerging sectors in each of these four areas.

Boosting generic STEM skills

19. In March 2006, the *Science and Innovation Investment Framework 2004 – 2014: Next Steps*¹² was published. This announced a number of ambitions to increase both the number of young people studying science and mathematics at A level, and the number of physics, chemistry and mathematics teachers.
20. In response, a ten-year STEM programme was developed, jointly led by the Department for Children, Schools and Families (DCSF) and the Department of Business Innovation and Skills (BIS), to educate the next generation of scientists and mathematicians. Actions include:
- Improving engagement through a more flexible secondary curriculum for mathematics and science and making GCSEs in the individual sciences of physics, chemistry and biology (triple science) more accessible to pupils who would benefit;
 - Improving the quality of teaching and learning by making available high quality continuing professional development through the network of Science Learning Centres, and the establishment of the National Centre for Excellence in the Teaching of Mathematics;
 - Introducing a new Science Diploma from 2011 (Advanced Level from 2012), responding to demand from employers and Higher Education for young people with the combination of theoretical knowledge and practical scientific skills they need to succeed;
 - Increasing the number of STEM Ambassadors to support pupils, teachers and schools; and
 - Encouraging young people to consider the relevance of STEM to their lives and career prospects through the *Science and Society strategy*¹³ and the *Science: [so what? so everything]* campaign.

¹² <http://www.dius.gov.uk/assets/biscore/corporate/migratedd/publications/f/file34265.pdf>

¹³ <http://www.rcuk.ac.uk/cmsweb/downloads/rcuk/scisoc/sisstrategy.pdf>

21. Uptake of mathematics and science at GCSE and A level has been rising steadily, which indicates that there is likely to be a strong future demand in higher education.

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?

22. In 2009 the Confederation of British Industries (CBI) acknowledged that British businesses needed to take greater responsibility for defining their higher skills needs and collaborating with universities to deliver them. We are now making sure that leading employers can take part in shaping how the Higher Education Funding Council (HEFCE) works with universities to get a better match between supply and demand, and to boost the employability skills of graduates.
23. HEFCE has also been asked to devise new funding incentives to support the most economically valuable programmes, so that the new approach can be implemented in the academic year 2011-12. This will build on HEFCE's £350 million support programme for strategic and vulnerable subjects, under which STEM courses receive the most support; and a £20 million national programme running from August 2009 to July 2012 to attract students to STEM subjects in higher education¹⁴.
24. In 2009/10, the Government provided 10,000 additional higher education places in STEM and other priority subjects, and HEFCE will be providing £10 million in 2010/11 to help universities switch activity into expanding STEM places. We are seeing rising numbers of students studying STEM subjects at university.

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?

Specific skills solutions for emerging low carbon sectors

25. In *Skills for Growth*, we announced a number of wide-ranging measures to secure a more flexible and responsive skills system delivering skills needed for sustainable economic growth. Particularly relevant for the transition to a low carbon economy will be:
- **Focusing more of the skills budget on areas of the economy which can do most to drive growth, including low carbon.** From 1 April 2010 a new Skills Funding Agency (SFA) will be responsible for funding post-19 learning in England. It will direct public funding quickly and efficiently to colleges and training organisations, in response to individual and employer demand. National skills priorities identified by the UK Commission, and those set out in the regional strategies, will be agreed by BIS and confirmed in the annual ministerial *Skills Investment Strategy*, against which the SFA will fund colleges and training organisations;

¹⁴ In 2008/09, entrant numbers to STEM disciplines increased as follows, compared to 2007/08: Mathematical sciences 12%; Engineering 8%; Computer science 7%; Biology 6%; Chemistry 4%; Physics 3%.

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- **Placing a new emphasis on skilled technician and associate professional skills at Levels 3 and 4.** From September 2010 we will reprioritise funds within available budgets to boost advanced and higher apprenticeship opportunities for 19-30 year olds through an additional 35,000 places over the next 2 years. The National Apprenticeship Service (NAS) has highlighted the renewable energy sector as one of its priorities for Apprenticeship development, and is reviewing the role of Apprenticeships in providing the skills for resource efficiency and low carbon. Sector Skills Councils (SSCs) are already working with their employers to develop new frameworks to support the low carbon agenda, for example in the wind energy and waste management sectors;
 - **Co-investing with employers to build capacity in low carbon skills.** We have launched a competitive prospectus for a new Joint Investment Programme (JIP). The SFA will seek expressions of interest and match fund selected proposals from Industry Training Boards and newly relicensed SSCs to tackle specific technical skills needs in areas key to economic recovery. Low carbon proposals are expected to feature strongly among the bids. The Programme will promote skills solutions cutting across traditional sector boundaries, with an emphasis on organisations working collaboratively, and on replicating emerging best practice across sectors and regions;
 - **Continuing to support collective employer action on skills through the formation of National Skills Academies (NSAs).** The 15 already established include the NSA for Nuclear, and the newly launched NSA for Power. They enable employers to drive and shape the design and delivery of training and qualifications in their sectors. As part of the 5th round of the NSA programme further proposals are going forward to the business planning stage which will bring the total number of NSAs to 18, including one covering Green Building Services in the Housing Energy Management sector, and another covering the emerging Biotechnology and Composites sectors;
 - **Supporting the rapid development of new occupational standards and qualifications** there will be action to reduce the development time for new qualifications from 12 to 6 months. The wind energy sector is a good example of what can be done to accelerate the development of new national occupational standards, Apprenticeship frameworks and foundation degree programmes when employer and supply-side coalitions come together around a voluntary Skills Accord;
 - **Disseminating best practice in low carbon skills delivery across the further education sector** through the Learning and Skills Improvement Service, as part of their wider support programme for new and emerging technologies from 2010-11.

Skills4Energy: Action by Further Education colleges for regional businesses

Background

The East Midlands Development Agency (emda) provided a £420,000 investment in the region's further education colleges to enable the purchase and installation of low carbon equipment for use in teaching. These include technologies ranging from photovoltaics and biomass boilers to hybrid drive vehicles and hydrogen fuel cells. The programme was enthusiastically received and the initial pilot phase was completed in December 2009, reporting some 2,000 training provisions to students and over a hundred engagements for training employees from local businesses.

The programme worked with another emda pilot programme, *Energy Connections*, to increase interaction between local business providing low carbon technology services and the regions' skills providers involved in the Skills4Energy programme.

Update

Following the encouraging results from the Skills4Energy pilot phase, a second allocation of funds (£200,000) was made in 2010 for the procurement and installation of additional low carbon technologies teaching equipment. Again, uptake was extremely positive with four colleges successfully bidding for the second tranche of capital funding, including ground source heat pumps and hydraulic equipment relating to offshore wind.

Looking ahead

The current phase will run through until 2012 and will deliver an additional 1,820 training places in low carbon technologies to students in the further education colleges as well as a further 300 places for employees from local businesses. The participating further education colleges are now creating six Knowledge and Technology Transfer (KTT) Hubs across six low carbon technologies themes, from vehicles and power systems, to innovation and leadership skills.

KTT Hubs will provide specialist support to innovating businesses.

The Skills4Energy programme underpins the region's commitment to the provision of low carbon skills to both new learners and employees and provides growing regional coverage across an ever increasing range of technologies.

26. In Budget 2010 we announced an additional 20,000 full, part time and foundation higher education places, with priority given to areas identified in New Industry, New Jobs and the national skills audit that will best support growth, including STEM. These will be funded from a £270m **Higher Education Modernisation Fund**, available in 2010-11 and administered through HEFCE.

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27. We also announced that, in order to help commercialise more of the innovative ideas from universities, BIS will be facilitating discussions between a group of universities to explore options for a collaborative vehicle to commercialise Intellectual Property from their research. A dedicated **University Enterprise Capital Fund** of up to £37.5m will provide crucial early stage funding for commercialisation of some of the most promising university innovations. Up to £25m of this fund will be supplied by Government, the rest by the private sector.

Higher Level Skills Partnership: Energy and Environmental Technologies

Background

The North West Higher Level Skills Partnership (HLSP) is increasing demand from employers for higher level skills provision and increasing the capacity of universities to respond to employer demand. Led by the North West Universities Association on behalf of its 14 members, HLSP is focused on brokerage (working with Business Link North West) and on the development and delivery of new skills provision meeting employer demand (working with SSCs). The project has been funded by HEFCE and the North West Regional Development Agency (NWDA) and works in partnership with providers and relevant regional organisations.

Operating across seven industrial sectors including 'Energy & Environmental Technologies', the project has provided funding to support the development of 60 new courses designed jointly by business and universities, and some short course continuing professional development (CPD) provision to meet the needs of those affected by redundancy and new graduates unable to find graduate level employment.

Update

Eight of the courses supported link directly to emerging low carbon sectors:

- Power System Protection Postgraduate CPD (University of Manchester)
- Nuclear Safety Case Postgraduate CPD (University of Central Lancashire)
- Certificate of Nuclear Professionalism (Open University with National Skills Academy-Nuclear)
- Foundation Degree in Wastes Management (Myerscough College)
- Post Graduate CPD in Fuel and Energy Generation from Waste (Lancaster University)
- Engineering Conversion for Operation Management in the Energy Sector (University of Central Lancashire)
- CPD in Smart Metering and Smart Grids (University of Manchester)
- Constructing Solutions for the Low Carbon Economy (University of Central Lancashire).

The first course starts in September 2010, with all eight to have commenced by January 2011. Over 50 employers have been involved in these developments including providing detailed feedback and input to specific modules in the development stages. Over 350 learners will have undertaken training by March 2013, with an additional 127 achieving a higher education qualification over this same period.

Looking forward

The project aims to achieve a step change in employer engagement with higher level skills. This will ensure that there is a significant increase in the proportion of the North West workforce with higher level skills and therefore an improvement in the knowledge economy of the region. The investment places the region in a strong position to move forward and lead in the delivery of a new generation of 'green collar' workforce. The HLSP demonstrates how national and regional funding can be brought together, working in conjunction with SSCs, and building on existing structures.

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

Getting more people interested

28. It is vital that young people have **better access to information** about the opportunities presented by the low carbon economy and can see a clear pathway to careers in key low carbon industries. We know we will need to ensure that there will be a continuing supply of young people with strong STEM skills, particularly at intermediate and higher levels. And we have already established a number of programmes which will provide young people with the knowledge and experience to make choices about their future.
29. We have clear plans to improve the quality of **careers education and information, advice and guidance** for young people. These build on the good progress already made in showcasing the opportunities in STEM careers, including in the low carbon industries. As part of the Government's Backing Young Britain campaign companies are able to access a range of practical and financial support to enable them to offer Apprenticeships, give a young person a job or provide a young person with the experience of work¹⁵. Opportunities available include:
- 3,500 subsidised internships in priority sectors, including low carbon;
 - 10,000 additional 'green jobs' through the Future Jobs Fund;
 - 5,000 environmental learning visits and 'green work placements' for young people aged 4-19, overseen by a consortium led by the Eden Project.
30. We are also encouraging universities and employers to work together to **build the market for high-level skills** by providing better information advice and guidance for learners.

¹⁵ <http://digital.bis.gov.uk/backingyoungbritain/>

We are putting in place a system where students can make genuinely informed choices based on an understanding of the teaching they can expect and the long term employment prospects it offers. And in 2009 we announced a new **Low Carbon Future Leaders** scheme giving up to 1,500 graduates the opportunity to gain paid work experience in a sector that will be providing jobs for the future.

31. In *Skills for Growth*, we announced a number of wide-ranging measures to secure a more flexible and responsive skills system to deliver the skills needed for sustainable economic growth. From 2010 an annual **national Skills Audit**, produced by the UK Commission for Employment and Skills, will provide the platform enabling Government to identify national skills priorities to drive the behaviour of the skills system¹⁶. Better information for employers, providers and learners is particularly relevant for the transition to a low carbon economy.
32. Government has recently published *Fuelling Potential*¹⁷, a progress update on the implementation of skills accounts and the **adult advancement and careers service** which becomes operational in August 2010. The new service will help adults assess their skills, find out which skills and qualifications will best boost their employment prospects, and which courses are available locally, underpinned by professional advice and guidance. The information, advice and resources provided will help make adults aware of the opportunities offered across the low carbon economy, and the skills and qualifications needed to progress in those jobs.

Adult advancement and careers service

From August 2010, the adult advancement and careers service and skills accounts will give everyone access to the best information, advice and resources to make more effective choices about skills, careers, work and life. This offer will be available online as well as through advisers on the telephone and face to face, and will include:

- Professional information and advice on careers and skills;
- Access to up to date labour market information, which reflects national, sectoral, regional and local intelligence;
- Comprehensive information on career paths, setting out the qualifications, skills and experience required for specific careers and jobs;
- A personal skills assessment, with the aid of online tools as necessary, to diagnose individual need;
- Access to up to date information on courses;
- Information on an individual's potential entitlement to public funding for training, and access to a skills account, containing a personal record of qualifications gained and funding invested in training;
- Intensive, ongoing support and guidance for those with greatest need.

16 http://www.ukces.org.uk/upload/pdf/NSSA_Volume%201_FINAL_BOOKMARKED_110310.pdf

17 <http://www.bis.gov.uk/assets/biscore/corporate/docs/f/10-648-fuelling-potential.pdf>

Stimulating employer demand for and investment in low carbon skills

33. Businesses need leaders and managers with the right skills to develop high performance business models and drive growth. We will continue to support the Train to Gain **Leadership and Management** programme, delivering support to at least 20,000 businesses in 2010-11. But we will improve the impact of the programme by prioritising SMEs who take up the opportunity of an enhanced health check, including consideration of how existing and new skills can help deliver their ambitions for growth.
34. We are creating **Low Carbon Economic Areas** (LCEAs) to capitalise on the strengths of particular regions where their geographic and industrial assets can help the UK secure global advantage¹⁸. LCEAs are focusing support on stimulating employer demand for low carbon skills, and accelerating the growth of low carbon industries and supply chains. They are providing a catalyst for new forms of collective employer engagement, attracting skills investment, filling labour market information gaps, and demonstrating skills solutions for the wider skills system.
35. From 2010/11 **Regional Development Agencies** will develop regional skills priorities statements with their regional and sub-regional partners, including those in the Low Carbon Economic Areas. These statements will be refined in the light of the national priorities identified in the UK Commission's national skills audit. At local level, sub-regional or city-level multi-area agreements and business-led Employment and Skills Boards, as well as local authorities will also help to stimulate demand and tackle the local skills needs of a low carbon economy.
36. The public sector spends an estimated £220 billion each year on **public procurement**. Government is committed to using this significant purchasing power to bring forward demand for low carbon and resource efficient goods and services and to support investment in the skills required to secure a low carbon future. Our ambition is to support 20,000 apprenticeships over the next three years through public procurement and we would expect many of these apprenticeship places to be in low carbon skill areas. This ambition is underpinned by a presumption that Departments and arm's length bodies include apprenticeship requirements in procurement decisions, where relevant and consistent with value for money principles and EU procurement rules.
37. This will be done by working with procurers and key suppliers in sectors with large environmental impacts and developing sustainable purchasing specifications as part of the **Government Buying Standards** (Buy Sustainable Quick Wins), developed by Defra.



