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POWERING EDUCATION : ENRICHING LIVES

Skills for Climate Change

Meeting the low-carbon challenge:

Identifying resources in the London further and higher education sector that support knowledge transfer to London businesses in the construction and building engineering sector

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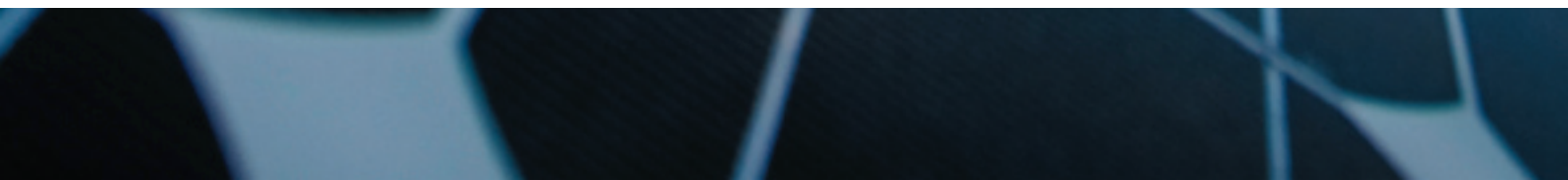

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List Of Acronyms

AURIL	Association of Universities Research Industrial Liaison
BIS	Department for Business, Innovation and Skills
BSF	Building for Schools
CE	Construction Excellence
CIPHE	Chartered Institute of Plumbing and Heating Engineers
CPD	Continuing Professional Development
DECC	Department for Energy and Climate Change
FiTs	Feed-in Tariffs
FMB	Federation of Master Builders
HVCA	Heat and Ventilation Contractors Association
IKT	Institute of Knowledge Transfer
KT	Knowledge Transfer
KTENs	Knowledge Transfer Exchange Nodes
KTP	Knowledge Transfer Partnership
LAD	Learning Aims Database
LCEA	London Carbon Economic Area
LDA	London Development Agency
LSBU	London South Bank University
LSC	Learning and Skills Council
NFRC	National Foundation of Roofing Contractors
NHBC	National House Builder Federation
NQF	National Qualification Framework
NSA	National Skills Academy
PRS	Privately Rented Sector
QCF	Qualification and Credit Framework
RICS	Royal Institution of Chartered Surveyors
RIBA	Royal Institute of British Architects
SRI	Sustainability Research Institute (University of East London)
UEL	University of East London

Executive Summary

This research was commissioned as part of the ***Skills for Climate Change*** programme to examine current knowledge-transfer competencies and activities in the London Further and Higher Education institutions and their capacity to drive forward the low-carbon agenda to support businesses in the construction and building services engineering sector.

We conducted two surveys:

- One, to gauge current channels of knowledge transfer provided by London F/HEIs to small-and medium-sized enterprises in the London Boroughs to support the low-carbon agenda;
- The other, with businesses in the London construction and building services engineering sector to gauge market-readiness for low-carbon technologies and construction methods, and the businesses' willingness to engage in knowledge transfer activities to develop their low-carbon knowledge and skills.
- The first was carried out with telephone support through an online questionnaire with London Further and Higher Education Institutions; the second through a primary research exercise of 760 London-based small businesses operating in the construction and building services engineering sector in four areas of trade and expertise: architects/designers, electrical engineers/installers, plumbing, heating and ventilation engineers and building contractors. The exercise was in two parts: initially an online questionnaire, followed by a telephone polling exercise of some 330 London businesses. These businesses were selected randomly across London Boroughs using the London Yell and Thompson online business directories.

We received responses from:

- Ten of the 27 London Further Education Colleges active in construction and building services engineering (just over 30%)
- Ten universities (50%) with engineering, architecture and design, construction and built environment departments.
- We received 116 responses (32%) from the London-based small businesses in our sample.
- We also prepared six case studies to inform emerging examples of good practice and leadership in knowledge-transfer initiatives that currently support the low-carbon agenda in the London F/HE and business construction and building services engineering communities.

Key Findings

Our overall findings highlight:

- A significant disconnection between the London businesses in our sample and the Further and Higher Education sector.

Responses from the London F/HEIs and those from small businesses in our sample also signalled immaturity and or early growth in:

- Low-carbon technologies and consumer markets in London, i.e. a lack of demand
- The development of education and training provision required to raise awareness and up-skill the existing workforce.

The constrained ***Knowledge Transfer Capacity*** of the London Further and Higher Education sector in low-carbon areas, exemplified by the findings of this research, has to be put into context. Our analysis concludes that it is symptomatic of a period of transition with high levels of uncertainty in the development of technologies and markets. These are currently affected by a number of factors:

- Insufficient knowledge of low-carbon technologies and products, a market-driven sector supported by small manufacturer-led installer companies (i.e. a 'niche market' in construction and building services engineering)
- Sluggish consumer demand and the relatively high level of investment required by individuals for low-carbon retrofitting in the large domestic property sector in London
- Policy development to support demand, such as the Green Deal, that has not yet been clarified or fully communicated to the wider public
- The recent impact of newly-introduced policy frameworks: Feed-in Tariffs
- Uncertainty around planned local development initiatives to support skills initiatives: such as the originally planned 'Retrofit Academy' under the Green Enterprise District in East London
- The complexity of the qualifications system and the time required to prepare and accredit new courses to meet the low-carbon skills requirement of the construction and building services engineering sector
- The transition to the new Qualification and Credit Framework.

This leads us to conclude that we have not yet reached conditions to achieve a critical mass of supply and demand to enable the required mainstreaming of low carbon technologies and building methods across all areas of the construction and building services sector in London to meet the low carbon challenge. The findings are of concern.

Paul Morrell, Government's Chief Construction Officer commented that:

"The 80% cut in carbon emissions by 2050 is a legal obligation and is, therefore, a ticking time bomb for the industry and the country. The scale of the challenge is 'terrifying' and includes a £250 billion retrofit of our entire housing stock at the rate of 2,000 homes per day between now and 2050. Every day we don't do 2,000; there is another 2,000 on the end of the programme."

Research shows that in London alone the projected learning outcomes required over the next ten years are in the order of 100,000. This means that the annual figure in London exceeds the total number that is known to have received training in environmental technologies over the past two years in the whole of the UK. 'Business as usual' is not an option. Innovative solutions have to be found.

Good or best practice in knowledge transfer is not a matter of one-size-fits-all. It is about innovation(s) in institutions, regulations, technologies, markets and supply chains gauged at different levels of intervention or actions, in strategically co-ordinated initiatives that are targeted and commensurate to the task at hand, and the impact it's set to achieve. Here, the task, as highlighted above, is significant in scope and scale.

Our case studies highlight different aspects of pro-active knowledge-transfer initiatives that have, and are, supporting efforts towards the mainstreaming of low carbon in construction and building services.

- ***The National Skills Academy for Environmental Technologies*** at the College of North West London, recently created with leadership, commitment and a focus on diversity in partnerships to address the skills' challenge
- ***MITIE***, an example in industry leadership and long-term strategic relationship-building with clients and suppliers at the heart of its low-carbon services innovation and customised client-focused low-carbon solutions
- ***The Centre for Efficiency and Renewable Energy in Buildings (CEREB)*** with a strategy aligned to its mission and commitment to sustainability
- ***The 'Merton Rule' & Quiet Revolution***, a successful planning/regulatory innovation, precursor of the Code for Sustainable Homes, that stimulated the adoption of new low-carbon technologies in building retrofits
- ***NICEIC and City and Guilds***, a partnership in 'product innovation' with the development of the C&G 2399 environmental technologies qualification series
- ***The FLASH programme***, a public/private and third-sector partnership between London HEIs, the Institute for Sustainability, and trade-associations, leveraging professional networks and project-to-project learning to demonstrate low carbon and energy efficiency in construction and building services engineering.

Recommendations

It is essential to focus on co-ordinated multi-level strategic interventions and knowledge transfer initiatives that are built upon:

- Clarified, targeted, strategically co-ordinated, well-communicated national and local policy-sets to support demand and adoption of low-carbon practices in the sector. This has to include a clear communication strategy aimed at the wider public on policies (e.g. the Green Deal) and their opportunities. This cannot be diffused or derailed by changes in political strategies with each new parliament. The public good associated with the low-carbon agenda has to prevail above and beyond party politics
- Well-articulated, practical awareness campaigns in environmental technologies and low-carbon construction methods and materials that meet business needs. Identification of innovative delivery channels and creation of right messages to attract hard-to-reach audiences such as the smaller SMEs. Campaigns must demonstrate that

for 21st century construction businesses to survive, low carbon isn't an optional extra; it has to be regarded as mainstream and incorporated into building engineering and construction practices.

Further education colleges can learn from some of the examples provided by our case studies and learn by working in partnership with industry to face the innovation challenge required by the mainstreaming of low carbon:

- The model of engagement of FE Colleges with industry to move beyond mainly acting as a 'delivery channel' for courses and qualifications.

Employer engagement in FE colleges needs to be less reactive and ad hoc principally driven by training programmes. It should be an integrated and consistent series of activities and interactions that support in building a strategic relationship that can shape and inform KT activity.

The example of MITIE in our case study signals that knowledge transfer is an on-going process embedded in relationships. There is a need to change, to shift to a new model:

- Long-term strategic relationship-building with industry focused on partnering for innovation and the development of customised solutions
- FEIs and HEIs (but particularly FEIs) gave signs of being 'market followers' in low carbon technologies
- Predicting requirements in immature markets and matching levels of training to the future of technologies: taking a leading and proactive position
- Overcoming discontinuities in projects and learning and using partnerships to enhance project-to-project learning.

1. Terms of Reference of the Study

This report is part of the larger ***Skills for Climate Change*** project whose main objective is:

"To research, develop and test a skills framework for employers and businesses addressing the challenge posed by climate change and sustainable development with a particular focus on construction and building services engineering. The outcome of the project is to help to improve productivity, innovation, enterprise and competitiveness, while enabling workers to develop the skills needed by businesses in a knowledge-based economy."

We need a housing and commercial building stock fit for the demands of tomorrow. The vast majority of the buildings we have today will still be with us in 2050. Yet, by then, the UK has committed to a reduction of 80% on CO_2 emissions against 1990s levels. Emissions in the domestic sector will have to be reduced by 31% by 2020. What we have to achieve in less than a decade is phenomenal.

The overall challenge is quite clear:

"If the world continues emitting greenhouse gases like carbon dioxide at today's levels then average global temperatures could rise by up to 6˚C by the end of this century. This is enough to make extreme weather events like floods and drought more frequent and increase global instability, conflict, public health-related deaths and migration of people to levels beyond any of our recent experience. Heat waves, droughts, and floods would affect the UK too." ***[DECC, 'UK National Strategy for Energy and Climate Change: Transition to a Low-Carbon Society', HM government, p.1 2009]***

There is much pressure on businesses in the construction and building services engineering sector to deliver stringent targets in making an ageing housing stock fit for the demand of a low, if not zero-carbon future. Innovation and building a strong knowledge transfer *'infrastructure'* is key to enabling a transition to a low-carbon and sustainable built environment. College, university and industry interactions are essential in creating an adequate stream of support to deliver on these commitments. Knowledge transfer activities between Further and Higher Education establishments and businesses in the sector, but also the capacity of F/HE institutions to deliver on the construction and building services engineering sector's requirements in information, knowledge and skills to meet the low-carbon challenge is paramount to making these legally-binding low-carbon targets a reality.

The research was established with the following aim:

- To highlight Knowledge Transfer (KT) capabilities of London Further and Higher Education institutions aimed at driving forward the low carbon agenda and assess the ways in which it is being delivered.