¹⁸ The first six LCEAs are in marine energy (South West), ultra low carbon vehicles (North East), civil nuclear energy (Yorkshire and the North West), Built Environment (Greater Manchester), advanced automotive engineering (the Midlands) and hydrogen energy (South Wales).

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38. Additionally, we are developing materials as part of a National Training Programme in **Sustainable Procurement** with Local Authorities. We aim to support the development of specialised modules on “carbon and energy efficiency” to help budget holders and procurers better understand at which points in the procurement cycle their decisions can make a difference in creating and supporting markets for lower carbon goods and services.
39. We also want to encourage **regulators** to work with BIS on cases where it is appropriate to reflect the skills capability of the labour force as one component of the regulatory framework. In their recent determination for the power distribution companies, for example, Ofgem has allowed an additional investment of £173 million on skills. We wish to see an ongoing dialogue between regulators and regulated industries, and the relevant SSCs, resulting in a shared understanding and approach to addressing the skills challenges facing their sectors.

Replicating good practice

40. As we look across the case study material in this chapter, and in the sector chapters that follow, we can see many promising initiatives being taken forward by employers, sector bodies and skills partners. What they have in common, and what is striking, is the innovative collective action that employers and skills partners are taking to tackle skills challenges in new industries without an obvious lead body. It is worth pausing to consider the different ways in which this voluntary collective action is being coordinated. For example:
- Major employers and strategic skills partners in the wind energy sector are making rapid progress in developing national occupational standards, new qualifications, and stimulating demand for STEM skills through a Skills Accord, **coordinated by an employer association;**
 - Major employers in the nuclear industry are stimulating individual and employer demand for apprenticeships through a highly successful skills passport scheme and specialist provider network, **coordinated by a National Skills Academy;**
 - Employer associations and sector bodies in the Housing Energy Management (HEM) sector are mapping specialist skills needs against available provision, and developing an action plan to address qualifications gaps, through a Government supported industry steering group **coordinated by a professional body;**
 - SME employers and strategic skills partners in the marine energy sector are making good progress in articulating regional skills demand and addressing specialist skills needs, as part of wider action being taken in a Low Carbon Economic Area **coordinated by a Regional Development Agency;**
 - Universities and employers in the North West are developing new skills provision to meet emerging regional demand for higher level skills in the energy and environmental technologies sector, **coordinated by a regional higher level skills partnership.**

Cross sector action coordinated by Sector Skills Councils

Background

Many low carbon skills issues cut across traditional sector boundaries. In 2009 a cluster of eight sector skills bodies came together, with support from DECC, to develop a Renewable Energy Skills Strategy covering specialist, transferable and cross sector skills in this emerging industry, and across the supply chain. The project is on track to complete the research and analysis phase in June 2010, and will cover job roles including research and development, development and planning, design and manufacture, construction and installation, and maintenance.

Update

BIS has asked the UK Commission to work with Sector Skills Councils (SSCs) to come forward with proposals for a streamlined SSC network which achieves a better fit with the sector boundaries of the future, like low carbon, while still keeping employers at the heart of the skills system. A number of SSCs and other sector bodies are now taking forward collaborative work on low carbon skills in a variety of ways, building on the work of the Renewable Energy Skills cluster. This includes:

- 11 SSCs and one ITB delivering a Low Carbon Skills Cluster Report to inform the UK Commission's national Skills Audit;
- Four SSCs and industry partners identifying skills gaps and shortages, and developing a skills delivery plan for DECC's Household Energy Management Strategy, *Warm Homes, Greener Homes*¹⁹;
- SSCs supporting skills demonstration projects in the Low Carbon Economic Areas.

Looking ahead

Sector skills bodies will continue to play a key role in helping their employers set out their skills needs, working increasingly in clusters that align with emerging markets. The new Joint Investment Programme will provide a significant opportunity for sector bodies to accelerate the delivery of Low Carbon skills solutions, with a funding guarantee from Government, and match funding from employers. A Low Carbon Steering Group has been established to coordinate all SSC activities and provide a single SSC voice for the UK Commission on low carbon skills issues.

19 http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/saving_energy/hem/hem.aspx

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41. These collaborations are at an early stage of development, as are the case studies elsewhere in this document. Stakeholder engagement is typically very strong, and there are encouraging signs of cross fertilisation. Some initiatives are demonstrating new forms of governance, new funding arrangements, new mechanisms for employer engagement and new types of partnership working as they work towards delivering the skills solutions they need. This suggests we are looking at a change model with potential to act as a catalyst. We are keen to better understand these innovations and to assess their potential for replication in other sectors and across the wider skills system.
42. As we take forward the wider reforms in our *Skills for Growth* strategy and our *Higher Ambitions* framework, we need to ask whether this approach to innovation will be sufficient – and whether, if we could find a way to **coordinate** similar collaborative skills initiatives in every sector, that would add up to the low carbon skills strategy we need. We need to ask what more we need to do.

4. **Is our overall analysis of the skills challenges, as outlined in this document, correct?**
5. **What are the best ways to replicate the examples of good practice provided throughout this document quickly and effectively?**
6. **Is stimulating innovation in skills development and delivery the best way forward?**

Skills across the Economy and for Key Sectors

43. We now consider in summary the challenges in key sectors of the economy and the implications for skills provision, as these are currently understood, as well as considering how we provide low carbon and resource efficiency skills across the wider economy. More detail on these challenges is set out at Annex 1.



Decarbonising the Power Industry

44. The power industry in the UK faces three major skills challenges:
- Ageing of the current workforce: some 80% of today's power industry workforce will retire by 2024, meaning that the industry will need to find in excess of 28,000 new skilled employees²⁰;
 - Significant new build: all nuclear power stations except for Sizewell B are set to close by 2023, while some 20 Gigawatts of new renewable generating capacity is already planned or under construction. Building replacement capacity will create demand for engineering and construction skills, and on a number of technical skills specific to new nuclear power stations;
 - New skills for new technologies: there is increasing demand for skills to deliver and operate new technologies, including large-scale renewable energy, infrastructure for Carbon Capture and Storage (CCS) and a modernised electricity network.
45. At the same time, the high carbon industries, such as oil and gas supply and refining, will require fewer workers over time as the move toward a low carbon, resource efficient economy gathers momentum. It is therefore essential that skilled workers from these high carbon industries can be re-skilled in low carbon activities, for example harnessing the skill set required for the refining industries, for use in CCS, and that there is a clear vision for the transition.

Cross-Cutting Responses

46. The National Skills Academy for Power, which was formally launched in March 2010²¹, will work through a network of existing providers, improving the quality of skills provision serving this sector, as well as developing new provision where there are gaps. The NSA for Power offers a particularly innovative and co-ordinated way to focus the further education system to deliver the skills that employers need now, and in the future, for the power industry.

Investment in skills, a regional approach in the West Midlands

Advantage West Midlands has invested £6.3 million in environmental technologies at the Power Academy training centre at Warwickshire College. The facility will train technicians for a new generation of power production, with a focus on turbines and low carbon power generation.

Advantage West Midlands and East Midlands Development Agency have also supported the Universities of Birmingham, Loughborough and Nottingham to work collaboratively on energy research, teaching and knowledge transfer, and support the Energy Technology Institute in driving forward successful development and deployment of low carbon technologies.

20 EU Skills Workforce Planning Model based on data collected to July 2009 <http://www.euskills.co.uk/home/resources/915/NSA+Evidence+Sheet+1>

21 <http://www.nationalskillsacademy.co.uk/academies/sectors/power/index.html>

47. With Energy and Utility Skills (EU Skills), the electricity industry has a strategy group – the Power Sector Skills Strategy Group – at which generators, grid, networks, contractors and manufacturers are all represented. This group guides the industry’s collaborative action on training and education, including research to identify the future demand for skills.

Renewable Generation

48. A substantial number of UK jobs could be created in the renewable energy industries. This is particularly true in relation to offshore wind, in which up to 70,000 UK jobs will be created by 2020²². Taking advantage of this opportunity will mean rapidly establishing the training pathways that will enable individuals and employers to develop the necessary skills. The UK has a strong skills base to build on; our experience in offshore oil and gas, and our existing strengths in engineering and construction, will be valuable to the growing renewable energy sector. The wind industry is driven by project development and construction, with around two thirds of new jobs being at Level 5 or above. Analysis by RenewableUK shows that there will be demand for more apprentice routes to Levels 2 – 4.

Rapid prototyping of new qualifications: Wind Energy

Background

RenewableUK²³ is leading collective employer action by tackling skills gaps at technician level and attracting people to their rapidly expanding industry. Lead employers, sector bodies and awarding bodies have developed a voluntary Sector Skills Accord. Employer commitments include resources to: build the evidence base for skills demand, develop industry specific National Occupational Standards and new Apprenticeship frameworks, produce career pathways and STEM guidance. The Sector Skills Accord was signed at the trade association’s Annual Conference on 21 October 2009 and the first apprenticeship programme is to be launched later this year.

Update

New national occupational standards are in place, providing an industry-wide benchmark for core competency areas for wind service technicians for the first time. Level 2 and 3 qualification frameworks have been finalised, and work to enable access to learner funding through relevant bodies across the UK is in progress.

RenewableUK has also started work on delivering its Skills Accord commitments on renewable energy careers guidance and STEM outreach. It is working with STEMNET²⁴, a UK wide organisation focused on increasing young people’s choices and chances through STEM. The vacancy pages of the RenewableUK website have been re-launched as a ‘jobs and courses’ page to disseminate information on all employment and education issues within the sector.

22 Estimate of UK employment from data in ‘Offshore wind power: big challenge, big opportunity’ (CTC743)

23 RenewableUK, formerly the British Wind Energy Association (BWEA)

24 <http://www.stemnet.org.uk/home.cfm>

Looking ahead

In September 2010 the first cohort of apprentices will start work. The recently approved NSA for Power will act as a 'go-between' for the sector's employers and skills provider network. This RenewableUK-led project has the potential to stimulate collective action in other emerging low carbon sectors where the skills infrastructure is complex, the skills needs have yet to be articulated and, as a result, the necessary qualifications have not yet been developed. We may wish to consider how this approach to accelerating qualifications development could be deployed more widely through the Low Carbon Skills Strategy.

Wind Energy Commitment

In line with the sector's ambition for the size of its workforce in 2017, and as part of our plans to deliver an additional 35,000 advanced and higher Apprenticeships to young adults aged 19 to 30 over 2 years from September 2010, **Government will co-fund the delivery of up to 2,500 Apprenticeships in the wind energy sector.**

The National Apprenticeship Service (NAS) has identified the renewable energy sector as one of its funding priorities for Apprenticeship development. This commitment is contingent on employers themselves generating demand for skills in this area through Apprenticeships, developing the necessary infrastructure, including frameworks and qualifications, and the capacity of colleges, providers and universities to deliver the necessary training.

49. In addition, it is important to recognise the opportunities offered by wave and tidal. Technology development is currently the primary focus, but the sector is expected to grow by 4 – 5% per annum to 2015. As well as the development of skills specific to this sector and direct recruitment from higher education, there is potential for significant transfer from offshore wind.
50. Although different in approach, the collaborative action taken by employers and skills partners in the nuclear, wind and marine energy sectors will be applicable to accelerating skills development in decarbonising other parts of the economy. For example, DECC is supporting EU Skills to lead a wider consortium of SSCs to review skills and training provision for renewable energy. This will determine where, across all four home nations, occupational standards, qualifications and accredited training are lacking and will be the first step in developing a strategy to fill the gaps.

Stimulating Marine Energy skills demand and supply in the South West

Background

The South West Low Carbon Economic Area (LCEA) for marine energy is supporting both Technology and Skills Demonstrators to accelerate provision of skills needed for marine energy. The project will showcase the supply of skills ahead of the curve both as a catalyst for the wider skills system and to stimulate latent employer demand, through engaging with an RDA led industry forum. Early plans developed by an RDA led skills strategy group include rolling out the HEFCE-funded Low Carbon Future Leaders²⁵ programme and a project to address urgent higher level skills needs in the low carbon area. Targets have been set for business assistance, the number of jobs created, individuals qualified, and for the additional funding leveraged.

Update

The SW LCEA is now informing wider SSC-led work on a Renewable Energy Skills Strategy, and providing a potential model for collective action in other low carbon sectors, like Housing Energy Management. Early successes include creating the mechanisms for effective engagement with employers, aligning regional funding streams, and drawing on the collective potential of skills partners, including several SSCs and NSAs, Skills Funding Agency, Association of Colleges, Foundation Degree Forward, National Apprenticeship Service, Universities South West, and Job Centre Plus.

The skills partners are conducting labour market research to inform a regional marine energy skills plan, due in July 2010, as part of a wider £2.4 million Low Carbon High Skills project, co-ordinated by Universities South West. The first strand of work will be to support product development to meet business needs. The second strand will deliver bespoke training solutions. The third strand is already under way, and will provide up to 250 part-funded graduate internships to low carbon businesses in marine energy and related areas. Work is also under way to link the regional ESF programme to the Low Carbon skills agenda to provide the initial flexibility needed where qualifications are still in development.

Looking forward

The LCEA skills project has become a benchmark for successful collective action where there might otherwise have been a market failure, with the potential to influence the approach in other low carbon sectors.

²⁵ Low Carbon Future Leaders: a Backing Young Britain initiative that will give 1,500 graduates the opportunity to work and gain paid work experience in a sector that will be providing the jobs for the future.

Nuclear Energy

51. The nuclear sector is long-established and currently employs 44,000 people, 24,000 of whom are employed directly by operators in nuclear power generation. The programme of nuclear new build, both in the UK and globally, will create a significant skills demand in the coming years. Energy companies have already announced plans to build up to 16GW of new generating capacity in the UK by 2025.
52. Action is being taken by Cogent, the NSA for Nuclear, the Engineering Construction Industry Training Board, and other bodies, alongside industry and funded by Government, to address the skills requirements across the sector.
53. The Cogent report, *Skills for New Build Nuclear*²⁶, announced alongside this consultation document, is a key step, supported by Government, towards addressing the nuclear skills challenge. The report is the first to generate a quantitative employment and skills scenario for new build reactors, with expert input from the industry. Predicted peak employment is approximately 14,000 jobs in 2021. In construction (including mechanical and electrical) the peak employment is estimated at 12,000 in 2021, in manufacturing at 1000, and in operation at 5,000 in 2025. The report contains recommendations on meeting these requirements, some of which require Government action, others of which are owned by the various sector skills bodies. The recommendations include:
- Industry supporting the sector skills bodies in expanding employer-driven foundation degree programmes, such as the nuclear strand in the Cogent Working Higher initiative, alongside HEFCE. Government and its funding councils to maintain funding support for such foundation degrees;
 - Sector skills bodies and industry aligning skills accreditation schemes to ensure safe working on a nuclear licensed site;
 - Sector skills bodies delivering the Basic Common Induction Standard and the Basic Nuclear Industry Context Award for Nuclear Industry Awareness. Qualifications must apply to all personnel prior to entry to any nuclear-licensed site, and be recorded on the Nuclear Skills Passport of the NSA for Nuclear;
 - SSCs raising demand for apprentices in the sector, backed by a Government commitment to prioritise funding for Apprenticeships in the nuclear energy sector as a strategic priority;
 - Industry and the sector skills bodies working with the Nuclear Decommissioning Authority to expand the popular and highly successful nuclear graduates programme across the new build sector.

²⁶ <http://www.cogent-ssc.com/>

Driving skills demand through the Nuclear Skills Passport

Background

The Nuclear Skills Passport has been developed by the NSA for Nuclear in partnership with Cogent SSC as an IT platform. It provides the sector's employees, employers and contractors with a record of the training and qualifications undertaken, that meet agreed industry standards. It features data sets that describe job roles, benchmarking to support workforce up-skilling, signposting to high quality providers recognised by the NSA, and a reporting suite to generate a range of company and industry statistics. The development and successful implementation of the Nuclear Skills Passport will support mobility and transferability across the sector, ensuring that the industry can respond to the peaks and troughs in demand as it progresses through cycles of operations, decommissioning and new build. The Skills Passport will also be of fundamental importance in driving up standards across the breadth of the industry and its supply chain.

Update

The NSA for Nuclear Skills Passport is an integral element of its employer offer. It now covers around 70% of the UK nuclear workforce. Implementation of the Skills Passport is currently being piloted with Magnox North; Magnox South; British Energy part of EDF Energy; Amec; Carillion; Lab Impex; NDA, VT Groups and Costain. In July 2009 senior executives from across the industry agreed that the Nuclear Skills Passport will be stated as 'Highly Desirable' in Supply Chain tenders, becoming a key differentiator in contractor selection. Additionally all those working in, and with, the nuclear industry will be required to achieve (as a minimum) the agreed national standards for: basic common induction, nuclear industry awareness and nuclear behaviours.

Looking ahead

The Nuclear Skills Passport has been developed to demonstrate excellence in nuclear skills. The approach taken by the NSA for Nuclear, working closely with the Sector Skills Council, Cogent, could be replicated across other low carbon sectors. The NSA for Nuclear is keen to work with employers in other low carbon sectors to develop a model suited to their sector.

NEF Assured – delivering quality assured training for the nuclear energy sector

The New Engineering Foundation (NEF), working with the NSA for Nuclear, have developed NEF Assured: the Quality Standard for Assuring Deliverers of Education and Training for the Nuclear Sector. This is an industry specific validation scheme for organisations wishing to be recognised as quality assured deliverers of education and training in/for the nuclear sector. The scheme is applicable to organisations operating in, or working with, the nuclear sector, most notably Site Licensed Companies and public and private providers of education and training.

Only organisations which are quality assured by the Skills Academy through NEF Assured, or an equivalent process, will be able to deliver education and training that counts towards an individual's Nuclear Skills Passport for the nuclear industry. The Nuclear Skills Passport will become an industry pre-requisite.

54. The NSA for Nuclear has been established, in partnership with Cogent, to coordinate, develop and roll out skills products for the nuclear industry. In its first three years, it intends to provide training for 1,200 Apprenticeships and 150 foundation degrees, as well as work-based training to help 4,000 employees move from operations to decommissioning.

Nuclear Energy Commitment

As part of our plans to deliver an additional 35,000 advanced and higher Apprenticeships to young adults aged 19 to 30, Government will co-fund the delivery of up to 1,000 Apprenticeships per year in the Nuclear Energy sector.

This is in line with the Cogent report *Next Generation Skills for New Build Nuclear*. There is an established Apprenticeship framework in Decommissioning, although some new higher level frameworks will be needed, and we expect to be able to provide pump-priming funding for those.

This commitment is contingent on employers themselves generating demand for skills in this area through Apprenticeships, developing the necessary infrastructure, including frameworks and qualifications, and the capacity of colleges, providers and universities to deliver the necessary training.

Carbon Capture and Storage

55. Carbon Capture and Storage (CCS) involves a combination of skills: mechanical and electrical to operate the power station, chemical to operate the capture plant and oilfield skills to develop and operate the storage system, plus, design and construction to build the plant. In the UK alone, the CCS sector could be worth upwards of £3bn a year by 2030²⁷, sustaining between 70,000 and 1000,00 jobs, half of which would be associated with existing activities such as boiler and steam turbine design, manufacture, construction and operation.

²⁷ Future value of carbon abatement technologies to UK industry, AEA Technology, 2009, URN09/738 and additional work to be published which considered gas-fired power generation

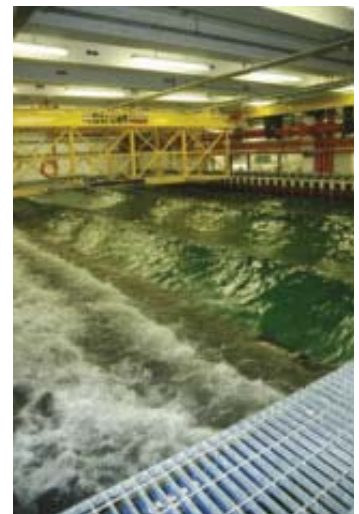
56. The key challenges are:

- Many of the technical skills needed for CCS are similar to existing industry skills in sectors such as power generation, chemicals or oil and gas. But the detailed skills breakdown is uncertain and there are no specific occupational standards or training routes;
- CCS is not yet a mature technology but needs to be developed to short timescales. Current demand for skills is limited to pilot projects, so market demand alone may not stimulate skills development in time;
- The technology overlap with other sectors means that CCS is exposed to competition for resources and skills.

57. We will work with industry and the skills system on the new skills needed for development and deployment of CCS. Fundamental to the expansion of the sector and skills base will be the increased uptake of STEM skills. In addition, there are several examples of existing joint industry and public body collaboration to draw on to help stimulate more specialist skills in CCS.

Providing cutting-edge research skills for Carbon Capture and Storage

The Engineering and Physical Sciences Research Council, in partnership with industry, is providing over £11 million for CCS Centres for doctoral training aimed at engineers and researchers. These include the Efficient Power from Fossil Energies and Carbon Capture Technologies Industrial Doctorate Training Centre based at The University of Nottingham. The Centre was established in partnership with the Midlands Energy Consortium – comprising the Universities of Nottingham, Loughborough and Birmingham – and a number of industry leaders within the power generation sector. The aim of the Centre is to develop engineering research leaders to tackle the challenges in producing near zero emission power from fossil fuels. It offers research engineers the chance to train as industry experts ready to implement CCS technologies. The four year doctoral programme equips research engineers with the knowledge and expertise to conduct cutting-edge research and work within highly skilled multi-disciplinary teams. Annual summer schools, in the UK and China, present unique opportunities to learn more about the challenges of meeting increasing global energy demands. The Centres will produce at least 10 students a year for five years.



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- 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?**
 - 8. For the power sector skills we have identified, what is the best way to accelerate skills development beyond what is planned?**
 - 9. What more can be done, both within the power industry, and through Government energy policy, to promote energy-related careers to young people?**
 - 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?**

Decarbonising Buildings and Construction



58. Emissions from the way we heat, cool and power buildings account for nearly half of the UK's emissions: 17% from non-domestic buildings and 27% from homes. The *UK Low Carbon Transition Plan* set out the Government's ambitions to cut emissions from homes by 29% on 2008 levels by 2020, and from workplaces by 13%. By 2050, emissions from homes need to be almost zero.
59. The majority of buildings that will exist in 2050 are already standing today. We need to find ways of reducing emissions from all types of building: new and existing, domestic and non-domestic. But there are also opportunities: our analysis suggests that retrofit activity could create up to 65,000 jobs in domestic retrofit installations and advice.
60. The transition to low carbon and resource efficient buildings, and subsequently zero carbon buildings, will create new and evolving demands for skills and knowledge. This is particularly evident in relation to STEM skills to develop, manufacture, implement and install new adaptation and mitigation technologies.

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61. National Occupational Standards (NOS) are particularly relevant in this sector and developing NOS that set out the competences required by each trade or profession is a key role for Sector Skills Councils. The SSCs are also involved, with awarding bodies, in developing new vocational qualifications on the Qualifications and Credit Framework to fill identified gaps. The Built Environment Skills Alliance²⁸ is an alliance of the SSCs covering built environment industries. They are working to update the NOS relating to industry trades and professions. The new standards will help ensure that further and higher education courses in built environment subjects cover low carbon knowledge and skills.
 62. Practical skills and more theoretical modules in renewable building are part of the modernisation of the construction NVQ system by ConstructionSkills²⁹, to lead the way for a credit point system applicable across the UK and Europe.
 63. We can build on these very positive steps forward, to ensure the skills system will be in a position to meet the latent skills development needs of the construction industry and the emerging demands of new technologies and methods. The skills providers themselves may need to adapt and respond, so that they are equipped to advise and develop courses that meet the needs of industry and individuals for the future.

Zero Carbon Buildings

64. To deliver our ambitions for zero carbon homes, industry has set up, with funding from Government, a dedicated delivery body: the Zero Carbon Hub. The work of the Hub includes identifying, testing and disseminating lessons learnt on the innovations needed to build zero carbon homes cost effectively. The Hub is identifying issues across the industry which need to be resolved, including skills. The National House-Building Council, Zero Carbon Hub and ConstructionSkills have been working in partnership to identify key issues and their possible impacts on the home building sector over the next decade, and how the industry might deal with the short, medium and longer term skills challenges it faces.
65. The overall aim of the Hub's research and consultation is to provide a 'route map' for the future direction of the house building industry and the skills implications this will present. We urge interested parties to engage with the Hub's consultation exercise³⁰. Government will consider the outcomes of the Hub's consultation alongside responses to this consultation in deciding our strategic approach in the lead up to 2016.
66. Construction Skills is also developing similar route maps for other parts of the construction sector.

²⁸ BESA comprise of Asset Skills, ConstructionSkills, ECITB, Energy & Utility Skills, Proskills, SummitSkills.

²⁹ ConstructionSkills is the Sector Skills Council for the construction industry

³⁰ The Hub published their consultation on 2 March 2010. See www.homebuilding-skills.com.

Retrofit

67. *Warm Homes, Greener Homes: A strategy for Household Energy Management (HEM)*³¹, sets out the Government's policy on cutting emissions from fossil fuels in homes by 29% by 2020. The measures include insulation, smart meters, micro-generation and advice to householders. The strategy aims to deliver:
- By 2011: six million homes to have received loft and cavity wall insulation;
 - By 2015: all lofts and cavity walls to be insulated, where practical;
 - By 2020: deliver eco-upgrades to up to 7 million homes;
 - By the end of 2020 all homes to have received a smart meter.
68. Successful delivery of the HEM strategy requires skilled trades people to reduce the energy usage in buildings. We estimate that we will need 21,000 – 35,000 installers of solid wall insulation and micro-generation to make this happen. Delivery of HEM also requires skilled people to advise householders on what is suitable for their property and how it can be delivered. There will also be opportunities in manufacturing the new materials and equipment needed – the skills for this are discussed in the section on advanced manufacturing. Skilled installers must deliver high quality work to meet Government ambitions and support consumer confidence. While the skills for installers of loft and cavity wall insulation exist in sufficient numbers, we are starting from a very low base for installers of more complex measures such as solid wall insulation. There are also few installers of micro-generation.



31 http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/saving_energy/hem/hem.aspx

The EEPH-led Household Energy Management project

Background

Companies providing energy efficient retrofit solutions for the domestic housing market need to increase their capacity to deliver insulation for solid wall homes, and innovative low carbon technologies. They also need to provide high quality advice if they are to stimulate consumer demand. A number of sector bodies, employer associations and skills partners have an interest in this market. The Energy Efficiency Partnership for Homes (EEPH) is coordinating their effort and input on skills to the HEM strategy. A first stage project, mapping how HEM skills training is currently delivered, identifying new skills requirements and options for meeting them in future, is due to complete in April 2010.

Update

Working with the same strategic partners, EEPH will lead a second stage project during 2010/11 to implement the findings of its review. This will include defining new job roles, competencies and occupational standards for all jobs engaged in the installation, operation and maintenance of energy efficiency and low carbon technologies in the home. In taking this work forward, EEPH will be looking to build governance arrangements, align funding streams and work with employers and skills provider networks to develop qualifications. It is already drawing on the good practice emerging in the SW Low Carbon Economic Area (LCEA) and in the Wind Energy sector. The project also has the potential to link up with the Greater Manchester and London LCEAs. These have the potential to act as test beds for demonstrating early skills solutions, and implementing findings from the EEPH review of retrofit skills.

Looking forward

The EEPH-led project is an excellent example of voluntary collective action where a number of sector skills bodies have an interest. This could include linkage to leading edge energy efficiency and retrofit work being undertaken by the Greater Manchester and London LCEAs.

69. The scale and nature of the programme to retrofit the existing housing stock will provide a range of training and job opportunities for people with all levels of skills. Government is working to maximise the benefit of our investment for unemployed young people and disadvantaged groups.

Regional Partnership Working for Skills Development

The London Low Carbon Economic Area has set up a number of programmes to help develop new low carbon skills in the capital. The London Development Agency Retrofit Employer Accord is investing in a brokerage approach to open up the jobs and skills opportunities associated with its Homes and Building Energy Efficiency Programmes. In addition, the Low Carbon Skills Forum, working to the London Skills and Employment Board, will enable London's transition to a low carbon economy by facilitating effective partnership working within the employment and skills sectors.

70. Clients will want assurance that suppliers have the skills to deliver a quality service, using a competent workforce. As the market grows, there is clearly a huge opportunity to respond with offerings that will meet that need. These could take the form of Competent Persons schemes, Quality Marks, and Consumer Codes – an existing example of this is the Microgeneration Certification Scheme.

Providing opportunity for all

Groundwork is currently the biggest single deliverer of the Government's Future Jobs Fund programme, a £1 billion initiative offering temporary work to unemployed young people and disadvantaged groups who may be affected by the recession.