Additionally this work is being used:

- To inform the design and production of a guide to knowledge transfer resources and competencies available in this sector in London
- The objectives of the project are to report on the different aspects of the supply side of knowledge transfer resources and competencies in the London Further and Higher Education sector and, on the demand side, the uptake of knowledge-transfer activities with a focus on businesses from the construction and building services engineering sector.

These objectives were approached in good faith with the original conviction that there is a large amount of knowledge-transfer activities in London FE/HE establishments relevant to the low-carbon agenda in construction and building services engineering sector in London.

2. Definitions

2.1 Knowledge Transfer

There is a variety of definitions of knowledge transfer. The Macmillan dictionary defines knowledge transfer as *"the process of communicating knowledge that has been developed in one part of an organisation to other parts of the organisation or to customers"*.

However, knowledge transfer is commonly applied to refer to two levels at which knowledge transfer activities are being undertaken: an intra-organisational level and an inter-organisational level. Finally, it is considered in relation to continuing professional development (CPD) for those engaged in knowledge-transfer activities.

The Association of Universities Research Industrial Liaison (AURIL) defines knowledge transfer as *"the systems and processes by which knowledge, including technology, know-how, expertise and skill, is transferred from one party to another leading to innovative, profitable or economic and social improvement"*. ***(Association for University Research and Industry Links – 2006, p.3)***

The House of Commons Science and Technology Committee underlined that the view of knowledge transfer taken, for example, by the Research Councils serving Higher Education Institutions, was often too narrow. The committee reframed the definition of knowledge transfer as being *"about transferring good ideas, research results and skills between universities, other research organisations, business and the wider community to enable innovative products and services to be developed"*.

In an earlier report focused on the evaluation of the creation of 11 Knowledge Transfer Exchange Nodes (KTENs) involving 14 Further Education colleges, the NEF defined knowledge exchange as *"the bi-directional flow of knowledge, expertise and skilled people between a college's 'science' base and its communities, contributing to economic competitiveness and productivity as well as social inclusion and quality of life."* ***(KTENs report, NEF 2008, p.18)***

2.2 Knowledge Transfer Resources

In this report Knowledge Transfer Resources refer to capabilities and expertise in specific areas of low-carbon construction and building engineering services. This includes teaching skills in emerging areas of low carbon technologies and building methods, knowledge of low-carbon materials and supply chain development.

2.3 Knowledge Transfer Methods

In the context of this report, Knowledge Transfer Methods refer to the methods/activities by which KT is being applied and delivered at the interface between F/HE establishments and businesses, namely: consultancy, CPD, collaborative research, participation to networks, conferences, workshops and briefings, the use and preparation of publications and media, spin-outs, licensing, apprenticeships, industry placements for students, industry placements for staff and secondment of industry personnel into the F/HE establishments.

3. Methodology

NEF has carried out back-to-back surveys with establishments in the Further and Higher Education sector (supply side), and businesses in the construction and building services engineering sector (demand side), to review the current channels that are being used to transfer and exchange information, knowledge and skills with industry.

3.1 The Surveys and Case Studies

The methodology adopted for this research used both quantitative and qualitative approaches. We prepared: two 'back-to-back' e-surveys and identified six case studies to highlight examples of good practice, as well as lessons learned from issues encountered in knowledge-transfer activities by Further Education/Higher Education institutions and by businesses in the construction and building services engineering sector.

3.2 The Survey Population

Both the 'supply-side' and 'demand-side' surveys were finite and geographically limited to Greater London Boroughs.

3.2.1 'Supply-side survey' Further and Higher Education Institutions

The main challenge with universities and further education colleges is that knowledge-transfer activities relevant to the low-carbon agenda, and construction and building services engineering, are spread across different departments in each of the institutions. For this survey we reviewed, and added to, our database of contacts in these institutions to administer the survey to respondents in all relevant departments to cover: architecture, engineering, the Built environment, business services and construction.

We contacted 57 London-based Further Education colleges and 21 universities. Twenty seven FE colleges and ten universities conduct activities in low-carbon technologies in the construction and building services engineering sector.

3.2.2 'Demand-side Survey' – Construction and Building Services Engineering Companies

The 'demand-side' survey targeted Greater London businesses in the construction and building services engineering sector. We created a random sample of companies in the construction and building services engineering sector using London online business directories ***(Yell and Thompson)*** as well as the ***Green Register*** and the ***Check-A-Trade*** online register covering four areas of expertise:

- The need to capture knowledge-transfer resources available to support low-carbon construction and building services engineering firms
- The need to capture knowledge-transfer activities applied to the low-carbon agenda in F/HE institutions across different departments relevant to the construction and building services engineering sector
- The need to capture some of the impacts of knowledge-transfer efforts in supporting business in the construction and building service engineering sector
- The need to understand the availability of the competencies, teaching and training skills available to support the adoption of low-carbon technologies and techniques in the construction and services engineering sector.

This resulted in creating a database of contacts with 760 Greater London-based SMEs in the construction and building services engineering sector including sole traders. In each borough, the sampling was done systematically across these different areas of trade and expertise. This was in an effort to maintain the representativeness of the sample and its relevance to the different area of low-carbon technologies and skills required for low-carbon construction and building services engineering and in particular the skills relevant to the retrofitting of the large private-housing sector, which is so critical to London.

3.3 The Questionnaires' Design

The supply side questionnaire was developed with the following four points in mind:

- The need to capture knowledge-transfer resources available to support low-carbon construction and building services engineering firms
- The need to capture knowledge-transfer activities applied to the low-carbon agenda in F/HE institutions across different departments relevant to the construction and building services engineering sector
- The need to capture some of the impacts of knowledge-transfer efforts in supporting business in the construction and building service engineering sector
- The need to understand the availability of the competencies, teaching and training skills available to support the adoption of low-carbon technologies and techniques in the construction and services engineering sector.

The demand-side of the questionnaire was developed with the following points in mind:

- The need to understand the current state of play for the many often hard-to-reach businesses in the sector and their approach, and/or perception of low-carbon technologies and building methods
- The need to achieve a better understanding of the uptake of London F/HE sector knowledge-transfer activities by businesses in the construction and building services engineering sector
- The need to understand businesses' preferred methods of knowledge transfer to handle information, to acquire and to integrate new knowledge and skills into their practices and their business development in line with the transition to a low-carbon future
- The need to understand businesses views on the F/HE sector in London and what it currently offers
- The need to capture factors that may encourage, rather than deter, businesses in the sector to participate in knowledge-transfer activities offered by F/HE establishments, and/or take up the low carbon business services, offers of training and short courses required to overcome the knowledge and skills gaps they are currently encountering

The complementarity between the supply and demand-side questionnaires was developed taking into account three key points:

- The need to look at the gaps between ways in which businesses are currently acquiring information, knowledge and skills in low-carbon technologies and the ways in which it is being delivered by establishments in the F/HE sector
- The need to understand the gaps between the need for resources and what is currently available to (pragmatically) support the dissemination of information, and the delivery of education and training to skill the new workforce and up-skill the existing workforce to meet the low-carbon challenge.
- The need to provide some recommendations to F/HE institutions as to what knowledge-transfer activities and competencies are required, or need to be improved to meet the needs and expectations of companies in the construction and building services engineering sector, thereby providing them with the support they require to meet the low-carbon challenge.

Both questionnaires were guided by two central 'hierarchical structures' to achieve:

- Consistent conceptual reference frameworks to 'knowledge transfer' and to 'low carbon subject areas of technologies and building methods'
- The collection of consistent and comparable data sets on the respective views, current practices and experiences of F/HEIs and businesses in the construction and building services engineering sector.

The two frameworks supported the need for a combined investigation of Knowledge-transfer activities and methods **(Table 1)** and the subject areas relevant to Low-carbon construction & building services engineering **(Table 2)**. Simplification of questionnaires at the point of delivery was a main concern to ensure a good response rate.

Knowledge Transfer Activites/Methods	Table 1
Media & Publications	Articles in academic journals
	Articles in Trade Associations and trade magazines
	Reports, briefs & other 'glossy' publications
	Online resources/Specialist websites
Events & Networking	Conferences
	Seminars, workshops & technology briefings
	Trade fairs & other events
Business services	Consultancy (i.e. one-to-one diagnosis, on site advice etc)
	Environmental auditing
	Commercialisation of IP & licensing of products
	Mentoring
	Hire of facilities and equipment
Collaborations – partnership working	Knowledge Transfer Partnerships
	Joint ventures & contract research
	Other Knowledge Transfer Partnerships (e.g. Innovation Vouchers etc)
People exchange/placements	Student placements in your business
	Lecturers/researchers placements
	Industry personnel seconded to F/HEIs
	Recruitment (to fill gap in low carbon knowledge and skills)
Education/training	Continuing Professional Development (CPD)
	e-learning/distance learning
	Short courses
	Work-based learning (including apprenticeships)
	Academic courses (PhD, MSc/MA/MPhil/BSc/BA)
	Vocational Courses (HND/Foundation Degrees; HNC/BTECs; City & Guilds; OCR Nationals; other)

Low-Carbon Technologies and Techniques	Table 2
Energy sources	Solar thermal
	Solar photovoltaic
	Heat pump
	Micro-wind generation
	Micro-hydro generation
Energy and water-loss reduction	Achieving air tightness
	Insulation techniques and methods
	Water recycling
Energy-use reduction	Low-energy lighting
	Low-energy appliances
	Design for solar gain
	Mechanical heat recovery
Legislation and standards	Building regulations (e.g. Part L)
	Code for Sustainable Homes
	BREEAM Certification and the Energy Act 2008

3.4 Case Studies

The six case studies illustrate best practice in low-carbon knowledge transfer and highlight the challenges faced and lessons learned by educators and businesses. The sample of case studies includes:

- The creation of the London National Skills Academy for Environmental Technologies led by the College of North West London giving a Further Education perspective
- The FLASH Programme giving a Higher Education perspective (Sustainability Research Institute – UEL)
- CEREB, London South Bank University
- MITIE, a large company's perspective
- Quiet Revolution, an environmental technology SME perspective on the retrofitting of a social housing 15-storey building in Croydon near the A 23
- The case of knowledge transfer through partnership working for the development of new qualifications (NICEIC).

4. Knowledge Transfer and the Low-carbon Agenda in F/HEIs

From the total of 27 London Further Education colleges with construction and building services engineering departments, we received ten responses after sustained efforts to engage with the targeted respondents. Those who responded wished to remain anonymous; hence we are not including the list of Further Education colleges who have responded and those who have not. In addition, we completed an in-depth interview with the newly created ***National Skills Academy for Environmental Technologies*** at the College of North West London as part of the case studies.

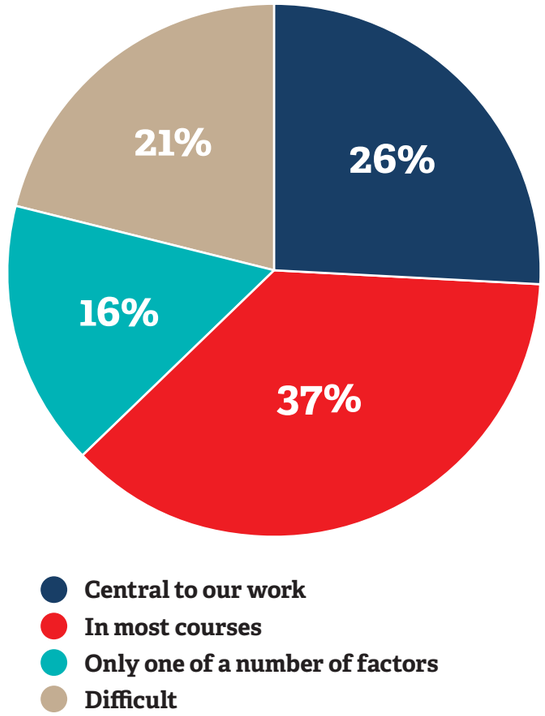
We received responses from ten universities that covered 50% of the HE sample. The results are presented in the sections below.