Groundwork is working with Government to gear up the supply chains of energy efficiency products by employing and managing teams of installers directly on community jobs around the country, and by working with the likes of British Gas, The Building Research Establishment and The Mark Group to train up the next generation of installers through Apprenticeships and work placement opportunities.

Eco-towns

71. Eco-towns³² are a major Government initiative designed to respond to the twin challenges of climate change and the need for more sustainable buildings, especially homes. As large-scale new communities with a minimum of 5,000 homes, eco-towns will be exemplars of sustainable development, required to meet the toughest ever sustainability standards for new development in the UK, as set out in the Eco-town Planning Policy Statement³³. They will provide a critical mass that will draw in a complete supply chain of low carbon and resource efficient materials, technologies and techniques. The construction phases are likely to create and support in the

32 The £60m Growth Fund allocations for the first wave locations were announced on 8 February 2010. This provides financial support for initial start up work and demonstrator projects in each of the four locations: Whitehill-Bordon (Hampshire), Rackheath (Norwich), North- West Bicester (Oxfordshire) and St Austell (Cornwall).
33 <http://www.communities.gov.uk/publications/planningandbuilding/pps-ecotowns>

region of 2,000 local jobs, including apprenticeships, in new green building skills, providing an ideal opportunity to develop and improve skills in this sector. Already Cornwall Council (St Austell eco-town) are working in partnership with local providers to create a centre of excellence for sustainable construction in the South West, and in the Bicester eco-town a green construction skills training programme has been set up.

- 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?**
- 12. What more could it do to deliver low carbon and resource efficient skills in all parts of the construction industry?**
- 13. What more should Government and industry do to ensure that those retrofitting existing buildings have the necessary skills?**
- 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?**
- 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?**

Decarbonising the Transport Sector

72. The Government's Low Carbon Transport Strategy sets out the scale of the challenges and opportunities for the transport sector and sets a course for delivering the low carbon transport system of the future. The strategy outlines the building blocks being put in place for longer term change through to 2050 and forms a key component of the UK Low Carbon Transition Plan.

Ultra-low carbon vehicles

73. The Government has a clear aim to position the UK at the global forefront of ultra-low carbon vehicles (ULCV) design, development, manufacture and use. The transition to these new vehicles presents significant business opportunities for the automotive sector, as well as for the emerging associated infrastructure, energy storage and digital interface sectors.
74. The Government has committed over £400 million of funding to encourage the development and uptake of ULCVs, including programmes to incentivise consumer demand and for the provision of associated infrastructure. This demonstrable commitment, together with the continuing push of CO₂ regulations, should provide employers with confidence to invest in equipping their workforce with the additional skills required for the transition to ULCVs.
75. The skills challenge to ensure that UK companies are well positioned to maximise business opportunities will be addressed primarily through the adaption of current skill sets to meet the demands of changing technology in the transition to ULCVs. For example, the supply of STEM graduates will continue to be critical in the research and development, design and engineering elements of the supply chain. An understanding of electronic systems as well as mechanical systems will increasingly be required, as will the application of chemistry (fuel cells, battery cells) in key ULCV technologies. A skilled manufacturing and maintenance workforce able to produce and work with key components of the vehicles will be essential.



76. Industry will also have a role to play in both the identification of skills gaps and in the encouragement of more businesses to engage with SEMTA³⁴ and higher education institutions.

Re-skilling the regional workforce – LCEA in ultra-low carbon vehicles

Background

One North East, the regional development agency, is developing the UK's first Low Carbon Economic Area (LCEA) for ultra-low carbon vehicles. The programme includes setting up the first training centre in the sustainable manufacturing of ultra-low carbon vehicles as well as the establishment of a Research and Development Centre as a focus for the region's universities and businesses, and the creation of a new business park.

Update

The Learning and Skills Council has given approval to more than £4 million to fund a National Skills Academy (NSA) training centre for the automotive industry. Together with employer and regional contributions, the total investment in the centre will be £8.5 million. The training centre, the Centre for Sustainable Manufacturing, Productivity and Innovation, will be established by Gateshead College, through the NSA for Manufacturing. Working closely with the National Apprenticeships Service, the centre will also be linked to an Apprenticeship Training Agency and will deliver a wide curriculum from age 14 upwards, giving learners access to the latest technology and production methods. Gateshead College is working with SEMTA to develop the new curriculum needed to support electric vehicle and battery manufacture, and after care service and maintenance, including a new foundation degree and MSc in partnership with the University of Sunderland.

Looking forward

The centre will enable global best practice in sustainable manufacturing to be transferred to supply chains in the manufacturing sector in the North East.

Aviation

77. Forecasts indicate that the requirement for new fixed wing civil aircraft could be worth \$2.6 trillion up to 2026. These new aircraft will need to be significantly more fuel efficient. A highly skilled workforce will be needed to enable the UK to become a leading nation in new low carbon aviation technologies.
78. Barriers to entry in the aviation manufacturing sector are very high. Subcontracting for the supply of assemblies or through joint ventures are the more likely opportunities for new businesses to enter. For new entrants to the sector, a key issue will be the need for some multi-disciplinary understanding of both mechanical and electronic systems, and of alternative sources of power generation, such as fuel cells and low carbon fuels. On the design side there will also

34 SSC for Science, Engineering and Manufacturing Technologies

be requirements to design for both recyclability and whole life energy savings – making parts, materials and components easier to recycle at the end of their lives and using the optimal balance of energy efficient, low carbon and easily recyclable materials.

79. However, growth in the demand for these skilled people is likely to result in increased competition between sectors for workers with specialist skills. To ensure appropriate provision of these specialist skills to all sectors, both new and existing workers must be engaged. There is potential for retraining of unemployed people with manufacturing skills and the need to encourage young people to study STEM subjects so they have the right background for entry to the industry.

Freight and Logistics

80. In the logistics sector there are two main areas of skills needs. At the very front line we can improve the skills of operators. Secondly, management skills will be required to ensure that good practices are followed.
81. Existing action focuses on two areas:
- The Department for Transport's Freight Best Practice Programme is supporting the SAFED initiative, efficiency benchmarking and low carbon technology choices;
 - Skills for Logistics³⁵ is working in partnership with the sector to address the historical lack of investment and co-ordination in training and skills, without which it will be difficult to achieve a significant reduction in the sector's carbon footprint. A National Skills Academy for Logistics was announced in March 2010.

Skills driving carbon reduction in logistics

Menzies Distribution, a distributor of newspapers and magazines, implemented a fuel efficient driving scheme with support from Department for Transport and Skills for Logistics. Half a day of training per driver showed an average potential saving of around 10% on fuel; modest funding has helped drive a comprehensive up-skilling programme that has had a significant impact on reducing emissions. Having gained valuable experience from the initial programme, Menzies has used this approach to maintain this improvement and ensure that there is no reversion to less efficient driving habits. Government has identified that improving eco-driving skills has the potential to save £300 million in fuel costs and 3 million tonnes of carbon emissions over five years across the sector.

Rail

82. New job opportunities are likely in supporting the operation of the rail network and improving its capacity. There will be a need for skills in civil engineering, rail infrastructure, and systems engineering, particularly for new high speed lines. There will also be a requirement for technicians and graduates in the electrical engineering, rail electrification, power control, and Electric Multiple Unit rolling stock areas. It will be important to ensure that these key skills are in place at the times they are needed.
83. There is generally a good supply of technician level training: most train operating companies have training and development schemes which can include a range of rail operation and rail maintenance and engineering topics. But the demand for skills in the rail sector is mixed with gaps in some of the high technology and rail systems engineering areas.
84. The Association of Train Operating Companies has reintroduced a graduate training scheme. There appears to be more of a demand for graduate level skills in building future infrastructure and therefore a strategic approach to providing future skills requirements may be required. There may be a role for some stimulated skills training initiatives to meet future demand.
85. The NSA for Rail Engineering was approved to move into business development in March 2010. It will receive nearly £3 million of Government investment through the Skills Funding Agency and has the support of organisations including Network Rail, Transport for London, Rail Freight Group, the Rail Industry Association and the Association of Train Operating Companies. The Learning and Skills Council has also approved a Tunnelling and Underground Construction Academy in Ilford, London, to be run by Crossrail. The new facility will receive £5 million public funding and will develop new courses and qualifications, providing training for up to 1,800 people a year.

- 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?**
- 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?**
- 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?**
- 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?**

Decarbonising Supply Chains across the entire Economy

86. In this section we discuss the emerging industrial and manufacturing sectors where the UK can seize competitive advantage, and the skills needed across the economy to improve resource efficiency, reduce waste and minimise carbon emissions.
87. Industry and manufacturing are directly responsible, collectively, for some 14% of total UK carbon emissions, more if distribution of finished goods and emissions from waste are included. Improving resource efficiency could reduce this. This means reducing resource use, increasing efficiency during the lifetime use of products, and minimising waste through recycling and recovery. Resource efficiency will also enable the UK to develop competitive businesses able to adapt to the challenges of the low carbon economy.
88. This change will cover primary industries, manufacturing, the service sectors, to end-of-life decommissioning and recycling.



Primary Production and Heavy Industries

89. The *UK Low Carbon Transition Plan* sets out the objective to reduce carbon emissions from the agriculture, forestry and land management sector in England by at least 3 million tonnes of CO₂e per year by 2022. Changes to farming practice and the application of new technologies offer farmers huge carbon reduction opportunities, bringing direct cost benefits in, for example, reduced input of fertilisers or energy. In addition, agriculture and forestry will increasingly be the basis of a new supply chain for renewable energy and crops, and for the burgeoning industrial biotechnology sector. The farming industry's new *AgriSkills Strategy and Action Plan: Towards a New Professionalism*, will consider the skills issues needed to deliver these changes.
90. Decarbonisation of the UK's important traditional heavy industrial base will be underpinned by decarbonising the power sector and by the introduction of new technologies such as Combined Heat and Power, and Carbon Capture and Storage in cement, iron and steel manufacturing, as well as direct energy efficiency measures. The skills needs for this element of the transition have been covered elsewhere in this document.

Advanced Manufacturing

91. There are many opportunities for UK businesses in advanced, low carbon and resource efficient manufacturing, many building on the UK's position as a global leader in these areas. The opportunities creating demand for new and evolving skills of key importance will be:
- Development and use of new raw materials, including bio-composites;
 - New types of manufactured product, such as those taking plastic electronics and silicon electronics approaches;
 - New industries such as chemical production through industrial biotechnology;
 - Extraction of recyclable materials for reuse and recovery and life cycle assessments;
 - Application of lean manufacturing methods;
 - Redesign of existing products with a focus on resource efficiency and a cradle to cradle approach, in which materials are continually recycled;
 - In product design, so that products use fewer resources in manufacture, have lower impact in use, and are easily recycled;
 - Energy minimisation by integrating waste recycling to energy;
 - Improved supply chain management;
 - IT that replaces goods and services with virtual equivalents and provides technology to enable energy efficiency.
92. The actions to increase the provision of STEM qualified employees laid out earlier in the document will be key to delivering the skills needed for these new opportunities. SSCs will work with industry to identify developing skills needs.

Food Sector

93. The UK food industry is the largest UK manufacturing sector, and an important contributor to the UK economy. It has an annual turnover of £121 billion and employs 3.1 million people, with total greenhouse gas emissions from the food chain, post-farm gate, estimated at around 43 million tonnes of CO₂e in 2006³⁶.
94. The sector is also varied in terms of the size of businesses with some major global players and multinationals and a long tail of small, often specialised businesses. The SMEs face particular difficulty in investing in appropriate training and releasing staff for extended periods. They may also face confusion in identifying which training bodies to approach, or in selecting the most suitable qualifications.
95. The new job opportunities in this sector are in food science, food technology, biotechnology, nanotechnology, IT, engineering (including design and manufacture of food production and storage equipment), and sustainability best practice, including energy management (reducing the overall carbon footprint of a business). Other areas include robotics, automation, and nutrient technology.
96. This will lead to specific requirements for:
- Technical staff who can operate and maintain new technologies needed to help achieve sustainable development objectives;
 - Staff at all levels who have awareness and understanding of sustainable development issues and specialists such as energy managers for larger businesses;
 - IT specialists to design and operate systems applicable to logistics, smart operating systems, and environmental control;
 - Consultancy and specialist trainers to help workforce raise sustainable consumption and production skills;
 - Designers and developers in related technical sectors such as production line engineering and refrigeration;
 - Scientists and technicians in areas such as biotechnology, nanotechnology, and robotics/ automation to develop new food products and production techniques.
97. Improve³⁷ has been developing sustainability based skills standards and frameworks (including on low carbon) with the participation of a range of sector employers, including a Food Supply Chain cluster being formed by Improve to cover Skillsmart Retail, People First and LANTRA.

³⁶ Environment Statistics (Defra). Includes food sector manufacturing, transport, retail, and catering (hotels & restaurants). The 43Mt figure is 26% of the total 2006 GHG emissions from the food chain, estimated at approx 160 Mt CO₂ equivalent.

³⁷ The Sector Skills Council for the food and drink sector

Service and Support Sectors

98. A wide range of businesses support the delivery and use of products after manufacture, whether those products are 'conventional' or low carbon. These businesses need to address their carbon and resource use and seize the competitive advantage in reduced costs in doing so. There has been significant progress made in this area in several industries, but to achieve a robust and meaningful reduction in carbon emissions in the long term there is a need to promote innovative energy and resource efficient technologies across all sectors.
99. For some industries, the major impact on climate change arises from the way in which people use products after purchase. In these cases, developing the knowledge and necessary skills to understand the motivation for consumer behaviour are as important as design skills.
100. However, the ability to make the most efficient use of resources and to reduce waste will be the key skill. Many of these skills needs will be met by actions already described to develop generic skills and to increase the number and quality of STEM skilled employees. But, employers and Sector Skills Councils will need to continue to work collaboratively to identify emerging skills needs.

New industry, new jobs, new skills requirements

101. Across all these product and materials supply chains there are a set of cross cutting skills required. There will be a need for:
- Scientific and engineering knowledge of emerging industrial applications such as composites, bio-composites, anaerobic digestion, third generation biofuels. Science and engineering qualifications are key;
 - Interdisciplinary and integrated thinking skills, including the ability to understand the wider consequences and effects of processes and choices of raw materials;
 - Interdisciplinary scientific skills, transcending disciplinary boundaries to look at product or process development lifecycles, also including, for example, development of metrics for measuring product standards for sustainable consumption and production. The skill involved in integrating environmental, social and economic criteria will be key;
 - IT skills to maximise the positive impacts IT can deliver across industry, through advanced analytical IT systems which can act as intelligent controls in low carbon processing and advanced manufacturing;
 - Managers and industry leaders to further develop skills in business analysis for new industries, leading to the deployment of innovative and resource efficient products and so generate market opportunities for UK firms. Businesses will also need an understanding of environmental regulations and their implications.

102. There will also need to be:

- New practical and vocational qualifications for the new process based work created e.g. for Waste Electrical and Electronic Equipment disassembly in waste management ; new practical qualifications for land managers which will enable the production of sustainable raw materials at the basis of all industrial processes; technicians to manage new processes;
- Up-skilling and continuing professional development for existing employees;
- A step up in the provision of and quality of generic management skills but also in sustainable procurement, lifecycle analysis, monitoring and measuring skills, carbon accounting, performance reporting, environmental management systems and risk management, together with more traditional STEM skills.

Going Green at Work – TUC Green Workplaces Project

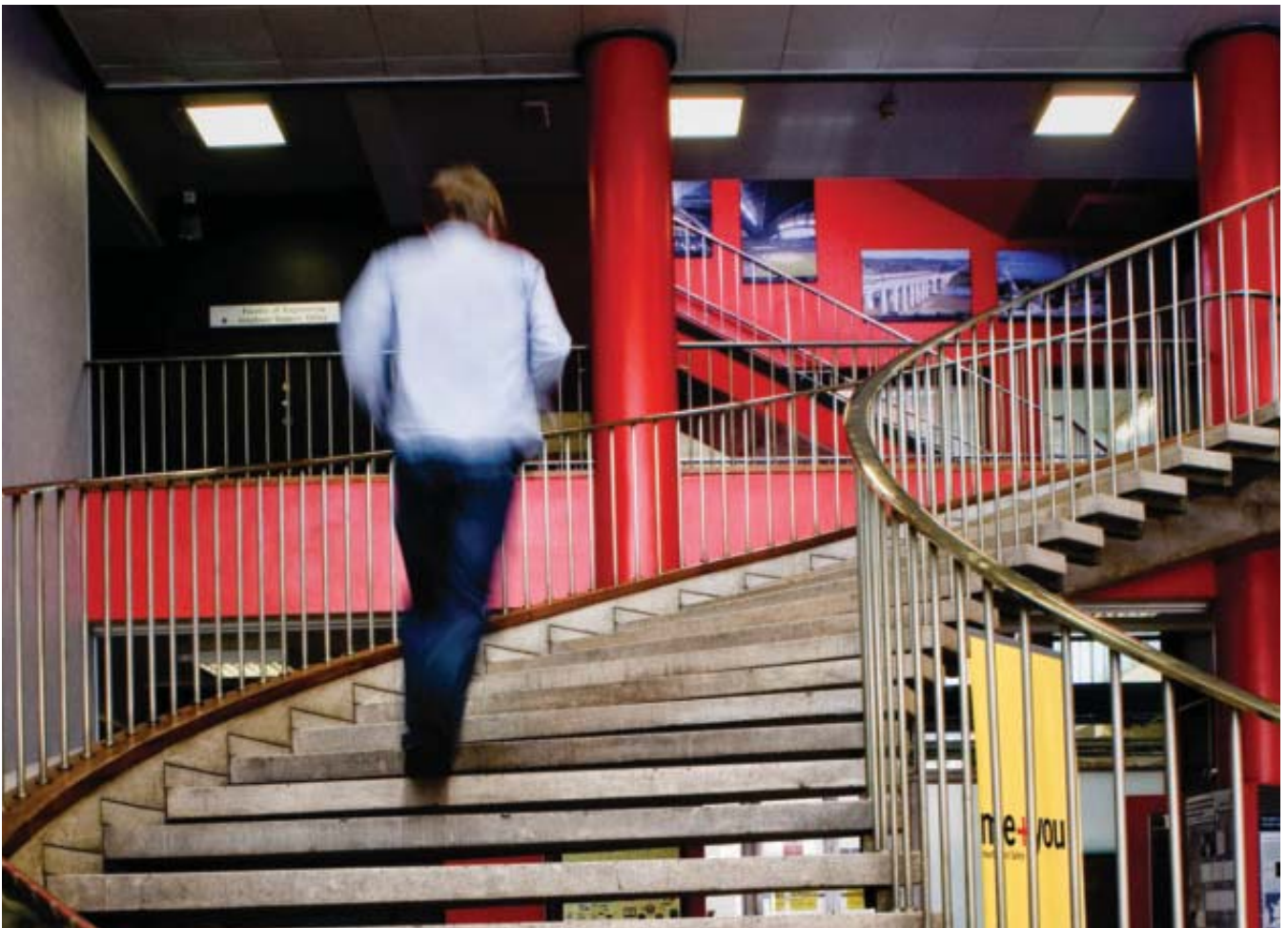
In 2008, the TUC gained Government funding through the Union Modernisation Fund to support union initiatives at a range of pilot workplaces aimed at making these workplaces “greener” and up-skilling workers.

Green Workplaces projects are workplace-based initiatives that bring together the practical engagement of both workers and management to secure energy savings and reduce the environmental impact of the workplace. This can be achieved through awareness-raising events, staff surveys and training workshops.

At Great Ormond Street Hospital, union members identified the potential for a more planned and sustained approach to energy saving and cutting resource use in the workplace. With work underway to redevelop and refurbish the hospital site, the project also presented an opportunity to ensure workforce engagement in the hospital’s sustainability strategy.

The project included a training day to up-skill workers and managers in new approaches to low carbon. Key to this was the participation of senior managers, such as the Chief Operating Officer, and the added value of having frontline workers involved was evident from the quality of technical, clinical and medical knowledge these participants were able to offer to the environmental discussions.

20. What more should Government and employers do to up-skill existing, and future, workers in the forestry and farming industries, in particular to support the emerging, and bio-energy, biomass processing and renewable heat sectors?
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?
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?
23. What are the key skills challenges in the service and support sectors to deliver improved resource efficiency and low carbon?



Skills for Adapting to Climate Change

103. A changing climate will bring fundamental changes to the UK economy and society and we will need many skills to help us respond. Changes will need to be made to existing skills sets, but there will also be new opportunities that demand new skills.
104. Skills will be needed to build adaptive capacity and to take adaptive action. These skills will often be complimentary to the skills needed to develop a low carbon and resource efficient economy. For example, both goals can be pursued in the way we construct and manage our transport infrastructure, implement energy efficient cooling or heating of buildings, and in the efficient use of water. But they can also be distinct, such as managing and mitigating the risk of extreme weather events: including floods or storm damage.
105. The need for adaptation will provide opportunities for businesses, both in terms of providing solutions and services in the UK and in exporting their expertise abroad. This is particularly important when companies and public and private investors invest in assets with a long life, such as major infrastructure projects.
106. Building adaptive capacity across society will require further research on the adaptation skills needed in the long term, and will demand a response by schools, universities and professional associations as well as Government. It is clear that the scale and pace of change we could face is unprecedented, and in some areas such as planning, we will need a step-change in the number of employees with the skills and knowledge to deal with adaptation. Government, working together with industry, will need to gather knowledge about skills capacity, particularly in the private sector, and what will be needed to ensure all sectors are properly equipped to adapt to the impacts from climate change.
107. The Climate Change Act requires Government to assess the risks posed by the impacts of climate change for the UK. This assessment will provide the evidence required for the development of a National Adaptation Programme in 2012. A risk assessment process will help Government identify gaps and needs, but we need to begin to put in place measures before the assessment is completed.

108. The Adaptation to Climate Change Programme in Defra is working across the public, voluntary and private sectors now, to increase the UK's capacity to adapt to the effects of climate change and understand the skills need.

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?



Annex 1: Sectoral Challenges: Further Background

This annex provides further material and detail on the opportunities and challenges in the key sectors and in adaptation discussed in the main document.

Annex 1a: Decarbonising The Power Industry

Nuclear Energy

1. The growth in employment in nuclear new build will coincide with a decline in employment in nuclear decommissioning. This will facilitate the transfer and re-skilling of workers into new build. Nevertheless, many opportunities will also arise for new entrants to the industry, particularly given that up to 70% of the current nuclear workforce will retire by 2025.
2. The Cogent report, *Next Generation: Skills for New Build Nuclear*, sets out the skills needs for the future of the nuclear sector. It contains a risk register of critical skills, crucial for advancing new build as quickly as possible. The issues raised reflect a need to improve both the capability (workers with the required levels of specific skills needed to work to the quality and safety standards expected in the industry), and capacity (the availability of an adequate base of people with general STEM skills from which to draw much of the future new build workforce) of the skills base. The report also contains many recommendations geared towards meeting both capacity and capability requirements, some of which require Government action, others action by the various sector skills bodies.

Smart meters

3. The development and deployment of smart meters and smart networks will require recruitment and training of installers and technicians to work with new technologies that are likely to evolve rapidly. In particular there will be a need for an increased installation capacity during the initial roll out of smart meters to end 2020. We also expect companies developing technology to embed complexity in equipment and supporting systems, such that these become outwardly simple to install and use, thereby reducing the need for specialist training.

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4. There will be increasing demand for skills to deliver and operate new technologies linked to smart networks, including for large-scale renewable energy, infrastructure for carbon capture and storage and a modernised electricity network to link these together. Smart networks can be used to manage power demand actively, (alongside smart meters, which with displays could themselves evolve from monitoring and reporting consumption through to integrating local renewables and controlling local demand). Many of the skills required are transferable and could also be in demand from other sectors, for example, for rail electrification.

Hydro-electricity and marine energy

5. Hydro-electricity and tidal barrage schemes are predominantly civil engineering projects, for which the UK has an established capability. However, existing engineering skills will need to be adapted to new and emerging technologies. We will also need to consider ways to attract current civil engineers to the new industry will need to be sought.

Carbon Capture and Storage

6. The world has around 1.4 TW of coal-fired electricity generation. However, the sheer size of coal's contribution to global energy and its importance to developing nations, means that alternative energy sources cannot take over its role for many years. It is therefore essential to tackle the emissions by capturing carbon at the point of use. A strategic programme of skills development could help deliver the required number of researchers, professional engineers, and technicians needed for CCS.
7. Demand for CCS skills should be stimulated by the four government-supported CCS demonstration projects which are planned for coal-fired plants. It is anticipated that the first project will be operational around 2014. The timing of the other three projects is expected to be announced in 2011.

Skills transfer

8. Pathways into jobs in the conventional power industry are well-established. These may need to be updated, for example, to ensure that occupational standards are aligned to technologies of the future. However, whilst the industry has apprentice and graduate traineeships upon which we can build, we must consider the capacity to deliver the training required.

Sector attractiveness

9. Despite very positive messages about career opportunities, the energy sector is almost invisible to young people in particular, who are often unaware of the career prospects it offers, and is not seen as a career of choice. Redressing this, building awareness of the career opportunities through an online information portal³⁸, and generally improving the 'sector attractiveness' are key activities for the National Skills Academies.

³⁸ <http://www.nuclear.nsacademy.co.uk/student-zone>

Action so far to meet skills gaps

10. The challenges have been acknowledged, and employers and others have taken action, both individually and in collaboration, to develop training courses and other skills initiatives, including:
- DECC is supporting EU Skills to lead a consortium of SSCs to review skills and training provision in the renewable energy sectors. This will determine, across all four home nations, where occupational standards, qualifications and accredited training are lacking and will be the first step in developing a strategy to fill the gaps;
 - The Cogent report sets out key areas for skills demand: both capacity and capability, in relation to engineering, engineering construction and specialist nuclear skills. Identifying need in the report is a key step forwards, to address skills needs for the nuclear industry;
 - The NSA for Nuclear has been established, in partnership with Cogent, to coordinate, develop and roll out skills development products for the nuclear industry. In its first three years, it intends to provide 1,200 Apprenticeships and 150 foundation degrees, as well as work-based training to help 4,000 employees move from operations to decommissioning;
 - Renewable UK is leading the development of a skills and training strategy for wind and marine renewables. This is currently developing Apprenticeship frameworks and will see trainees for turbine technicians start their courses in the new academic year in 2010;
 - Government has accepted the recommendations of the Gibson Report on construction engineering, and will support a programme to recruit 1,000 apprentices a year, which will equip the UK workforce for the clean coal and nuclear construction programmes.



Annex 1b: Decarbonising Buildings and Construction

Jobs and opportunities

11. There are areas of growing demand, but generally, the construction industry in the UK is characterised by an historic lack of investment in skills, which is exacerbated by its fragmented nature and reliance on subcontractors. There also needs to be more investment in formal research, development and demonstration. This is most notable in house-building, which has tended to rely on the supply chain for significant innovations. While there has been considerable innovation at the project and site level by many firms, mechanisms for sharing good practice and lessons learned could be improved.
12. Recent climate change legislation and more stringent building regulations are beginning to drive change among some specialist and larger companies, for example, incentives such as Feed-In Tariffs and the Renewable Heat Incentive will encourage building owners to incorporate renewable micro-generation, and will create demand for new and adapted skills. The Carbon Reduction Commitment will also encourage greater energy efficiency in non-domestic buildings.
13. The house building industry is particularly sensitive to fluctuations in the economy. As a result, the industry keeps its labour force as flexible as possible with a heavy reliance on subcontractors. This flexibility contributes to skills shortages in periods of growth. Research conducted on behalf of ConstructionSkills³⁹, found that ‘there is strong evidence from both employers and construction workers that less is invested in the training of staff who are employed on a labour-only subcontractor basis’⁴⁰.

Specific sub-sectoral needs and issues

14. We will need a rapid response by employers and the skills system, to provide the right training to new entrants to the construction market and to up-skill the existing workforce. This will apply right across the building supply chain from developers and designers, funders and mortgage providers, through site managers, trades-people, compliance and enforcement bodies, facilities managers, to end users (including use and maintenance of homes or workplaces and appliances within them). New construction techniques may also lead to an increase in offsite manufacture with onsite assembly and a different set of skills to support that, including a new approach to on-site project management.
15. There is a need to embed an understanding of strategies and options to adapt to climate change at all levels. For example, ensuring that adaptation solutions do not work against mitigation measures by adding to carbon dioxide emissions, and to seize the business opportunities in construction and retrofit businesses. Employers will increasingly look for new recruits to have relevant skills and to be aware of what ‘low carbon’ means in a real site situation.

39 <http://www.cskills.org/>

40 The Effect of Employment Status on Investment in Training, the Construction Industry Training Board (DFES, 2003), report available at: <http://www.constructionskills.net/research/researchactivity/nationalandregionalreports/effectofemploymentstatus.asp>

Zero Carbon Buildings

16. The Government has set out a clear route map for zero carbon new homes from 2016, and consulted on an ambition for all new non-domestic buildings to be zero carbon from 2019 (with new public sector buildings leading the way from 2018)⁴¹. The Zero Carbon Hub offers a sound basis for taking forward research and actions to fill skills gaps for domestic buildings, but skills gaps for non-domestic buildings also need to be identified and addressed.