4.1 Commitment to Low Carbon

Around a quarter of FE/HE respondents combined (26%) stated that the commitment to the low-carbon agenda was central to their work in construction; over a third (37%) indicated that they would incorporate low carbon into courses and qualifications when their experts judge it necessary. A fifth (21%), however, found it difficult to integrate low carbon into the curriculum **(See Figure 1 below)**.

While the majority of FE and HE respondents combined considered the Low Carbon agenda as 'central to their work' or 'to be integrated in most courses', four out of nine respondents from the Further Education sector found it difficult to integrate low carbon into their courses. This is highlighted in table 3 below. Additionally, although 37% of respondents indicated that low carbon would be integrated into courses and qualifications when their experts judged it necessary, it does not mean that this has been done and low-carbon skills have yet to be integrated into vocational and short courses targeted at up-skilling the existing workforce. As we will see in section 4.4.3 on education and training, our websites and college prospectus searches show that low-carbon short courses, targeted at up-skilling existing workforce and vocational courses in construction and building services engineering, are still slow to take off.

Figure 1: F/HEIs commitment to the low-carbon agenda



FE/HE Commitment to the Low-carbon Agenda			Table 3
Rate your organisation's commitment to the low-carbon agenda	**Total**	**FE**	**HE**
It is central to our work in this sector	5	2	3
We incorporate low carbon into most of our courses/qualifications as individual subject experts judge appropriate	7	3	4
It is only one of a number of factors that shape our work	3	0	3
We find it difficult to integrate low carbon/sustainability into the curriculum and the delivery of courses	4	4	0
Total	**19**	**9**	**10**

F/HE Commitment to Knowledge Transfer			Table 4
Rate your organisation's commitment to knowledge transfer	**Total**	**FE**	**HE**
It is central to everything we do	11	7	4
It happens in pockets around the institution	4	1	3
We are aware of it but beyond our normal teaching and research activities do little to emphasise knowledge transfer	3	1	2
Not sure what this is	1	0	1
Total	**19**	**9**	**10**

4.2 Commitment to Knowledge Transfer

Knowledge transfer is reported to be significant by the majority of respondents with only one respondent having difficulty understanding the concept. Fifty eight percent of respondents suggested it was central to everything their institution did. The breakdown of the London FE and HE establishments' responses project a feeling of a strong commitment to knowledge transfer overall. However, in the case of Further Education colleges a review of websites and additional research into current practices raises the question as to whether the intentions effectively meet the reality, as there are limited signs of this being put into practice. Results in the following sections will also put this finding into question.

4.3 F/HE Knowledge Transfer Competencies and Skills in Low-carbon Technologies

For the purpose of this work we recorded two aspects of knowledge transfer competencies and skills in low-carbon technologies.

- The F/HE establishments' current competencies and teaching capabilities in low carbon technologies, building and services engineering methods
- Their intention in acquiring competencies and teaching capabilities required to engage in knowledge-transfer activities in low-carbon technologies, building and services engineering methods

To address these issues, respondents were asked to rate their current skills from 'basic' to 'expert' for each of a number of low carbon technologies, construction methods and policy and regulation directly relevant to the low-carbon agenda **(as per Section 3, Table 2)**. The results are presented in **Tables 5, 6 and 7 on pages 52, 53 and 54.** Respondents were also asked to indicate if, and how, they intended to develop and/or acquire competencies and skills in low carbon technologies and building construction methods in the future. The results are presented in **Table 8 on page 55.**

4.3.1 Current Competencies and Skills in Low-carbon Technologies

The combined results for HE and FE in table 6 show that respondents claim their expertise is greatest *in solar energy, regulation and water recycling*. They have least expertise in *design for solar gain, micro-hydro technology, mechanical heat recovery and air tightness*, the latter being a requirement of building regulations.

When results are separated between HE and FE, as in **Table 6 (HE) and Table 7 (FE) on pages 53 and 54**, the contrast is quite significant. Results underline that HE has the strongest confidence in their expertise in micro-generation technologies as compared with the FE sector, while greater emphasis for the HE sector is put on their expertise in solar technologies.

The results for FE however, in table 7, underline weaknesses (i.e. design for solar gain, mechanical heat recovery and achieving air tightness) more than any particular strength in low-carbon technologies. It also records significant scoring in the category 'not something we do' and does not highlight clear areas of recorded expertise that might have been expected to figure in the FE sector's strengths such as energy loss reduction: insulation techniques and methods, or energy loss reduction: low energy lighting.

Overall, the current picture remains that of a weak engagement and limited expertise in low-carbon technologies and construction methods in the London FE sector, with pockets of greatest area of expertise in solar technologies in the London Higher Education sector.

The colour coding denotes the number of institutions engaged, with pink being a low level (0-1 institution), yellow being medium engagement (2-4) and green being the highest (5+ institutions) level of engagement.

4.3.2 Intended Development in Competencies and Skills in Low-carbon Technologies

The second set of results reports on what the respondents intend to do in the foreseeable future in order to acquire new, or to develop, their current level of competencies in low-carbon technologies and building techniques against the same framework detailed in **Section 3, Table 2**.

The options provided to the respondents give us an indication of their intentions in procuring and/or developing low-carbon competencies and skills. The results are given in **Table 8 on page 55**.

These results clearly indicate that, in future, respondents are most likely to increase their expertise in solar generation (both thermal and PV) and least likely to develop skills in micro-wind generation, design for solar gain and BREEAM certification (i.e. policy and regulation).

Combined, these results suggest that FE/HE institutions are following the stimulus from developments in the current market for solar generation. However, solar technologies constitute only a fraction of low-carbon technological opportunities for the construction and building services engineering sector. While solar thermal and solar PV are currently experiencing the greatest (relative) demand pull among low-carbon technologies, meeting the challenge of low carbon buildings requires leadership and a drive to create the future. Meeting the challenges of carbon reduction targets in 2016, 2020 and 2050 requires emphasis on a variety of technological opportunities and innovations.

A purely market-driven shift in technologies and practices in the FE/HE sector will be missing the variety of efforts that are required to meet the challenges of the low-carbon agenda, including the need for a change in mind sets, culture, knowledge and skills to ensure the preservation of the environmental value that is not always a market priority. Just responding to the market falls short of providing leadership to create the low-carbon future.

4.4 Knowledge Transfer Methods and Activities in London's F/HE Sector

This section presents an overview of knowledge-transfer activities undertaken by London Further and Higher Education establishments as applied to different methods of delivery, enabling them to engage with the larger business and professional community.

Using the framework presented in **Section 3, Table 1 – Knowledge Transfer Activities**, the table below reports on different aspects of knowledge-transfer activities undertaken by London F/HEIs, through Media and Publications, Business Services, People Exchange, Collaboration/partnership working, Education and Training.

4.4.1 Overview of F/HEIs' knowledge transfer activities over the last three years

This section provides an opportunity to reflect on two sets of evidence on the variety of methods used by the F/HE sector to acquire knowledge and information. It reviews:

- The frequency at which London F/HEIs have used the different methods to acquire knowledge and information from the wider community over the last three years
- The frequency at which London F/HEIs have used these different methods to acquire knowledge and information and engage in knowledge transfer,

specifically in relation to low carbon construction and/or building services engineering in the last three years

Results indicate that both the FE and HE sectors are using online resources and published articles (in academic and trade press) the most frequently. These are fairly conventional resources traditionally used by people working in the education sector both as a source of information and of knowledge exchange. However, while the respondents indicate that they used these frequently (e.g. 'every month') as a source of information, the use of these resources to support information and knowledge exchange in low-carbon subjects is significantly lower, **as reported in Table 10 opposite**.

4.4.2 Knowledge-Transfer Methods for Business Services Delivery

In this section respondents were asked to indicate how frequently they engaged in knowledge-transfer activities with businesses, using a variety of methods such as e-learning, CPD, consultancy and/or KTPs.

Table 11 over the page, highlights that while e-learning, CPD courses, consultancy and KTPs are activities that some of the respondents engage in regularly (i.e. at least once a month) the proportion of respondents who indicate that they never take part in these activities, or quite rarely (i.e. less than once per year or once/twice a year) is just as great, if not much greater.

Table 12 over the page, indicates a growing discrepancy (as compared to Table 11), in the number of KT activities and the frequency of engagement in service offerings provided in zero carbon subject areas to businesses in the construction and building services engineering sector. For example, four respondents indicate that they engage in low carbon consultancy, three do so once a month and one every quarter. However, seven indicate they never do so, three do so less than once a year and one does once a year. A total of 11 respondents (50%) barely and mostly never engage in low-carbon consultancy.

The discrepancies in FE/HE engagement in KT activities in business services are compounded by results in **Table 13 over the page**. These results show that only three FE respondents, just under a third, indicated they had engaged in consultancy services to deliver low-carbon solutions (regardless of the frequency of their engagement), and only two in the provision of CPD. The respondents from the FE sector fall substantially behind respondents in the HE sector in areas they might have been expected to lead, such as CPD, which is one of the designated areas of services that support the up-skilling of an existing workforce. It is extremely significant in the case of the transition to low carbon in construction and building services engineering.

The activities of consultancy, knowledge-transfer partnerships and CPD have been identified as the typical activities that would determine an institution's focus, commitment and intent to drive KTT. Engagement in these activities are key performance indicators as to KTT engagement overall.

4.4.3 Education and Training in Low-carbon Technology Areas

This section provides an analysis of the different types of courses and training available in the London F/HE sector that are specifically related to low-carbon technologies and building methods. These include: Continuing Professional Development (CPD), e-learning and distance learning, short-courses, work-based learning (including apprenticeships), academic courses (PhD, MSc/MA/MPhil/BSc/BS) and vocational courses (HND/Foundation Degrees; HNC/BTECs; City and Guilds; OCR Nationals).

The respondents were asked to indicate which courses they provided in the different low-carbon areas of environmental technologies and construction methods **(Section 3, Table 2)**.

Table 14 on page 56 shows the data for all FE and HE results combined. Across the range of zero carbon subjects vocational courses are the most frequently offered, closely followed by academic and then CPD. The findings in Table 14 reinforce the results found in Section 4.3.1, which highlighted London HE and FE colleges had relatively greater competences in solar-energy technologies. In Table 14, solar energy is the area in which most courses are being provided, followed by heat pumps and building regulations. Vocational courses (which include Foundation Degree courses) are the highest scoring channel for delivery, while work-based learning is clearly not yet being made available in low-carbon technologies and construction. Short courses that offer a significant channel for up-skilling the existing workforce do not come through as being very highly rated.

Most Frequently Used Media for Acquiring Knowledge and Information — **Table 9**

How often in the last three years have you used these knowledge-transfer methods in connection with any subject?	Every month	Every quarter	Twice per year	Once per year	Less than once per year	Never
Online resources/specialist websites	13	3	0	0	1	0
Academic journal articles	9	3	4	1	0	0
Articles in Trade Associations' publications and trade magazines	11	1	4	0	0	1
Seminars, workshops & technology briefings	4	7	3	3	1	0
Reports, briefs and other glossy publications	9	1	3	0	0	2
Trade fairs and other meetings	4	8	1	2	1	1
Conferences	4	4	1	3	4	1

Most Frequently Used Media used for Acquiring Knowledge and Information on Low-carbon Technologies — **Table 10**

How often in the last three years have you used these methods to engage with topics on zero-carbon construction developments?	Every month	Every quarter	Twice per year	Once per year	Less than once per year	Never
Online resources/specialist websites	8	2	3	0	2	1
Articles in Trade Associations' publications and trade magazines	4	4	6	0	2	1
Academic journal articles	3	2	6	2	1	2
Seminars, workshops & technology briefings	2	6	1	3	4	1
Trade fairs and other meetings	2	7	0	4	2	2
Reports, briefs and other glossy publications	3	2	5	0	1	3
Conferences	2	4	0	3	5	2

Knowledge-transfer Methods used for Business Services — Table 11

How often in the last three years have you used these methods to deliver services and learning support to businesses?	Every month	Every quarter	Twice per year	Once per year	Less than once per year	Never
E-learning/distance learning courses	5	1	1	4	3	2
Continuing Professional Development courses (CPD)	4	3	2	1	2	5
Consultancy services	6	1	1	1	1	7
Hire of facilities and equipment	4	3	1	1	1	8
Business mentoring	5	1	0	1	2	6
Knowledge-transfer partnerships	5	2	0	0	2	8
Environmental auditing	4	1	0	1	1	10
Access to funding, start-up & business growth support	3	1	0	1	1	10
Other knowledge-transfer schemes	2	1	0	0	3	9

Knowledge-transfer Methods used to Deliver Services in Zero-carbon Construction and Building Services Engineering — Table 12

How often in the last three years have you used the following KT methods to engage with businesses in topics on zero carbon construction?	Every month	Every quarter	Twice per year	Once per year	Less than once per year	Never
Consultancy services	4	3	1	1	1	7
Knowledge-transfer partnerships	3	2	1	0	1	9
Hire of facilities and equipment	2	3	1	0	1	9
Continuing Professional Development courses (CPD)	3	1	0	1	3	7
E-learning/distance learning courses	3	0	0	2	4	6
Environmental auditing	2	2	0	1	1	9
Business mentoring	2	0	1	0	3	8
Access to funding, start-up & business growth support	1	2	0	0	1	11
Other knowledge-transfer schemes	1	0	1	0	3	8
Other (please specify)	1	0	0	0	1	8

KT Methods used to Engage in Zero-carbon Construction — Table 13

Knowledge-transfer activity	All	FE	HE	KPI on KT Activities
Consultancy services	10	3	7	3 (FE) 7 (HE)
Knowledge-transfer partnerships	7	2	5	2 (FE) 5 (HE)
Hire of facilities and equipment	7	3	4	
Continuing Professional Development courses (CPD)	8	2	6	2 (FE) 6 (HE)
E-learning/distance learning courses	9	3	6	
Environmental auditing	6	0	6	
Business mentoring	6	2	4	
Access to funding, start-up & business growth support	4	1	3	
Other knowledge-transfer schemes	5	1	4	
Other (please specify)	2	1	1	

List of Low-carbon Short Courses in Construction and Building Services Engineering Available in London FE Colleges — Table 17

College	Course Title	Level	Duration	Start Date (if applicable)	QCF	Full/ part time	Awarding Body
Kensington and Chelsea	Extended Certificate in Construction and the Built Environment: Design For Sustainable Homes	3	36 Week(s)	04-Jan-12	N	Part Time	Edexcel
Westminster Kingsway	Sustainable Development	1	5 weeks	01-Apr-11	Y	Part Time	NCFE
Harrow - Whitefriars Training Centre	Renewable Energy Awareness	3+	4 weeks	Tbc	N	Part Time	BPEC
Greenwich Community	DIY Solar Power	n/a	1 day	Tbc	N	Part Time	n/a
Greenwich Community	DIY Wind Power	n/a	1 day	Tbc	N	Part Time	n/a
Harrow - Whitefriars Training Centre	Part L Energy Efficiency	3+	1 day	Tbc	N	Part Time	BPEC
Harrow - Whitefriars Training Centre	Water Regulations	3+	1 day	30-Mar-11	N	Part Time	BPEC
Kingston College: The Power Assessment Centre	Solar Thermal Domestic Hot Water Heating		2 days	Tbc	N	Part Time	Not specified
Kingston College: The Power Assessment Centre	Air Source (to water) heat pumps		1 day	Tbc	N	Part Time	Not specified
Bexley	Domestic Hot Solar Water		2-3 days	Tbc	N	Part Time	Not specified

Note: a) This table was completed on 15th of April 2011 and will need to be updated regularly to ensure that information remains accurate; b) currently BPEC is in a position to develop QCF units but BPEC courses are not currently QCF.

Table 15 on page 57 presents result solely for the Further Education sector. The low scoring of work-based learning and Apprenticeships, however, is a concern as it is a policy priority. Work-based learning is also significant in relation to the up-skilling of existing workforce to close the skills gaps in this sector.

Results for the HE establishments have a clear focus on academic courses and the delivery of academic qualifications across the whole range of low-carbon subject areas applicable to the construction and building services sector. This demonstrates a consistent commitment of these institutions to the sector and the low-carbon agenda. It should, however, be noted, that for the low carbon or 'green' agenda to be embedded, engagement and participation from both HE and FE colleges in development of all types of courses (vocational and academic) across the broad spectrum of technologies, techniques and legislations/regulations and management pertaining to low carbon needs to be increased. The key to all courses is that they should demonstrate application and not just theoretical principles.

Thorough desk-based research of FE colleges' websites, through course search engines and course brochures, show very little trace of any Level 3 courses in environmental technologies, whether through e-leaning, CPD or short courses. The results of these detailed searches are presented in **Table 17 on previous page**. There is little evidence to show that FE establishments are gearing up to provide courses to ensure the up-skilling of the workforce in low-carbon technologies on the scale needed to meet the legally binding low-carbon targets.

Our initial review for low-carbon construction and building services engineering vocational courses in FE colleges in early March 2011 had yielded practically no results. We therefore undertook to review all courses made available by FE colleges on their dedicated websites in April 2011, to list all those currently available that have any relevant low-carbon content. To ensure that we didn't miss out on any relevant low-carbon construction or building services engineering content, we included all courses that had at least one stated element in the wording of the course's description that was applicable to a knowledge or skills-set relevant to low carbon construction. The results are listed **in Table 18 on page 59**.

In April 2011, ten London colleges out of the 27 offering vocational courses for the construction and building services engineering sector had some element of environmental science, sustainable construction, construction science and materials, construction technology and environmental design, environmental awareness and building science. By April, the number of FE colleges recording some engagement with the low-carbon agenda matches the number of respondents to our research from the FE sector. South Thames College's *Plumbing, Heating and Ventilation* level 2 course stipulates 'rain-water harvesting' and offers building science and environmental science at level 4. Richmond-upon-Thames Level 1, *Access to Building Services Engineering* course (City and Guilds), is recognised under the QCF and includes environmental awareness and building service engineering science as mandatory units.

While the results of this search appear to show the start to 'mainstreaming' of sustainability and the low-carbon agenda into the content of vocational courses, results and interaction with colleges when asking for clarification as regards the QCF status of their courses clearly demonstrate the feeling that course provision is in a state of transition, with those dealing with calls not being able to provide full information.

We consulted the Learning Aims Database (LAD) to search for currently available QCF qualifications and units for courses with relevant low-carbon content for the construction and building services sector. The results of this search have been cross-referenced with the OFQUAL database and are presented in **Table 19 on page 60**.

It is noticeable that the vast majority of the QCF courses with some low-carbon focus, and listed on the LAD, have only been available since the autumn of 2010. Many are listed with a date of 1-Nov-2010. A number of others have just come on stream in February 2011. Some of these courses will be relatively short in duration and will likely be targeted to up-skilling existing workforce or adding to (traditional) core skills developed through training at levels 1, 2 and 3.

The process of transition to QCF and the SFA funding for post-19 learners is still taking its course. Developments in education and training are still entwined into the process of this transition and the uncertainties that are accompanying the development process of new qualifications. For an example, see our case study highlighting the knowledge-transfer process associated with the development of courses in the City and Guilds 2399 series in Section 6.

Further education colleges are still finding their way In the midst of the implementation of many policy changes, and the process of development of new courses and qualifications suited to the demand of the low-carbon era in construction and building services engineering. This is a challenge in an industry sector that has recently been quite severely hit by the recession and a general downturn in demand.

5. The 'Demand Side': Construction and Building Services Engineering Sector

5.1 Responses and Overcoming Barriers to Engagement

The survey was dispatched to approximately 760 companies in the construction and building services engineering sector covering:

- Architecture/design
- Building contractors
- Plumbing heat and ventilation
- Electrical engineering/installers

We were met with considerable apathy on the part of businesses. The response proved poor.

We conducted a phone pilot of 60 calls to engage and encourage feedback. Two companies responded to the full survey. The rest evaded having to reply. There were clearly two aspects to the 'resistance' encountered:

- First, the sample included a large section of hard-to-reach sole traders, micro and small enterprises engaged in construction and building services engineering in London. Many declined to provide the number of people they employed but confirmed that this number was below 25 employees.
- Secondly, telephone interactions with businesses appeared to indicate that:
  - They perceived the market as not ready, i.e. there was a lack of demand
  - They appeared to be reluctant to embrace the low-carbon challenge beyond their traditional practices

Telephone interactions seemed to highlight two factors:

- The companies identified the high costs involved with new technologies and low-carbon refurbishment as putting off their clients. Some mentioned that their clients were not really interested in low-carbon solutions beyond basic efficiency requirements using traditional methods
- There appeared to be cultural rigidities on the part of the companies we spoke to that seemed to be impairing a shift to low-carbon thinking as the guiding norms for their practices or for changing their practices

Cultural rigidities in views and attitudes to the market and working practices appeared to be hindering the mainstreaming of sustainable construction and/or a drive for 'innovation' for the adoption and the integration of low-carbon technologies and methods into their operations.

5.2 Reformulating an Outreach and Engagement Strategy

It was clear that we were facing significant barriers to obtaining the data that we required from these businesses, despite taking great care in providing a simple and fast questionnaire. We decided to take on board the basic messages that we were receiving during the telephone pilot and put them to the test over the phone by calling approximately 330 Greater London-based SMEs from our sample.

We developed a phone polling strategy focused on three questions to filter the respondents. The three questions were designed to test the propositions that emerged from our initial telephone contacts with companies, and were formulated as follows:

- Do you find that your clients are requesting new build or refurbishment work that includes low carbon technologies, or the use of new low-carbon building methods and materials, such as retrofit?
- Are you changing your work practices to meet these clients' needs?
- Have you tried, or are you interested in, accessing help and advice to deliver work that involves new low-carbon technologies and building methods?

The first question was formulated to test market-readiness for low-carbon technologies and building methods

(i.e. the demand-pull). The second was devised to check on the companies' willingness to adapt and change practices to accommodate to the requirements of low carbon technologies and building methods. The third was formulated to test their readiness to seek support and to use services to acquire the information, knowledge and skills they did not currently have to respond to the low-carbon agenda in construction and building services engineering.

We conducted 323 phone calls. A significant number of respondents hung up before the first question was explained, indicating a total lack of interest. The calls were made to businesses spread across the design/construction and building services engineering sector, namely architects, building contractors, plumbing and heating services and electrical engineering. One hundred and nineteen companies engaged and answered the three questions, some providing additional comments and information on their perceptions of current market conditions. The results are recorded in **Figure 2 on page 24.**

5.3 Profile of Respondents in the Construction and Building Services Engineering Sector

The profile of the respondents, **presented on page 24 in Figure 2**, to our phone polling included four major areas of expertise in new built and refurbishment: architects/design, building contractors, plumbing, heating and ventilation and, finally, electrical engineers/installers.

5.4 Overview of Responses to the Three Polling Questions

The summary of the responses to the three polling questions are presented **on page 24 in Figure 3**.