Retrofit

17. With two thirds of the 2050 housing and non-domestic stock already built, we need to focus on tackling emissions from existing homes and non-domestic buildings. By reducing the amount of energy needed in buildings and decarbonising the energy they do need, householders and businesses can radically reduce their environmental impact and their energy bills.
18. Skills and training provision in this industry is fragmented. There is no single qualification or standard which installers are required to achieve through their training. Some training is provided by further education colleges, and employers provide work-based training for installers. Manufacturers also provide training, but this is usually geared towards installing their own systems and products. We will need creative solutions to roll out training to sufficient people to provide a skilled workforce quickly from this patchy landscape. This will require new forms of collective action, potentially along the lines of the DECC-sponsored Household Energy Management Steering Group.

The role of local authorities, and the skills required

19. Planning is fundamental to delivering a sustainable built environment where low carbon lifestyles can be the norm. It is central to the delivery of new homes and supports business and communities build a low carbon future and prepare for the impacts of climate change. Research which looked at the implementation of national planning policy on climate change highlighted the importance of having in place the right skills and experience in the planners who are expected to deliver it. Government has recently announced a package worth £9.75 million to build skills and capacity across the range of local authority responsibilities needed to tackle climate change. This will help build the skills and knowledge planners need, including in planning for increased renewable energy supply, and encouraging local communities to take positive action on climate change. This package will also fund the Royal Town Planning Institute (RTPI) development of a virtual learning environment for continuing professional development with a focus on climate change. All of the work on building capacity will complement RTPI's commitment to review and change its education and lifelong learning requirements to ensure that all its members have the knowledge and skills to respond effectively to climate change.

41 <http://www.communities.gov.uk/publications/planningandbuilding/newnon domesticconsult>

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20. The Government recognises the importance of having sufficient skills in local government to handle all forms of planning applications. That is why it continues to put in place initiatives to build local authority capacity. These have included: the Post Graduate Planning Bursary Scheme; the provision of Planning Delivery Grant/Housing Planning and Delivery Grant; and the funding the Homes and Communities Agency's Skills and Knowledge Directorate, Advisory Team for Large Applications and the Planning Advisory Service. The Government will also provide support to planners and other local authority staff engaged in climate change activities, to help increase their skills and knowledge.
 21. In terms of local authority building control, a consultation on proposed changes to Part L (energy efficiency) of the Building Regulations included a strategy for training and dissemination to be delivered in the run up to the changes planned for October 2010⁴². Government aims to deliver similar awareness programmes to support future amendments.
 22. Key areas for local authority leadership on sustainable construction, to ensure the right levels of knowledge and skills are in place, could include:
 - In their roles as planning authorities and building control bodies;
 - Early adoption of higher standards or development of exemplars in the design and use of their own (new or existing) buildings;
 - Influencing the development of higher standards or exemplar buildings by other public sector partners in their area;
 - Planning for and facilitating links into community energy networks.

Eco-towns – Bringing it all together

23. Eco-towns⁴³ are conceived to respond to the challenges of climate change and the need for more sustainable buildings, especially homes. As large-scale new communities with a minimum of 5,000 homes, eco-towns will be exemplars of sustainable development, required to meet the toughest ever sustainability standards for new development in the UK, as set out in the Eco-town Planning Policy Statement⁴⁴. They will provide a critical mass that will draw in a complete supply chain of low carbon and resource efficient materials, technologies and techniques. The construction phase could potentially create and support up to 2,000 local jobs, including Apprenticeships in new green building skills.
24. Government announced the four first potential eco-town locations on 16 July 2009, and has allocated a share of £60 million growth funding to each to facilitate initial start-up work and demonstrator and exemplar projects that have the potential to stimulate innovation and skills development in areas such as technology, housing, construction (including retrofit), planning, biodiversity and transport. This will enable residents to see first-hand the latest technology,

42 <http://www.communities.gov.uk/publications/planningandbuilding/partlconsultation>

43 The £60m Growth Fund allocations for the first wave locations were announced on 8 February 2010. This provides financial support for initial start up work and demonstrator projects in each of the four locations: Whitehill-Bordon (Hampshire), Rackheath (Norwich), North- West Bicester (Oxfordshire) and St Austell (Cornwall).

44 <http://www.communities.gov.uk/publications/planningandbuilding/pps-ecotowns>

such as electric car charging points, properly insulated homes built to the toughest ever standards and systems for saving water and recycling or composting waste.

25. Government has also committed £2.5 million for exemplar education projects in these locations, including retrofitting primary schools, providing eco-features for new build and developing sustainable construction training.
26. Government announced a further £10 million would be made available to other local authorities⁴⁵ who were keen to adopt the eco-towns PPS standards in their local plans to help shape major new development. On 9 March 2010 this was allocated across 10 local authorities and City Region Partnerships which are actively taking eco-town plans forward as part of their local planning work.
27. Across the first and second wave potential eco-town locations the exemplar 'demonstrator' projects will include a range of innovative retrofit and new-build projects providing the opportunity for new low carbon skills solutions to be developed. These include:
 - A new-build sixth form centre in Bicester, featuring a solar roof with integrated photovoltaic panels and ground source heat pumps to generate energy, grey water recycling and air heat recovery;
 - A project at Shoreham Harbour which will feature well designed and appropriately positioned building integrated wind turbines and an innovative lighting system, the first time that such an innovative system will be built in the UK and one of the first such projects anywhere in the world;
 - Opportunities in production of biomass pellets (Whitehill-Bordon, Hampshire);
 - The operation, construction and maintenance of small scale district heating schemes, for example, in Yeovil, Somerset;
 - The retrofit of existing terraced and new build housing, including the remodelling of hard to treat homes in an entire traditional terrace and street in Gainsborough, Lincolnshire.

Skills transfer

28. The SSCs and Industrial Training Boards are responsible for working with industry to identify skills requirements. The Low Carbon Cluster Assessment report, emphasised that a crucial first step in improving skills for low and zero carbon is improving the knowledge base of the workforce, which will need to move up a learning curve: from awareness, through understanding and occupational knowledge, to competence⁴⁶.

45 <http://www.communities.gov.uk/news/housing/1399305>

46 Sector Skills Councils: Low Carbon Cluster Sector Skills Assessment Report, <http://www.sscalliance.org/nmsruntime/saveasdialog.aspx?IID=974&SID=1858>

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29. New build and retrofitting to higher standards will require a range and combination of mechanical and electrical engineering skills. We need to ensure this need is articulated to higher and further education providers and professional associations to ensure that the number of trainees is increased. Buildings also need to be managed better, ensuring facilities managers have the knowledge and skills to maximise the performance of their buildings and identify potential new areas for improvements.
 30. Many of the skills required are cross-cutting and not captured under one discipline. For example, architects may not be aware of all available technologies, engineers may not appreciate the wider context and require a broader training. This has been emphasised in a recent report by the Royal Academy of Engineering, which suggested a new discipline of building engineering physics⁴⁷.

Actions so far

31. The Technology Strategy Board's (TSB) Low Impact Buildings Innovation Platform is seeking to invest £70 million to assist business harness the growing market for environmentally sustainable new buildings and to stimulate the development of innovative solutions to improve the energy efficiency and environmental performance of existing buildings. This will include developing the supply chain and build process which will help with skills development. The TSB's Modern Built Environment Knowledge Transfer Network brings together stakeholders to share knowledge and plan for the future.
32. Further, the Chief Construction Adviser, Paul Morrell, is leading an IGT review⁴⁸ of the construction industry to ensure it is fit for purpose for delivering a low carbon future. Each of the five workstreams, on cross-cutting issues, new and existing housing, new and existing buildings, infrastructure and major projects considers skills challenges in the sector. The work includes a study of the steps Government and industry could take to improve diversity, innovation and up-skilling in the construction industry. The IGT will continue to develop its recommendations for the final report to Government at the end of 2010, which will highlight ways for skills gaps to be met, and feed into the Low Carbon Skills Strategy.

47 Engineering a low carbon built environment: The discipline of building engineering physics, http://www.raeng.org.uk/education/vps/pdf/Engineering_a_low_carbon_built_environment.pdf

48 Emerging findings of the Construction IGT, Low Carbon Construction published at: <http://www.bis.gov.uk/assets/biscore/business-sectors/docs/10-671-construction-igt-emerging-findings.pdf>

Annex 1c: DECARBONISING THE TRANSPORT SECTOR

Jobs and opportunities

33. The transport sector accounts for 14% of UK carbon emissions. It will be important for the industry to support both the identification of skills gaps and encourage more businesses to engage with SEMTA and higher education institutions.
34. The supply of STEM graduates will continue to be critical in the research and development, design and engineering elements of the supply chain for low carbon transport. An understanding of electronic systems as well as mechanical systems will increasingly be required, as will the application of chemistry (fuel cells, battery cells) in key ultra-low carbon vehicles technologies. A skilled manufacturing and maintenance workforce able to produce and work with key components of the vehicles will be essential.

Ultra-Low Carbon Vehicles

35. The Government has committed over £400 million of funding to encourage the development and uptake of ULCVs, including programmes to incentivise consumer demand and for the provision of associated infrastructure. This demonstrable commitment, together with the continuing driver of CO₂ regulations, should provide employers with confidence to invest in equipping their workforce with the additional skills required for the transition to ULCVs. The skills challenge to ensure that UK companies are well-positioned to maximise business opportunities will be addressed primarily through the adaption of current skill sets to meet the demands of changing technology in the transition to ULCVs.

Aviation

36. Over the past 40 years the aviation sector has delivered a range of technological and operational improvements which have made aircraft more fuel efficient. Achieving greater fuel efficiency is essential for the industry both to achieve sustainability and provide room for growth in terms of passenger numbers. Historically, the cost of aviation fuel has provided a strong incentive to operators and manufacturers to increase efficiency, consequently reducing CO₂.
37. In the medium term, the A320/737 series re-engineering or replacement programmes offer future growth prospects. In the shorter term, new programmes, such as the Airbus A350XWB, Boeing 787 and Bombardier C-Series offer a substantial workload to the UK sector. New regional and business aircraft and emerging platforms from new manufacturers in areas such as China, Japan and Russia are also targets for the UK sector.

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38. Aviation is a safety-critical industry, with long lead-times for technological developments, which have to meet exacting international standards. As such, aerospace research and development has always been characterised by high investment costs, long development timeframes, and considerably longer business plans. Low carbon aerospace is no different. Partnerships and collaborations across the industry will be important in minimising the costs of research and development activity.
39. ADS⁴⁹ is developing a skills roadmap to capture the 'demand' signal and there is a cross sector Composite Skills Working Group comprising business, BIS, SEMTA and Cogent representatives to assess the skills requirements in this area.

Freight and Logistics

40. The major freight skills needed are:
- Eco-driving training for HGV drivers⁵⁰;
 - Knowledge and handling of lower carbon HGV technologies including readily available technologies such as aerodynamic fairings and low rolling resistance tyres; and less readily available electric and hybrid vehicles and high blend sustainable biofuels and biogas;
 - Carbon measurement, monitoring and reporting for the freight transport supply chain, consistent with Government guidelines on measurement and reporting methods; and
 - Supply chain management and planning to minimise carbon impact, and low-carbon warehousing techniques and technologies.

Rail

41. The Government's major programme of rail electrification will deliver substantial carbon savings as electric trains emit less carbon than the diesel trains they will replace. In addition, the increased use across the network of regenerative braking will help to reduce energy consumption by capturing and converting back to electricity the energy that would otherwise have been lost when braking. In the medium to long term, high speed rail offers the potential for further carbon savings.

⁴⁹ ADS is the trade organisation for AeroSpace, Defence and Security industries

⁵⁰ It is estimated that by training 90% of HGV and van drivers in schemes such as the Safe and Fuel Efficient Driving (SAFED) programme, up to 3 million tonnes of CO₂ over a five-year period and £300 million in fuel costs for the industry per year could be saved

Annex 1d: Decarbonising Supply Chains Across The Entire Economy

Jobs and opportunities – a whole economy transition

42. Industry and manufacturing are collectively and directly responsible for some 14% of total UK carbon emissions, more if distribution of finished goods and emissions from waste are included. There will be major new opportunities for jobs to put in place low carbon and resource efficient processes in all industries, across all raw material and product supply chains.
43. Key actions to make this happen will be to assess the full life cycle environmental impacts associated with choices of raw material inputs, and for the manufacturing industry to 'close the loop'. Integrated manufacturing processes can feed off each other so that waste products in one sub-sector can be raw material for another, in a so-called industrial symbiosis approach. Development of these new specialised processes will require expert engineering and other high level technical skills to make the necessary links between production systems.



New opportunities – Industrial symbiosis

Some of the most rapidly expanding growth industries use inputs which would previously have been considered waste, or by-products of other industries, and therefore offered minimal economic value. This new integrated approach, often referred to as industrial symbiosis, will be challenging: manufacturing and raw material supply chains will need to be re-engineered, and new skills will be needed.

The UK has the potential to be a world leader in the area of industrial symbiosis. The National Industrial Symbiosis Programme (NISP) is the first in the world to be launched on a national scale and is at the forefront of industrial symbiosis thinking and practice. It engages traditionally separate industries in a collaborative approach to find competitive advantage involving physical exchange of materials, energy, water and by-products together with the shared use of assets, logistics and expertise. In a recently published review of the Programme⁵¹ it is estimated that over the past 5 years in England NISP has:

- Generated £176 million additional sales in industry
- Saved businesses over £156 million
- Attracted £116 million in private investment⁵²
- Diverted 7 million tonnes of business waste from landfill
- Reduced CO₂ emission by 6 million tonnes

Land management for primary production: agriculture, forestry

44. The farming industry's new *AgriSkills Strategy*⁵³ and *Action Plan: Towards a New Professionalism*, aims to encourage farmers to invest in skills development, allowing them to capitalise on the business benefits of clearly demonstrating skills and professionalism to customers and regulators. Central to this is providing a more coherent Continuing Professional Development framework for recognising and building on existing skills.

Biomass for renewable heat and power generation

45. When sourced sustainably, biomass energy can make a significant contribution to reducing carbon dioxide emissions. A key skill will be an ability to analyse the full life cycle of production processes to ensure that carbon savings generated do not simply displace emissions elsewhere, particularly through leading to indirect land use change.