5.5 Responses to Question 1

Responses to question 1, **page 25 in Figure 4**, show the consistently overwhelming lack of demand for low-carbon technologies and construction methods across the different sector of activities and the markets these companies are operating in. Architects consistently mentioned the need to push for low-carbon technology and commented that this required a lot of effort on their part, often to no avail.

However, compared to the other groups, electrical engineering/installers are reporting greater level of queries about low carbon technologies, mostly solar PV. Yet, it is quite noticeable when looking at the results of question 2 and question 3, that this reply does not imply they are necessarily more willing or interested in seeking help, advice, or additional training (Q3) even though they come across as a group highly willing to change their work practices to adapt to customer demand (Q2).

5.6 Response to Question 2

Responses to Question 2**, page 25 in Figure 5**, show greater discrepancies in answers between the building contractors and electrical installers, plumbing and heating engineers and architects. Architects were the most forthcoming to the idea of needing to change their work practices to keep up with rapid changes in technology and regulation. Plumbing, heating and ventilation engineers and electrical engineering/installers were the most willing group to change their work practices, albeit if demand required it. General building contractors remained the most resistant but also the largest group represented in our sample.

5.7 Response to Question 3

Responses to Question 3, **page 25 in Figure 6**, are striking in a number of ways. It is evident the architects and building designers were by far the most open and proactive in Continuing Professional Development and willing to undertake short-courses, while the electrical engineering/installers group appeared to be the least motivated in seeking help and advice or training.

Among the architects/designers, many evoked the fact they often sought advice from their peers or through professional networks. However, when confronted with the question as to whether they would seek advice or training from the F/HEIs the answer was qualified. A common reaction was there was little on offer, or little that they ever heard about that would provide them with opportunities for quality technical short courses and/or CPD. However, the vast majority appeared willing to consider engaging with a HE or FE institutions if it could deliver something relevant to their needs, and if information about the courses and CPD were communicated to them rather than them having to seek it out. A few respondents evoked their reservations or the limitations of attending trade fairs as a source of information. They suggested that in their experience it was hard to judge the robustness and performance of technologies (new products) because of the predominant sales and marketing approach of the manufacturers exhibiting at these events. Therefore, they were wary of the quality of information they received through these channels and said they would welcome a more pragmatic, impartial approach to gaining information and experience with different products and technologies, enabling them to be able to make informed decisions.

Reactions from the building contractors, plumbing, heat and ventilation companies and electrical installers were somewhat different, vis-à-vis training, and generally the procurement of low-carbon knowledge and skills. While they indicated they would be willing to seek advice, they qualified their answer by indicating that this meant that they would likely outsource to experts if the demand for such technology and low-carbon building methods grew in demand. This amounted to declining training. They did not appear to question the existence and supply for such experts and how such experts would come on stream when they would require them. There appeared to be a lack of awareness of potential shortages and bottlenecks to respond to their needs for those 'experts' if the demand for low-carbon technologies suddenly increased as a result, for example, of new regulations coming into effect.

6. Case Studies

The section below presents a set of case studies that highlight key aspects of best practice in knowledge-transfer processes. Each experience is unique; however, these case studies, each in their own way, demonstrate significant aspects of knowledge transfer that we also used to prepare the *Knowledge Transfer Process Checklist* included in Annex 3.

6.1 The National Skills Academy for Environmental Technologies – College of North West London (CNWL): Taking a Partnership Approach – Diversity Pays

CNWL is the newly appointed hub for the National Skills Academy (NSA) for Environmental Technologies. It is currently the only National Skills Academy for Environmental Technologies approved in London and the South East. It heads a partnership of nine member learning providers. CNWL is a further education college working from sites in Willesden and Wembley. It caters for more than 14,000 students a year on more than 300 different full-time and part time courses. More than 4,500 students are based in the Faculty of Technology, which is the largest in an FE college in the UK.

It offers an extensive range of industry-approved courses in the construction and engineering disciplines, including automobile engineering, civil engineering, building crafts, building services engineering, manufacturing, production and maintenance engineering, electronics and computerised systems engineering, and construction engineering management, from Level 1 to Foundation Degree level. Of particular interest is the C&G 2399 scheme in Environmental Technologies that the college is accredited to deliver.

In January 2011 CNWL was formally appointed as one of the first 14 hubs of the National Skills Academy for Environmental Technologies. Each hub heads up a cluster of training providers charged, firstly, with raising the awareness of employers of the need to up-skill their workforce and then provide the training necessary to achieve accredited qualifications. It is probably worth noting this is one of the biggest clusters in the National Skills Academy for Environmental Technologies.

Figure 2:
Profile of Respondents in Construction and Building Services Engineering Sector

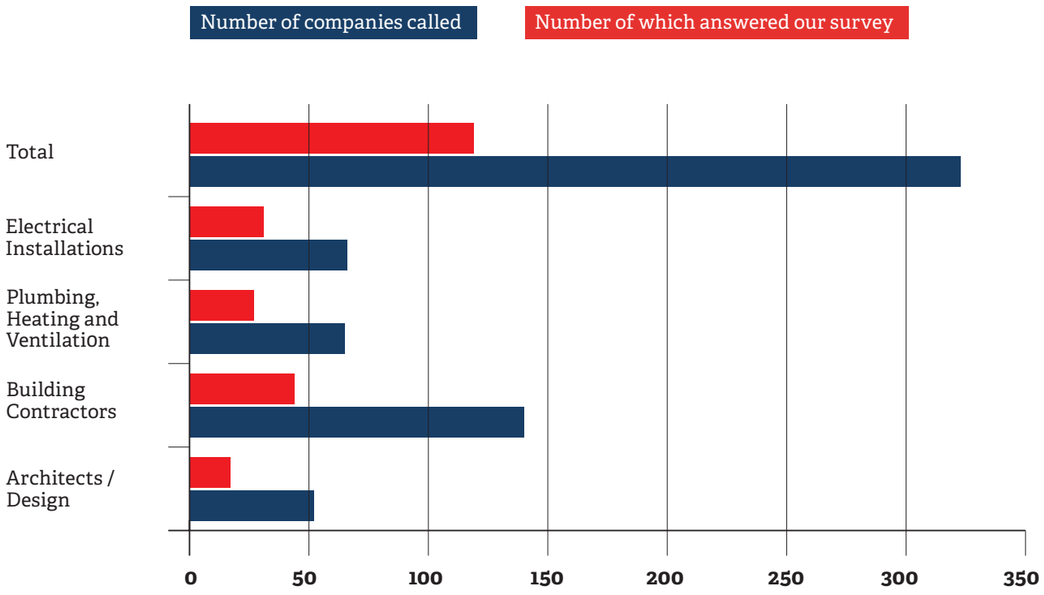
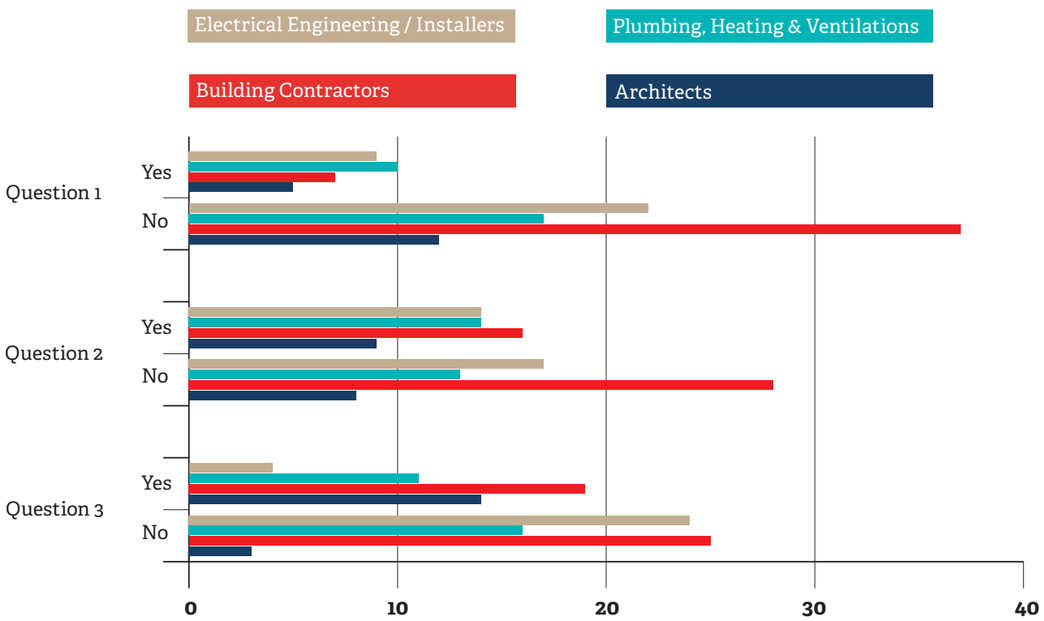


Figure 3:
Summary of Responses from Businesses in the Construction and Building Services Engineering Sector



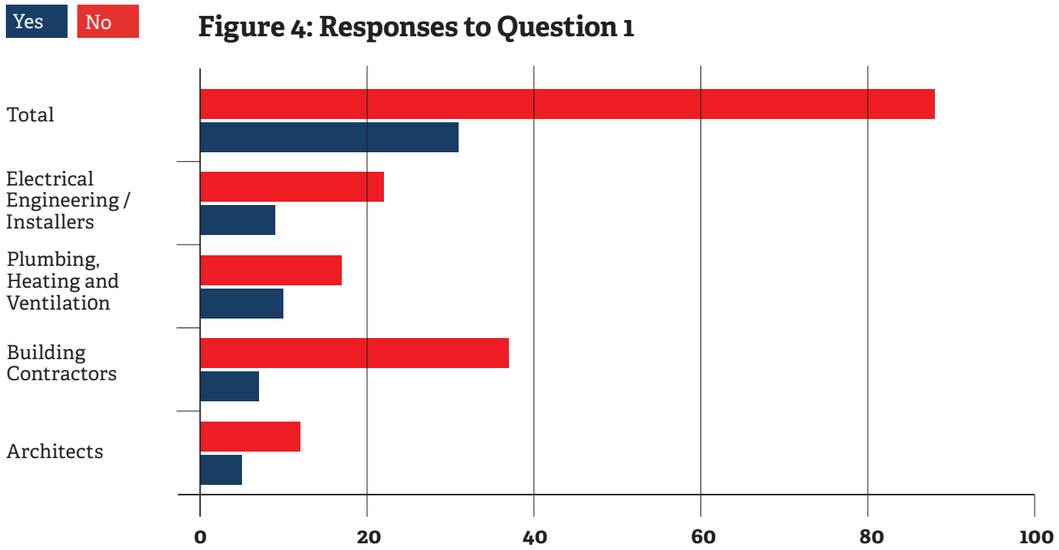


Figure 4: Responses to Question 1

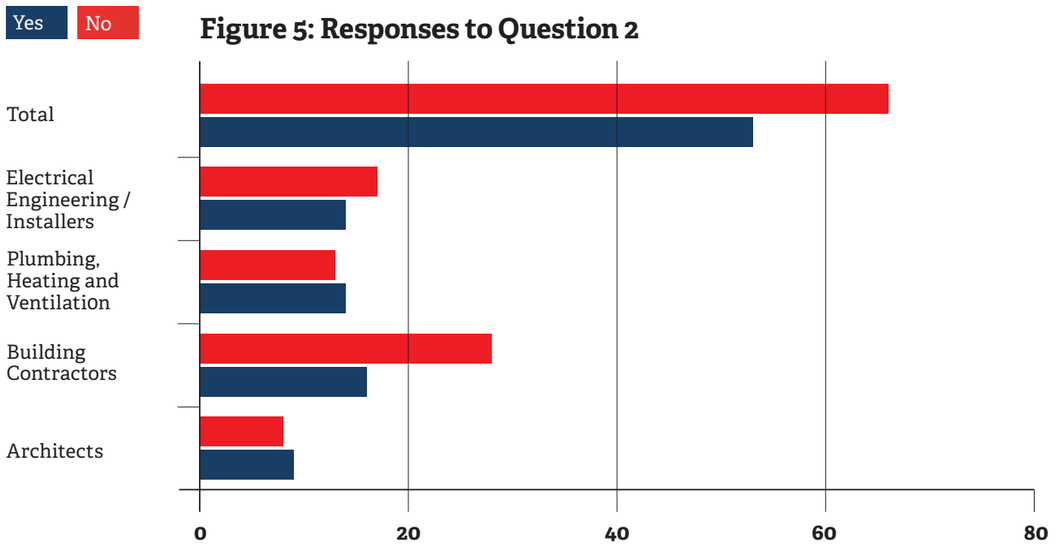


Figure 5: Responses to Question 2

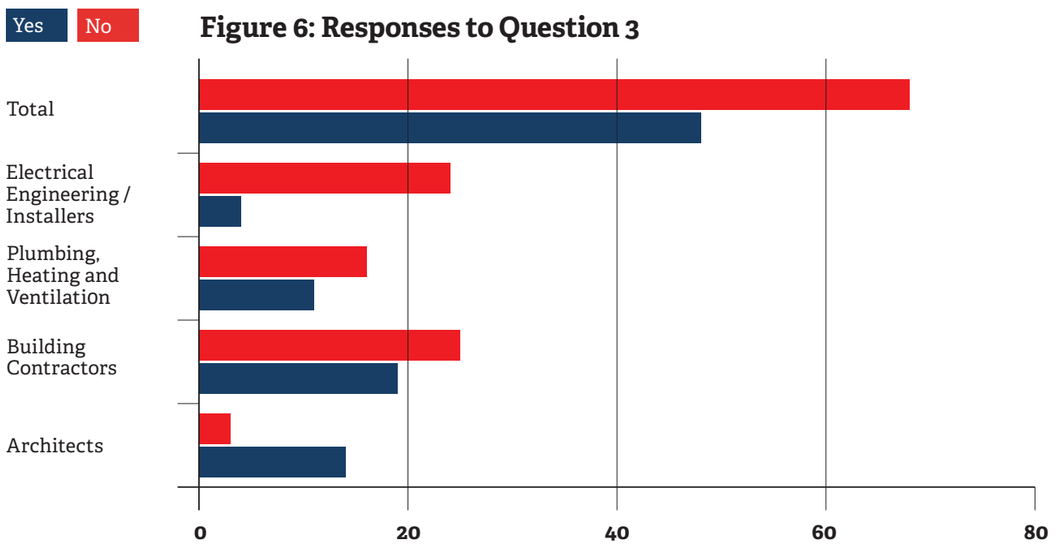


Figure 6: Responses to Question 3

6.1.1 National Skills Academy in Environmental Technologies and the Low-carbon Challenge

Research shows that in London alone the projected learning outcomes required over the next ten years are in the order of 100,000. This means the annual figure in London exceeds the total number that it is known to have received training in environmental technologies over the past two years in the whole of the UK. So business as usual is not an option – innovative solutions have to be found.

The challenge for the cluster is three-fold:

- To find and engage the large number of small and micro employers that work in the London area
- To raise awareness among the employers to the point where they recognise and act upon the need to up-skill both themselves and their workforce
- To deliver the training in ways employers and employees find attractive and that acknowledge constraints of time and money.

6.1.2 Leadership and Partnership Building: Ensuring Commitment, Diversity and Complementarity

From the outset, when Pat Leavey, Head of the Faculty of Technology at CNWL, decided to submit an application to be one of the first hubs of the National Skills Academy for Environmental Technologies, he considered very carefully who he would invite to become partners. His criteria were:

- Achieving a broad base of employer contacts
- Having a variety of expertise in raising awareness and learning delivery models
- Being able to offer a mixed economy approach to learning
- Offering a more comprehensive coverage across London.

This focus on commitment, variety and complementarity of expertise and geographical coverage, led to an innovative partnership of experienced learning providers including:

- Private training providers – Able Skills & Logic4Training
- An e-learning organisation – skills2learn
- A higher-education institution – London South Bank University
- An educational company, Think Up, that specialises in transformational learning
- A second FE college – Lambeth College.

The strength of the cluster of nine organisations that work with CNWL is the diversity of learning opportunities it offers. This diversity is seen by CNWL to be crucial in delivering the step change in skills development needed to meet the needs of the low-carbon agenda.

6.1.3 First Steps into an Action Plan

This newly approved partnership has now put the first steps of its plan into action: A series of awareness raising seminars were delivered by skills2learn, hosted at CNWL. ***http://www.e-renewable.co.uk/index.html***

The 'Big Rig', developed by Think Up and erected at CNWL was host to a renewable competition in the week leading up to CNWL's annual Industry Day. The final between an all women's team and a team from Ealing, Hammersmith & West London College took place on Industry Day. It proved a great success and achieved its aim of transformational learning.

CNWL is supporting private training providers to become accredited centres for C&G 2399 scheme in Environmental Technologies:

- Two formal cluster meetings have been held with a further one planned. These are held at different partner premises each time, allowing for cross-fertilisation of ideas and approaches
- Shared 'train the trainer' events
- Use of the Joint Investment Programme to kick-start employer engagement, through subsidised courses for employers.

Sixty outcomes are expected to be achieved by the end of July.

6.2 MITIE: Leading the Way

MITIE is a leading outsourcing and energy services FTSE 250 company with over 60,000 people and revenues in excess of £1.7bn. It prides itself on providing long-term infrastructure planning, facilities and energy management, as well as day-to-day services that can save clients' money and energy and maximise their returns.

Knowledge transfer is intrinsic to all MITIE's activities and includes the creation and development of effective communications with partners and clients. This case study focuses on how MITIE sets up and embeds knowledge transfer in its activities and relationships to build a better awareness and understanding of low carbon in client companies, to sustain capacity-building in its corporate structure and among its technical client-facing staff and to ensure innovation and competitiveness in rapidly evolving markets.

6.2.1 The Knowledge-transfer Challenge

MITIE made the decision in the 1960s, before it was fashionable, to take a proactive approach to delivering clients' needs and advising them on energy services. Over the years, this proactive approach to energy efficiency has manifested itself in a number of ways and MITIE has been leading the way by embedding low-carbon, knowledge-transfer activities through:

- The adjustment to a low-carbon, energy efficient corporate services' strategy by developing its managerial functions
- Staff development and training
- Relationship building with client companies
- Innovation in services, e.g. through offering Carboncare Health Checks on its website and CarbonCare as one of its services.

The adjustment of the managerial functions to a low-carbon, energy efficiency services' strategy was supported with the appointment of Directors for Low Carbon and Energy. Capacity-building, staff training and supporting innovation and competitiveness in services and service delivery, however, pose MITIE with a number of challenges:

- Predicting requirements in an immature market and matching the level of training to perceived need
- Ensuring its staff have an operational knowledge of the theory behind the various technologies used by their client base so they are skilled to work in different client premises across a range of manufactured products
- Maintaining good technology foresight to keep ahead of markets and ensure effective innovation and competitiveness in their services and operations.

6.2.2 Successful Knowledge Transfer: Long-term Strategic Relationships are Key

At the heart of MITIE's achievements is the development of dynamic capabilities and competences in relationship-building through effective sustained communications and knowledge exchange with:

- Its client base
- Its suppliers
- Partners with cutting-edge technology and market foresight.

Each client relationship starts with a customised value proposition, based on offering a coherent blend of solutions to meet the client's business needs, starting with the client's first articulation of those needs and building on them. In this relationship, knowledge transfer is seen as multi-directional, evolutionary process working from the premise that no one has all the answers. It is a learning process based on trust and sustained communications. MITIE gathers significant intelligence on its clients' specific requirements to inform service delivery and innovation. MITIE's approach to service innovation has grown to reflect the customised strategic focus of its long-term dynamic client relationships. To achieve its current position as market leader, MITIE has had to adopt a different perspective on the services it offers from one of how you operate and maintain buildings to long-term strategic adviser and deliverer of solutions that bring real cost and reputational benefit.

Strategic long-term relationships with clients also provide intelligence on the knowledge and skills required by MITIE's technical client-facing team. Emphasis on a low-carbon agenda has been translated in the introduction of resource efficiency modules into apprenticeship programmes. MITIE controls the relevance and quality of its apprenticeship programmes by establishing long-

term strategic partnerships with education and training providers.

Finally, technology and market foresight is maintained by accessing intelligence through their alliance with leading Higher Education research organisations such as the Centre for Efficient and Renewable Energy in Buildings (CEREB).

6.2.3 Achieving Positive Outcomes

There are two significant lessons to be drawn from MITIE's approach to knowledge transfer.

One is that long-term strategic relationships are key to achieving positive outcomes in knowledge transfer.

The second is that knowledge transfer is successful when you have the right audience for the message. MITIE takes great care in making sure it is addressing the right messages to the right person in the company. Targeted communications increase the effectiveness and success of knowledge transfer. MITIE made sure it was upping its game and talking to the right people when addressing business benefits rather than operational issues. It has a simple message:

> *"The companies and people you interact with operate in a number of guises – do not limit your knowledge transfer to the most obvious role. Suppliers can also be clients."*

6.3 The FLASH Programme - University of East London, Sustainability Research Institute

FLASH was established as a vehicle for knowledge transfer to address the challenges of the need for a rapid transition to low-carbon construction. Therefore, the programme is designed to support the adoption of low-carbon technologies and low carbon building methods and materials in the construction and building services engineering sector, and as an opportunity to leverage outcomes of the Technology Strategy Board's (TSB) *Retrofit for the Future* programme so it could benefit a wider range of SMEs in that sector. Match funding was derived in part from the link with the TSB's *Retrofit for the Future* programme. This partnership helped the programme achieve substantial ERDF financial support.

FLASH has been designed to help these businesses to seize the commercial opportunities arising from the move towards a low-carbon economy, but also as a significant effort to support businesses in achieving environmental awareness and better resource management, from energy, water to waste.

The FLASH programme is part-funded by the European Regional Development Fund (ERDF). It provides a range of business support to London-based SMEs working in construction or other built environment industries, technologies and professions.

6.3.1 The FLASH Partnerships

The FLASH programme is a partnership between Trade Associations, the Technology Strategy Board and HEIs, including the University of Greenwich, London South Bank University and the Sustainability Research Institute from the University of East London (UEL). The programme is led by the Institute for Sustainability. UEL's Sustainability Research Institute is a delivery partner.

Partner Trade Associations and professional bodies include: Construction Excellence (CE), RIBA, CIPHE, RICS, the Federation of Master Buildings (FMB), the National Federation of Roofing Contractors (NFRC) and, finally, the support of the TSB. The FLASH Programme does not have any Further Education partners.

The partnership was established to leverage Trade Associations' and professional bodies' membership networks to support effective business outreach across a variety of relevant trades and to optimise opportunities to introduce the diversity of complementary knowledge and skills required for low-carbon construction and building services engineering.

6.3.2 Meeting the Low-carbon Challenge: FLASH Services & Knowledge transfer Activities

The FLASH programme services are conceived as capacity-building services dedicated to London SMEs in the construction and building services engineering sector that are members of its networks and those that register with the FLASH programme. It is offered to SMES with less than 250 employees and/or with a turnover of less 50 million Euros. FLASH services cover all aspect of sustainable development in business management, resource efficiency, low-carbon technology, materials and methods and the process of innovation (innovation management).