51 <http://www.nisp.org.uk/Publications/Pathway.pdf>

52 http://www.nisp-ecoreg.ro/about_us_approach.aspx

53 <http://www.agriskillsforum.co.uk/>

46. The Government is committed to doubling the amount of timber sustainably harvested from woodlands in England. In addition there is potential for a considerable number of new jobs to be created upstream in the supply chain such as firewood suppliers and wood fuel processors⁵⁴. The industry is growing, and supported gross value added of around £140 million in 2008. This is likely to rise to up to £1 billion to £1.2 billion if the Forestry Commission woodfuel target is achieved. With this backdrop of expansion, the wider forestry industry reports problems recruiting the skilled workers needed to manage woodlands, including young people, managers with practical or technical expertise and craft workers. In response, LANTRA⁵⁵, industry and Forestry Commission England are introducing a new Trees and Timber Apprenticeship in September 2010.
47. There is significant potential for job creation in the biomass supply chain. But there is a lack of understanding and awareness, both of the potential of biomass as a fuel and of the technologies necessary to achieve the greatest carbon savings. Notably there is a lack of skills and knowledge in energy and environmental consultancies to advise on the design of appropriate biomass heating or combined heat and power systems. Engineers and facility managers lack the skills for the manufacture, installation and maintenance of biomass heat systems. Due to this gap, companies are struggling to meet the demand for these installations.

Other primary industries: the extractive industries

48. We recognise that there are also carbon savings to be gained at the stage of mining primary resources but the skills changes needed have not been fully assessed. Government is currently exploring this area and would welcome evidence from stakeholders.

Concrete, aluminium, steel and glass production

49. Decarbonisation of the UK's important traditional heavy industrial base will be underpinned by decarbonising the power sector and by the introduction of new technologies such as Combined Heat and Power and Carbon Capture and Storage in cement, iron and steel manufacturing, as well as direct energy efficiency measures. The skills needs for this element of the transition have been covered elsewhere in this document.

Composites

50. The composites sector, and the industries it supports, requires researchers, innovators, technologists, designers and highly-skilled processing technicians with skills in the areas of manufacture, assembly, disposal and maintenance, repair and overhaul. The supply chain to these industries is predominantly from SMEs and it is here where the biggest challenges are faced in increasing commitment to and investment in training.

⁵⁴ Preliminary estimates for employment and economic activity of the woodfuel industry, indicate that the woodfuel industry supported around 2,800 full-time jobs in 2008. We expect this number to increase in the range of 25,000 to 30,000 by 2020 if the Forestry Commission woodfuel target is fully met.

⁵⁵ Lantra is the Sector Skills Council supporting skills, education and training for the UK's environmental and land-based industries.

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51. The National Composites Network has identified the current skills needs within the main manufacturing sectors as:
- Automotive: Greater competence in computer aided design engineering, 'crash' durability and cost modelling skills, prototype development, project management skills and tooling and jigging skills;
 - Aerospace: Materials and process structures design, materials and process engineers, design and stress engineers for composite structures and people with large scale processing experience;
 - Marine: Carbon fibre specialists, laminators and knowledge of product and process techniques.
52. New product development and project management skills are needed, to provide the ability to generate products from the technologies being researched in collaboration with higher education institutions and Technical Research Organisations. Graduates are needed with degrees which include a greater focus on composites, and industrial experience. This requires commitment from companies to provide sandwich placements. Qualified technicians are also needed that understand composites and the associated design and manufacturing processes.
53. As existing raw materials become more scarce or difficult to source due to either supply or price, low carbon bio-composites can be substituted in a variety of products. They can also be used in the manufacture of sustainable, renewable materials for the building sector. In many cases, traditional manufacturing and building skills can be easily adapted to work with sustainable renewable raw materials.
54. Bio-materials can be easily interchanged with their conventional counterparts, but their processing requires specialist understanding. There are skills gaps in the production of new plant-based raw materials. To scale up use of these low carbon materials, the key challenge will be to raise awareness of their potential uses and to ensure that they are planned into manufactured products at the design stage.

Industrial Biotechnology

55. As the chemicals sector adapts to a low carbon economy, chemicals and materials will be increasingly produced using industrial biotechnology, rather than petrochemicals. Industrial biotechnology is grounded in fundamental research using biological systems to produce materials, chemicals and energy. In the current market growth phase, a wide range of specialist skills are required, from the cultivation of feed-stocks and land management to the operation, control and maintenance of industrial plant.
56. The chemicals industry also has an important role in delivering a low carbon economy. The global industrial biotechnology market is predicted to grow to between £150 and £360 billion by 2025 in the chemicals sector alone. Global industrial biotechnology chemical sales are currently estimated at £35-£53 billion. This represents 3-4% of global chemical industry sales (£1.25 trillion in 2008). The market for industrial biotechnology in the UK is predicted to grow by 5-11% a year to between £4-12 billion by 2025. There is evidence from studies from UK Trade and Investment that the availability of skilled talent is often the top factor in where globally mobile investors choose to place their knowledge-intensive investments, so success in this endeavour offers potential for major competitive gains for the UK.
57. There will be a need for specific high level graduate and post-graduate skills for exploitation of industrial biotechnology along with measures to prevent a shortage of appropriate skills at all levels to enable industrial biotechnology products, processes and technologies to be successfully developed and introduced to the market. There is a particular need to develop and retain individuals from a bioscience background who are able to interact and work successfully with engineering and manufacturing colleagues, and conversely, for engineers who are able to work effectively with colleagues from the chemical and biological sciences.
58. Three specific recommendations of the industry-led Industrial Biotechnology Innovation and Growth Team⁵⁶ addressed the skills challenge posed by the application of the technology to the chemicals and chemistry-using sectors:
- The key skills and research organisations: EPSRC, BBSRC, professional institutions in chemical engineering, chemistry and biology, SEMTA and Cogent, should intensify their collaborative working to develop a joint strategy on industrial biotechnology skills by the end of 2009. A Skills sub-group has been set up by Industrial Biotechnology Leadership Forum in order to facilitate discussion between those organisations and this is working on a joint skills strategy;
 - Development of a new taught MSc, MRes or similar qualification in Industrial Biotechnology skills. Work to date has shown that courses are available, but that a more coherent package needs to be presented to future students. This activity will be taken forward in 2010;
 - Establishment of a Centre of Excellence to build on UK scientific expertise to accelerate the innovation and knowledge transfer process for Industrial Biotechnology in the UK.

56 <http://webarchive.nationalarchives.gov.uk/20091118102323/http://www.berr.gov.uk/whatwedo/sectors/chemicals/IBIGT/page44395.html>

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59. BIS has invested £12 million towards the creation of open access demonstration facilities to increase the capability of the National Industrial Biotechnology Facility. This facility will be fully operational by December 2010 and will help to de-risk access to new products and processes, enabling people to develop the necessary skills for scaling-up biotechnology opportunities.

Plastic Electronics

60. Plastic electronics involves manufacturing of electronic circuits by printing on flexible surfaces. It is an emerging sector with huge long term potential. It makes it possible to produce a wide range of innovative products more cheaply and efficiently than previously viable, with products ranging from large area ultra-efficient lighting to low cost solar cells. The global market for plastic electronics is forecast to rise from \$2 billion today to \$120 billion in 2020, with the potential to generate a wealth of opportunities for the UK.
61. Plastic electronics demands a multi-disciplinary approach to develop and exploit the core technologies. For example, materials scientists and chemists who also understand electronics will be needed, as well as printing process engineers who understand materials science. In addition, skills needs will change over time as the sector moves from basic research and early stage product development through to mature manufacturing processes. Skills requirements will shift from postgraduate researchers, towards skilled technicians and engineers to operate and maintain high-quality, high volume production and processing equipment.
62. The UK has very good foundations on which to build for this sector, with strengths in materials development, coating and deposition equipment, as well as electronic design. Postdoctoral training programmes should include modules covering innovation and management. In addition, training provision in entrepreneurship should help promote spin-outs from universities.
63. The UK Centres of Excellence in Plastic Electronics will play a key role in training multi-disciplinary engineers and scientists. Further, the Strategic Investment Fund is supporting a £20 million expansion of the Printable Electronics Technology Centre. This will be a national, state-of-the-art, open access facility for the development of manufacturing processes and production of prototype devices, and will be a key resource in providing the training infrastructure within which the next generation of scientists and engineers will learn their trade.

Food and Drink production, processing and distribution

64. The UK food industry is a large and vibrant sector. It has an annual turnover of £121 billion and employs 3.1 million people. This makes the food and drink industry the largest UK manufacturing sector, and an important contributor to the UK economy. This brings with it significant environmental impacts, with total greenhouse gas emissions from the food chain, post-farm gate, estimated at around 43 million tonnes of CO₂e in 2006⁵⁷.
65. There is a need to recruit at all levels, but future jobs will increasingly be at higher levels and already there is a shortage of skills in some of these areas including leadership and management, professional, skilled trade and technician.
66. The industry has historically not been seen as an attractive sector in which to work, and there is a need to recruit substantial numbers of new entrants to replace the retiring ageing demographic. There are significant skills needs across the sector, notably in the areas of tackling carbon emissions and overall sustainability performance.
67. Access and availability of the right type of accredited and modular training would be the biggest single contributor to delivering the skills that are needed. This sector consists of over 20,000 processing and manufacturing enterprises, and most are SMEs or micros. These enterprises are particularly stretched to send their staff on long, costly courses. As part of its modular based reform of sector qualifications the Sector Skills Council Improve, the Food & Drink Sector Skills Council, has developed a range of unit based sustainability skills that can be delivered individually or embedded in a wide range of qualifications and awards for delivery to the existing workforce. The delivery of these is being promoted through the National Skills Academy for Food Manufacturing to meet evidenced demand from employers.
68. Improve has been developing sustainability based skills standards and frameworks (including low carbon) with the participation of a range of sector employers. Improve is also working to make the sector more attractive to young people. Its Schools Challenge⁵⁸ has proven to be highly successful with nearly 14,000 school students involved. Improve's work to promote the sector as a career of choice is considered to have played a major part in reversal of the decline of take-up of food science and technology as a subject, with 111 new courses commencing in 2009, and six new higher and further education institutions offering that subject. The high level of existing commitment in the sector, alongside involvement in delivering a sustainable food and drink supply chain, can be actively promoted as providing career opportunities with some of the UK's leading companies.

57 Sourced from Environment Statistics (Defra). Includes food sector manufacturing, transport, retail, and catering (hotels & restaurants). The 43Mt figure is 26% of the total 2006 GHG emissions from the food chain, estimated at approx 160 Mt CO₂ equivalent

58 <http://www.improve-skills.co.uk/careers/food-and-drink-schools-challenge>

End-of-life: waste management, recycling and reuse

69. Traditional waste management operations such as waste storage, landfill and incineration and scrap metal recycling have increasingly given way to a range of recycling and recovery operations. These include: physical screening of construction waste; composting and anaerobic digestion of biodegradable waste; recycling of plastics, glass and other packaging; enhanced metal recycling, and vehicle and WEEE (Waste Electrical and Electronic Equipment) dismantling. The amount of waste sent to landfill is reducing, given that waste management now involves the collection and treatment of landfill gas to produce energy, and incineration is giving way to *energy-from-waste* plants. Waste is now linked to recovery to the point where it meets specifications for use and can cease to be waste.
70. Skills and knowledge to enable these processes will need to be continually improved, and Government will need to consider ongoing training requirements in relevant courses and qualifications. The competence requirement in waste management has done much over the years to promote professionalism in the industry and enhance its reputation.
71. The skills system will need to take account of specific skills for different types of operations and respond to changing technology and encourage continuous competence. These skills will link together understanding of resource efficiency issues and life cycle thinking, the waste hierarchy, and carbon reduction, alongside more traditional pollution control issues associated with emissions and discharges. The expansion of the competence requirement to all waste recovery and disposal operations will enhance waste knowledge and skills, providing this is done in a proportionate and relevant manner.

Annex 1e: Skills for Adapting to Climate Change

72. The Government has commissioned research to identify the business opportunities arising from the need to adapt to a changing climate. This work (due in Spring 2010) supplements the significant resource that the Government has allocated, and will continue to provide, to increase the understanding of a changing climate and its consequences.
73. Some sectors are already responding well to the challenge. Adaptation skills are already being developed in service provision such as management and financial services. When organisations embed the skills climate risk in their risk management processes and decision making, they are more likely to gather the information to allow them to make appropriate adaptation decisions, founded on a strong evidence base. However, it will take time for organisations to reach this point and many need to significantly increase the capacity to do so. It is clear that early action will pay off.

Actions so Far

- A Defra led 'Business, Engagement and Skills' project is underway, to support the private sector in addressing the impacts of climate change on business and to encourage appropriate risk management strategies that incorporate climate impacts. The project aims to ensure that UK businesses are well prepared for the impacts of climate change and are best placed in a global economy to maximize opportunities and minimize costs. The project will help to ensure that priority business sectors have access to the evidence and research they need to make effective adaptation risk assessments, and have support in identifying key opportunities and technological solutions in response to a changing climate;
- Departmental Adaptation Plans are being developed by each Government Department and will set out more detailed responses about addressing the impacts of climate change and the related skills needs;
- The UK Climate Impacts Programme has developed a number of free on-line tools to help businesses and others to manage their risks and improve adaptive capacity⁵⁹. Many forward thinking trade associations and representative organisations are also beginning work in this area;
- The Local and Regional Partnership (LRAP) Board – funded by Defra via the Adaptation to Climate Change Programme – is working to facilitate action on climate change adaptation at a local and regional level by highlighting best practice, enhancing skills, providing toolkits, and encouraging joint working between local and regional agencies;
- The cross-departmental Infrastructure and Adaptation project led by Defra is working with the Engineering the Future group specifically to look at how the engineering profession can maximise its contribution to adapting our national infrastructure. Throughout 2010 the group will be taking forward a joint programme of work aimed at:
 - Identifying the opportunities for the country's engineering sector to take a global lead in designing and engineering climate resilient infrastructure.

59 <http://www.ukcip.org.uk/>

- Identifying the barriers preventing action and the future development of engineering skills, knowledge transfer and awareness raising that may be required.
 - Establishing a more structured process of engagement between Government and the engineering profession on infrastructure and adaptation.
74. In addition, the rolling programme of the review of building regulations will consider the challenges of climate change adaptation, and will identify where standards need to be strengthened. Work as part of delivery of national standards for sustainable drainage will also highlight skills challenges and help set the agenda for improvement.
75. Local authorities are also being given new responsibilities to: manage surface water; increase the use of sustainable drainage systems in both new and existing building stock; reduce the risk of surface water flooding resulting from rainfall, and improve water quality and amenity. Local authorities and property developers will require drainage engineering, urban design and landscaping skills for design and approval of sustainable drainage systems, particularly to encourage the use of natural features. Government will consider whether there is a need for further new skills in the ongoing management of these features. Manufacturers, suppliers, builders and landscapers will need to increase their understanding and skills to move towards more sustainable building practices to reduce surface runoff and lower the flood risk.
76. Action at all these levels is starting to have an impact. Government will not have all the answers, however, or all the levers at its disposal. Having a long term vision of what skills are needed and in what quantities is part of Government's role, but we will be working alongside companies, trade associations and other business organisations and the wider public sector and look to them to identify skills gaps, whether in training or guidance, and to take or propose action as a result.