FLASH Innovation is being offered by the University of Greenwich's School of Architecture and Construction and the Business School. It is delivering support in business development and innovation. Greenwich also offers practical workshops, networking opportunities and access to students and academic resources.

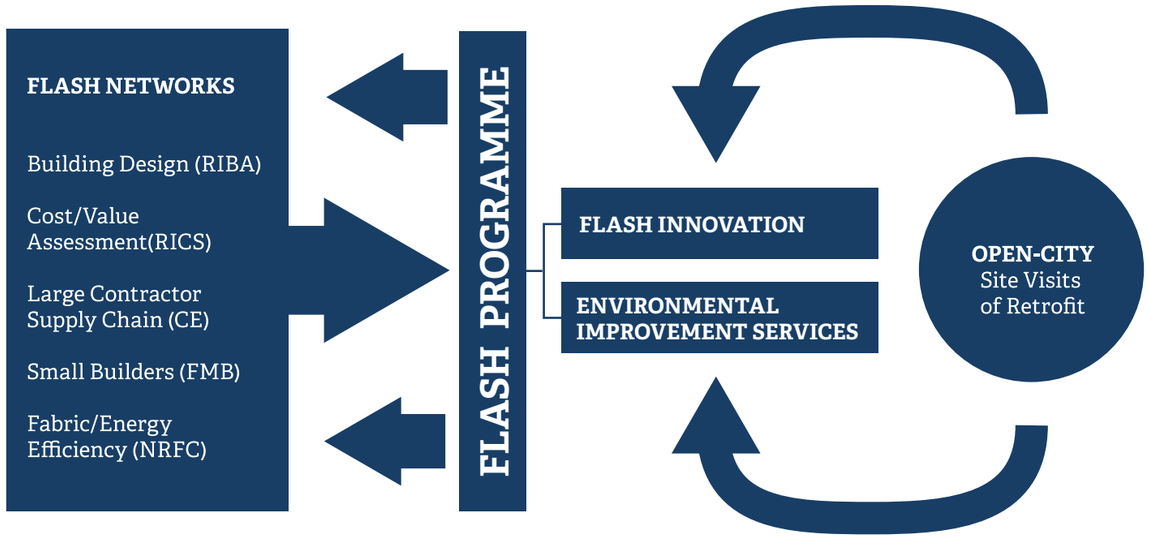
FLASH Environment and Improvement Services, are being offered by several of the university partners but in particular by UEL. The focus is on providing business with environmental audits, advice to increase efficiency and reduce costs through improving waste management, energy usage and taking care of effective recycling. Emphasis is on sustainability awareness, managing carbon emissions and capacity-building. The range of services provided are being delivered by a number of the partners: workshops, one-to-one support and site visits drawing on the legacy of the *Retrofit for the Future* programme.

6.3.3 Leveraging Networks and Project-to-project Learning for Capacity-building

FLASH Networks are based on a substantial stakeholders engagement process in which Trade Associations and professional bodies are bringing their membership the opportunity to join the programme through which they are offered a 'time budget' that enables them to access the value of 12 hours free advice. The number of FLASH Networks presented in **Figure 3 on page 24** is not exhaustive. It also includes: BSK-CiC, a Community Interest Company supporting the development of London SMEs and leading a Renewable Energy Network and Electrical Services Network, and the Chartered Institute of Plumbing and Heating Engineers (CIPHE) leading the Plumbing, Heating and Ventilation Network.

UEL has a long standing experience of support to London SMEs in a variety of sectors that they have sustained through funds from successive projects and has been very strong in proactive networking and leadership over the years. The FLASH programme extends this on-going knowledge exchange effort and collaborative activities with local SMEs to the construction and building services engineering sector.

Figure 7 – The FLASH Programme



Some of the companies have been engaged in knowledge-transfer activities with UEL through a number of projects, for example, the Barking and Dagenham Company, OCL Regeneration Ltd, which specialises in sustainable material solutions for construction and industrial use. Initially, UEL worked with OCL in product research and development on sustainable materials. The UEL team is now involved in supporting the quantification of the environment saving OCL would make by using OCL's services in waste management and materials recycled that are all initiatives delivering significant environmental value, as well as affecting a company's costs and, therefore, the company's bottom line.

Through the Open-City projects, FLASH members benefit from the opportunity to visit some of the retrofit sites, which are made available to give SMEs in construction and business services engineering a better understanding of the practical and commercial opportunities of the market in retrofit.

Example: Open-City Retrofit Site Visit to Tower Hamlets Passivhaus (retrofit)

The aim with this social housing retrofit is to show that deep-energy cuts are possible with social housing stock. As the UK's exposure to, and experience of, Passivhaus grows, Open-City aims to show how improved thermal comfort, reduced energy bills and lower CO_2 emissions are possible for millions of people in existing houses. The building uses external thermal insulation and very high levels of building envelope draught proofing. A robust demonstration building is being produced, where specific heat energy requirements are to be reduced by 95%, while also reducing complexity, minimising primary energy use and creating a healthy indoor environment with plenty of fresh air.

The design strategies for a planned occupancy of seven people of this particular site included:

- Space heating through air with mechanical heat recovery ventilation (for winter) and space cooling secured by natural ventilation for the summer and cross ventilation
- Water heating provided by solar hot-water technology with a gas-condensing boiler as a top up
- A strategy for minimising thermal bridges included continuity of insulation with exterior insulation, loft insulation and under-floor insulation of the entire structure.

The impacts for this particular development are significant:

- Electricity usage is expected to be almost cut by half after refurbishment
- Gas use will be slashed from its prior 35786 kWh/year to a staggering 3898 kWh/year
- Primary energy requirements are being offset by renewable energy enabling significant CO_2 savings.

Open-City is an opportunity for London SMEs to access demonstrator projects that contribute to opening minds, demonstrate technologies and low-carbon materials and construction methods. This will hopefully help build commitment from other SMEs and professionals across the FLASH programme's networks to initiate and/or support similar developments.

The FLASH programme has a currently advertised programme of workshops available at ***http://www.instituteforsustainability.org.uk/flashworkshops.html***.

FLASH is due to run for a period of 15 months in London. However, the demand and its early success have already prompted discussion for an extension to the programme, 'FLASH Plus', which is being negotiated to offer similar opportunities in the South East. The project, however, does not currently involve establishments in the Further Education sector, a point that was raised during the interview with the Sustainability Research Institute's (SRI) Director at UEL, Darryl Newport. However, SRI maintains strong relationships with the East London NSA in construction and local FE colleges.

6.4 Centre for Efficient and Renewable Energy in Buildings (CEREB)

The Centre for Efficient and Renewable Energy in Buildings (CEREB) is a unique, teaching, research and demonstration resource for the built environment, hosting a number of renewable and intelligent energy solutions.

CEREB was officially opened by the Mayor of London in June 2010. It has been developed as a partnership between London South Bank, City and Kingston Universities, with funding from the Higher Education Funding Council for England (HEFCE), the London Development Agency (LDA) and M&E Sustainability.

6.4.1 Capitalising on Tangible and Intangible Assets

CEREB is located at roof level of the new London South Bank University (LSBU) teaching facility K2. It has direct access to data from all the different technologies providing the services to the working building, together with the innovative technologies built into the Centre itself.

There is also the ability to showcase developing technologies and to trial new products in a real life setting where the results can be closely monitored. This makes it an invaluable resource for understanding how to design, operate and manage technologies for future low-carbon buildings - both new build and retrofit.

The data from the monitoring systems is available via web interfaces that will allow it to be used for collaborative research worldwide, which will give the Centre an important international dimension.

The Centre is fully equipped for the courses and seminars to be broadcast over the web. A series of webinars are planned as part of the programme and bespoke training can also be delivered in this way.

Its host organisation, LSBU, has the highest number of KTPs per member of staff in the UK.

6.4.2 A Strategy Aligned to the Mission

In order to achieve its mission and remain a sustainable entity it has a requirement to build a group of high-performing networks and a reputation that means it becomes the place to go for innovative solutions and state of the art education and training.

It has adopted a number of approaches to penetrating the market:

- It takes full advantage of existing high-level contacts and networks
- It makes sure it belongs to the right clubs
- It makes a virtue of the close link between research and teaching
- It targets its markets very carefully
- It exploits its location on a roof in the centre of London.

6.4.3 Leadership, Market Development and Capability-building

In the short time that CEREB has been operating it has been a huge success. However, in order to achieve its mission and remain a sustainable entity it has to build up and maintain its stakeholder and customer base. In a very short time, i.e. barely a year, CEREB has taken on the challenge to penetrate the market and build its reputation as a centre of excellence for innovative solutions and high-quality education and training in renewable technologies.

In order to build itself a sustainable future, CEREB has relied on strong leadership, market development through networks (academic/research peers and industry) and an effective communication strategy.

- CEREB has effectively exploited the high-level contacts and networks developed through its staff, particularly Prof Tony Day, Director of CEREB and Prof of Energy at LSBU, and previous students
- It has joined all the right clubs, which will bring it into regular contact with employers, clients, other professionals and research bodies, for example:
  - Trade associations such as HVCA & ECA
  - Energy Institute
  - Clients such as GLA.
- It maintains a very close link between its roles to showcase, undertake cutting edge research and deliver education and training courses
- It is developing its role as a data hub. Supporting commercial property owners to demonstrate that their buildings meet environmental standards is going to become ever more important
- It is developing an Associate Partners programme. Depending on the project, associate partners may have:
  - Access to the data the centre generates to carry out research projects
  - Link with the expertise of the universities to provide training to their staff
  - Access to the Centre for hosting community/charitable events (depending on availability)
  - Access to Centre Managers' time for work on projects.

CEREB has given careful attention to:

- Planning a series of webinars as a major delivery vehicle along with exploring remote delivery of bespoke training
- Advertising its stunning location as a venue for social as well as educational events, bringing in a new clientele who can be introduced to the work of CEREB in a low-key way that can be followed up.

6.5 Partnership-working and Knowledge Transfer in Course Development: NICEIC Micro-Generation Course Development

NICEIC is the UK electrical contracting industry independent voluntary body now branded NICEIC but formerly known as the National Inspecting Council for Electrical Installation Contractors. NICEIC has been granted a license under the Micro-generation Certification Scheme (MCS).

MCS is an internationally-recognised quality assurance standard and an independent scheme that certifies micro-generation products and installers in accordance with consistent standards. Offering accredited qualifications in gas, water and renewable technologies among others, it is designed to evaluate micro-generation products and installers against robust criteria, providing greater protection for consumers. To date, NICEIC has 26,000 registered contractors included in its membership and has trained more than 500 professional installers currently working within the electro-technical industry.

NICEIC has been involved in a number of initiatives driving quality assurance in the supply chain of large initiatives, such as that undertaken by the London Borough of Southwark, which is the biggest public property owner in London. NICEIC also has an ongoing consultative partnership with City and Guilds in the design of their electro-technical qualifications and has recently developed an apprenticeship scheme with Bedford College.

This case study is an outline of a partnership effort in undertaking knowledge transfer through course development to support the growing demand for effective up-to-date training in Solar Photovoltaic, Solar Thermal and Air and Ground Source Heat Pumps.

6.5.1 A Partnership in Knowledge Transfer

Since 2007, NICEIC has been involved in a partnership with City and Guilds (C&G), through which it has developed courses in Inspection and Testing, the C&G 17th Edition Wiring Regulations and its latest project, the 2399 qualifications in Environmental Technologies, which it offers to both members and non-members alike.