Annex 2: List of Consultation Questions

In responding to these questions we would welcome reactions both in relation to the overall economy, and to the situation in relation to specific sectors, industries, or areas. We would also welcome examples of innovative and effective practice, which might have the potential for wider replication.

- 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?**
- 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?**
- 3. How can more colleges and universities be encouraged to respond to the need for specialist skills in emerging low carbon sectors?**
- 4. Is our overall analysis of the skills challenges, as outlined in this document, correct?**
- 5. What are the best ways to replicate the examples of good practice provided throughout this document quickly and effectively?**
- 6. Is stimulating innovation in skills development and delivery the best way forward?**
- 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?**
- 8. For the power sector skills we have identified, what is the best way to accelerate skills development beyond what is planned?**
- 9. What more can be done, both within the power industry, and through Government energy policy, to promote energy-related careers to young people?**
- 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?**
- 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?**
- 12. What more could it do to deliver low carbon and resource efficient skills in all parts of the construction industry?**

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13. What more should Government and industry do to ensure that those retrofitting existing buildings have the necessary skills?
 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?
 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?
 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?
 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?
 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?
 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?
 20. What more should Government and employers do to up-skill existing, and future, workers in the forestry and farming industries, in particular to support the emerging bio-energy, biomass processing and renewable heat sectors?
 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?
 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?
 23. What are the key skills challenges in the service and support sectors to deliver improved resource efficiency and low carbon?
 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?

Annex 3: List of Stakeholders Consulted

British Association of Colliery Management
2 degrees network
ActionAid
Advantage West Midlands
Advisory Committee on Carbon Abatement Technologies
AEA Energy and Environment
Age Concern England
Agricultural Industries Confederation
Airport Operators Association
Alcatel Lucent Ltd
Aldersgate Group
All Party Parliamentary Climate Change Group
Alstom Power Systems
Anglo American
Apache North Sea Ltd
Archbishop's Council
Areva
Arts Council England
Arup Group
ASDA
Association for the Conservation of Energy
Association of Electricity Producers
Association of Manufacturers of Domestic Appliances
Association of Train Operating Companies
Automobile Association
B&Q
BAA
BAE Systems
Bank of England
Barclays Bank Plc
Barclays Capital
BEAMA Ltd (British Electrotechnical and Allied Manufacturers' Association)
Bio Group
Bio Regional
Black & Veatch
BP Plc
BRE (BRE Group)

British Air Transport Association
British Bankers Association
British Ceramics Confederation
British Chambers of Commerce
British Council
British Energy Group Plc
British Gas Group
British Glass
British Land
British Nuclear Fuels
British Plastics Federation
British Property Federation
British Retail Consortium
British Venture Capital Association
British Water
BT Group
Business Council for Britain
Business Link London
CABE – the Commission for Architecture and the Built Environment
CAFOD
Cambridge University
Campaign against Climate Change
Campaign for Better Transport
Carbon Action Network
Carbon Capture and Storage Association
Carbon Disclosure Project
Carbon Limiting Technologies
Carbon Markets and Investors Association
Carbon Neutral Company
Carbon Trust
Climate Change Committee
Cement Association
Centre for Climate Change Economics and Policy
Centre for Environment, Fisheries and Aquaculture Science
Centre for Sustainable Energy
Centrica Plc
Chamber of Shipping
Chartered Institute of Architectural Technologists
Chartered Institute of Environmental Health
Chartered Institute of Housing
Chartered Institute of Logistics and Transport
Chemical Industries Association

CHPA (Combined Heat & Power Association)
Christian Aid
CISCO System
Citizens Advice
Civil Aviation Authority
Civil Nuclear Police Authority
Climate Action Network
Climate and Health Council
Climate Change Capital
Climate Change Forum
Climate Group
Climate Outreach and Information Network
Cogent
Commission for Integrated Transport
Commission for Rural Communities
Community: The Union For Life
Confederation for Passenger Transport
Confederation of British Industry
Confederation of UK Coal Producers
Construction Industry Council
Consumer Focus
Co-operatives UK
Cornwall Energy Associates
Corporate Leaders Group on Climate Change
Corrotherm International
Corus
Country Land and Business Association
Countryside Council for Wales
Campaign to Protect Rural England
Credit Suisse First Boston
Cycling England
10:10 campaign
Diageo
Doosan Babcock
Dow Chemical Company Ltd
Drax
E3G
E-Skills UK
Eaga Partnership Ltd
East England Development Agency
East Midlands Development Agency
Eco2 Ltd

Economic Engineering and Physical Sciences Research Council
Economic Social Research Council
Ecotricity
EDF
Emissions Trading Group
ENER-G
Energy 4 All
Energy Agency / EAPG
Energy Efficiency Partnership for Homes
Energy Industries Council
Energy Institute
Energy Intensive Users Group
Energy Networks Association
Energy Retail Association
Energy Saving Trust
Energy Technologies Institute
Energy Watch
Engineering and Physical Sciences Research Council
Engineering Construction Industry Training Board
Engineering Employers' Federation
English Partnerships
Environ UK
Environment Agency
Environmental Industries Commission
Environmental Protection UK
EON
Ernest & Young
ExxonMobil
Fairfield Energy
Federation of Petroleum Suppliers
Federation of Small Businesses
Food and Drink Federation
Food and Environment Research Agency
Forestry Commission
Forum for the Future
Foundation Degree Forward
Forum of Private Business
Freight Transport Association
Freightliner
Friends of the Earth
Fuel Poverty Advisory Group
Gas Forum

Gaz de France
General Electric
Greater London Authority
Global Action Plan
Global Cool Foundation
Global Environmental Change Committee
Good Energy
Grantham Research Institute on Climate Change and the Environment, LSE
Green Alliance
Green Buildings Council UK
Greenpeace
Hadley Centre (Met Office)
Halliburton
Heat Pump Association
Help the Aged
Henderson Global Investors
HG Capital
Home Builders Federation
Homes and Communities Agency
HSBC
IBM
ICOM Energy Association
IEA Clean Coal Centre
Imperial College Improve
Industrial and Power Association
Ineos
Infrastructure Planning Commission
Institute of Directors
Institute for European and Environmental Policy
Institute for Public Policy Research
Institute of Civil Engineers
Institute of Development Studies
Institute of Mechanical Engineers
Institute of Sustainability
Institution of Engineering and Technology
Institute for Environmental Management and Assessment
Institutional Investors Group on Climate Change
Intergen
International Institute for Environment and Development
International Marine Contractors Association
International Power PPLC
ISOenergy

Johnson Matthey
Joint Nature Conservation Committee
KCA Deutag
Kings College
KPMG
Land Securities
Lantra
Large Investment for Energy
Life IC Limited
Lifelong Learning UUK
Local Government Association
London Accord
London Development Agency
London Energy Brokers Association
London Investment Banking Association
London Pension Fund Authority
London Remade
Low Carbon Accelerator
Low Carbon Economy Ltd
Low Carbon Vehicle Partnership
Major Energy Users Council
Manufacturing Technologies Association
Marine Management Organisation
Marks and Spencer
Menzies Distribution
Micropower Council
Mitsubishi Power Systems
Morrisons
National Air Traffic Services
National Association of Citizens Advice Bureaux
National Apprenticeship Service
National Council for Voluntary Organisations
National Energy Action
National Energy Foundation
National Farmers Union
National Federation of Women's Institutes
National Grid
National House Building Council
National Housing Federation
National Insulation Association
National Landlords Association
National Non-Food Crops Centre

National Skills Academy for Nuclear
National Trust
National Union of Mineworkers
National Union of Students
Natural England
Natural Environment Research Council
Nautical Petroleum
Nessco Ltd
Network Rail
New Carbon Finance
New Economics Foundation
New Engineering Foundation
Nissan
North West Development Agency
North West Higher Level Skills Partnership
Northern Ireland Environment Agency
Npower
NTL World
Nuclear Decommissioning Authority
Nuclear Industry Association
Ofgem
Oil & Gas UK
Oil Firing Technical Association
One North East
Operation Noah
Oxfam
Oxford Climate Policy
Oxford Institute for Energy Studies
PermaRock Products Ltd
Permira
Petroleum Industry Association
Planning Inspectorate
Pro Enviro
Production Services Network
Prospect
Public Utilities Access Forum
Quidos
RAC Foundation
Rail Freight Group
Rail Safety and Standards Board
RenewableUK
Railway Industry Association

RegenSW
Renewable Energy Association
Renewable Fuels Agency
Renewables Advisory Board
RIBA
RICS
RMT
Rolls-Royce
Royal Academy of Engineering
Royal Commission on Environmental Pollution
Royal Society Association
Royal Town Planning Institute
RSPB
RUSI (National Security and Resilience)
RWE npower
Sainsburys
Sandbag
Science Museum
Scottish and Southern Energy
Scottish Power
Scottish Renewables Forum
Severn Wye Energy Agency
Sheffield Forgemasters
Shell UK
Siemens UK
Skills for Logistics
Sky
SLP Engineering
Social Enterprise Coalition
Society of British Aerospace Companies
Society of Motor Manufacturers and Traders
SolarCentury
Solid Fuel Association
South East England Development Agency
South West Of England Regional Development Agency
Subsea 7
Sussex Energy Group
Sustainable Development Commission
Sustainable Energy Academy
Sustrans
Talisman Energy
Transition Town Network

TearFund
Technology Strategy Board
Teeside Power Limited/GDF
Tesco
The Climate Outreach Information Network
The Coal Authority
The Coal Forum
Tomorrow's Company
Total E&P UK PLC
Town and Country Planning Association
Toyota Europe
Trade Union Sustainable Development Advisory Committee
TUC
Tyndall Centre Climate Change and Energy Programme
UK Atomic Energy Agency
UK Business Council for Sustainable Energy
UK Climate Impacts Programme
UK Coal
UK Commission for Employment and Skills
UK Construction Products Association
UK Energy Research Centre (UKERC)
UK Petroleum Industry Association
UK Sustainable Investment and Finance Association
UK Youth Climate Coalition
UKTI Energy team
UNISON
UNITE
Universities UK
University and College Union
University of York
Virgin Group
Warwickshire College
Wellcome Trust
Westinghouse
Whitehall in Industry Group
Wildlife Trust
World Energy Council
WRAP
WWF-UK
Yorkshire Forward
Zero Carbon Hub

Annex 4: The Consultation Code of Practice

1. Formal consultation should take place at a stage when there is scope to influence policy outcome.
2. Consultation should normally last for at least 12 weeks with consideration given to longer timescales where feasible and sensible.
3. Consultation documents should be clear about the consultation process, what is being proposed, the scope to influence and the expected costs and benefits of the proposals.
4. Consultation exercise should be designed to be accessible to, and clearly targeted at, those people the exercise is intended to reach.
5. Keeping the burden of consultation to a minimum is essential if consultations are to be effective and if consultees' buy-in to the process is to be obtained.
6. Consultation responses should be analysed carefully and clear feedback should be provided to participants following the consultation.
7. Officials running consultations should seek guidance in how to run an effective consultation exercise and share what they have learned from the experience.

Comments or complaints

If you wish to comment on the conduct of this consultation, or make a complaint about the way this consultation has been conducted, please write to:

Consultation Co-ordinator
Department of Energy and Climate Change
3 Whitehall Place
London SW1A 2HD
Email: consultation.coordinator@decc.gsi.gov.uk

Annex 5: Glossary of Terms

BIS	Department for Business, Innovation and Skills
CO ₂ e	Carbon dioxide equivalents
CLG	Department for Communities and Local Government
CST	Council for Science and Technology
DECC	Department of Energy and Climate Change
Defra	Department of Environment Food and Rural Affairs
DCSF	Department for Children, Schools and Families
DIUS	Department for Innovation, Universities and Skills
EEPH	Energy Efficiency Partnership for Homes
EPSRC	Engineering and Physical Sciences Research Council
HEFCE	Higher Education Funding Council for England
HEM	Housing Energy management
HLSP	Higher Level Skills Partnership
KTT	Knowledge and Technology Transfer
LCEA	Low carbon Economic Area
LCEGS	Low Carbon Environmental Goods and Services
Level 2	Level 2 skills. Equivalent to: GCSE grades A*-C; BTEC First Diplomas and Certificates; Apprenticeships
Level 3	Level 3 skills. Equivalent to: A levels; BTEC Diplomas, Certificates and Awards; Advanced Apprenticeships
Level 4	Level 4 skills. Equivalent to: BTEC Professional Diplomas, Certificates and Awards; Higher Apprenticeships
Level 5	Level 5 skills. Equivalent to: Foundation degrees.
LSC	Learning and Skills Council
NAS	National Apprenticeship Service
NSA	National Skills Academy
NSA-N	National Skills Academy for Nuclear
NSAP	National Skills Academy for Power

NOS	National Occupational Standards
R&D	Research and Development
RDA	Regional Development Agency
SFA	Skills Funding Agency
SME	Small or medium sized enterprise
STEM	Science, Technology, Engineering and Maths
SME	Small and Medium-sized Enterprise
SSC	Sector Skills Council
SWRDA	South West Regional Development Agency
TSB	Technology Strategy Board
UCEA	Universities and Colleges Employers Association
UKCES	UK Commission for Employment and Skills
UKERC	UK Energy Research Centre
UKTI	UK Trade and Investment

The following images are taken from *Global Warning: The Last Chance for Change* from www.dakinibooks.com

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Page 33, left image: CCS Plant, Algeria – BP plc

Page 35: Sustainable House, Maryland USA – Reuters/Stefano Paltera/Solar Decathlon/Handout

Page 37: Solar Panels, Burstadt Germany – Reuters/Alex Grimm

Page 41, right image: Aircraft trails – TopFoto/ImageWorks

Page 55: Solar Panel installation, Germany – TopFoto/Keystone





BIS | Department for Business
Innovation & Skills

Contact: lowcarbonskills@decc.gsi.gov.uk

Responses to the consultation should be sent to this email address.

Department of Energy & Climate Change
3 Whitehall Place
London
SW1A 2AW
0300 060 4000 (standard national rate)
www.decc.gov.uk

Department for Business, Innovation and Skills
1 Victoria Street
London
SW1H 0ET
020 7215 5000
www.bis.gov.uk