NICEIC and C&G began their partnership with the intention to ensure qualifications developed by C&G met with the needs of the industry. C&G appointed NICEIC Group as its lead consultant for the future development of electro-technical qualifications.
A knowledge transfer-partnership in course development promised much for all parties:

- It ensured C&G was able to offer precise training to an industry in which innovation is industry led, ensuring an up-to-date and informed workforce were continually graduating into the industry
- It allowed NICEIC to use its unique relationship with industry personnel to construct qualifications meeting its members' CPD needs.

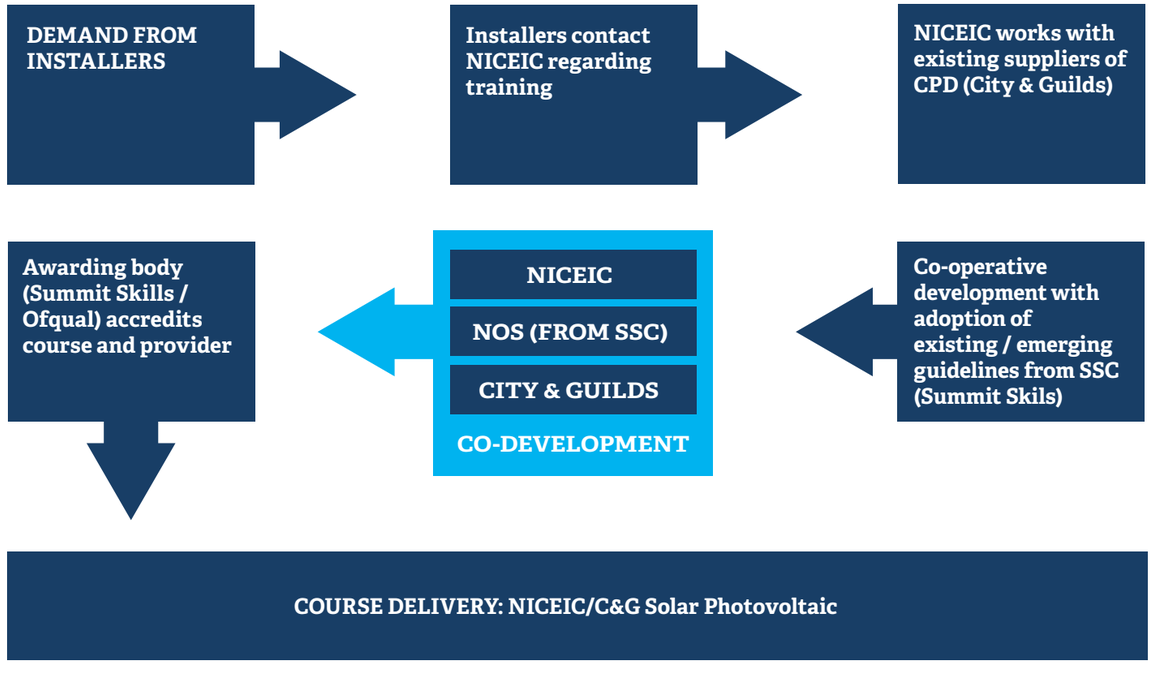
With the introduction of the feed-in-tariff in April 2010, NICEIC members saw an increase in consumer demand for renewable technologies. This led NICEIC members to contact the association regarding the training needed to offer these technologies to customers. Darren Staniforth, the NICEIC Technical Development Manager responsible for the development of NICEIC training and the introduction of new courses, was faced with a number of obstacles in designing new qualifications to meet the needs of the industry and consumers. These challenges included:

- Ensuring qualifications met with the requirements of the National Occupational Standards (NOS) outlined by the Sector Skills Council for Building Services Engineering; Summit Skills
- Offering training through channels and in a format that would decrease the 'down time' necessary for working installers to undertake the training. This would involve developing a learning and assessment strategy that would mitigate the inconvenience posed to installers by missing working days as well as having to pay for course enrolment
- Taking steps to ensure those technicians working in the development process were fully up to speed with current technological standards
- Updating the course content periodically to ensure course materials were kept in step with these technological developments
- Ensuring assessment centres offering the course were able to keep pace with industry innovation, updating the practical provisions used to assess students
- Keeping qualifications relevant to the CPD needs of installers while encouraging the uptake of qualifications by trainees and young people.

6.5.2 The Co-developmental Process

The prior existence of a developmental partnership between the two organisations ensured C&G and NICEIC were in a great position to respond to the changing needs of the industry. Working from the National Occupational Standards developed by Summit Skills as a basis, C&G and NICEIC built the curriculum and assessment strategy. The finished qualification was then passed back to Summit skills and Ofqual for accreditation and funding clearance. The process undertaken by NICEIC and C&G is depicted in **Figure 8**.

Figure 8: NICEIC – Qualification Development Process (C&G 2399)



The development process spanned a period of 14 weeks, from the uptake of the NOS standards to full accreditation by Ofqual. NICEIC maintains regular consultation with C&G to ensure the qualifications are kept in step with the latest technological developments.

6.5.3 Overcoming the Barriers in a Knowledge-transfer Partnership

Having identified the unique obstacles posed during the development process, NICEIC and C&G took steps to traverse them by:

- Offering online learning and assessment via multiple training centres. This allowed students to alleviate the financial burden of attending a four-day course in person
- Placing technical consultants on secondments within the manufacturing industry; ensuring the qualifications were developed in line with current industry standards
- Seeking final accreditation from Ofqual and Summit Skills (as is standard practice) while maintaining regular consultation with C&G and Summit Skills regarding industry innovation
- Entering into an apprenticeship scheme with Bedford College, reaching new students and helping plug the skills gap in the electrical contracting industry.

6.5.4 Rise in Demand

Having trained in the region of 500 individual installers since the inception of NICEIC's renewable technology qualifications in May 2010, it hopes to train in the region of 5,000 new installers in 2012, either directly through NICEIC tutors or indirectly through third-party events.

The steady increase in demand for renewable technologies from consumers has filtered through to the educational sector, with the demand for training and CPD from existing installers rising in tandem with trainee and apprenticeship applications. The success of the NICEIC pilot apprenticeship academy at Bedford College has also led to plans to extend the scheme to other colleges in the next few years.

6.6 Quiet Revolution: The Merton's Rule and the City House's Retrofit in Croydon

Quiet Revolution was established in 2005 as a manufacturer and installer of micro and mini-wind turbines. Employing more than 40 personnel between its head office in London and its manufacturing plant in Pembrokeshire, it offers wind turbine installation for commercial and private initiatives. In 2006, it was approached to take part in the retrofitting of a 1970's office building in Croydon, south of London, owned by the property developer Fairviews.

The project was a joint venture between four partners including MITIE, Quiet Revolution and Fairview Homes. The building, City House in Croydon, was to be re-developed to create 200 high-rise apartments and 100 ground-based dwellings. Fairview Homes, the property developers, secured private finance for the retrofit through the sale on plans of the 200 converted dwellings.

6.6.1 The Retrofit Challenge

The challenge associated with the retrofit rested with the introduction of a planning regulation, the Merton's Rule. The Merton Rule is a precursor to the development to the Code of Sustainable Homes and the Feed-in Tariffs legislation, which did not exist at the time.

In 2003, Merton Council developed and adopted a ground-breaking planning policy stipulating that all new residential developments comprising of ten or more units had to incorporate renewable energy production to off-set at least 10% of predicted carbon emissions. The Merton Rule is a landmark in (institutional) innovation. While it posed a challenge for the Croydon retrofit, it also constituted an opportunity for customising a low carbon energy retrofit solution from a wide-range of micro-generation technologies that could all be potentially considered as part of the redevelopment process.

Quiet Revolution was brought into the project as a technology partner and supplier of mini-wind turbines to address these renewable energy needs.

6.6.2 The Process under the Merton Rule

The decision was taken to tackle the buildings renewable energy demands by installing micro-wind turbines in conjunction with a biomass Combined Heat and Power system. The Biomass system was installed by a separate company, while the turbines were installed on the roof of the building to maximise their exposure to prevailing winds and improve performance. These methods were seen as the most cost effective and efficient combined energy sources for the demands of the retrofit. The project was one of the first of this type in the UK and posed several challenges for Quiet Revolution. These included:

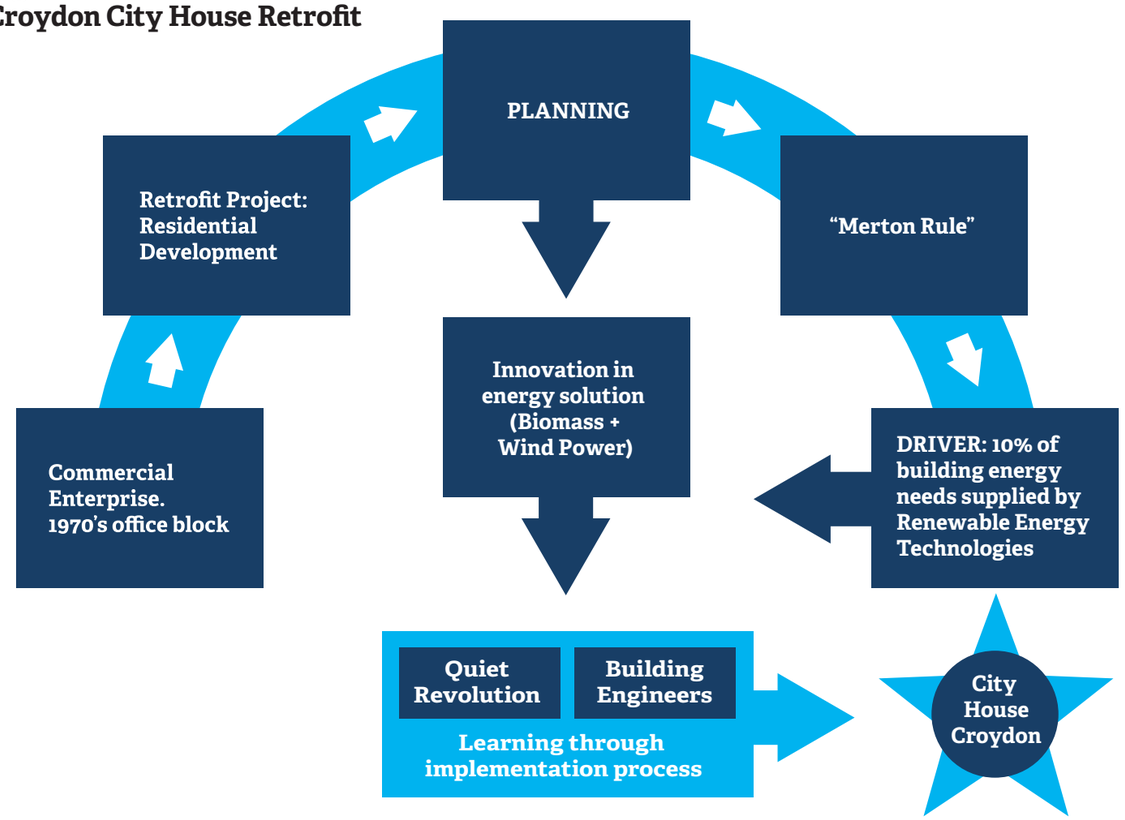
- Ensuring the location provided the correct wind resources for the use of wind turbines to be viable
- Mitigating the amount of vibration transferred to the structure to decrease noise and disturbance
- Installing the correct specification of wind turbine to the correct quantity to ensure the required capacity standards of the Merton Rule were met
- Assessing and accounting for the effect of rooftop obstacles on the performance of the turbines
- Overcoming operational difficulties during installation as the building is located in a busy urban area close to the A 23.

Quiet Revolution was chosen for the project because of its industrial expertise and in particular, its specialised wind-turbine designs. The 'Quiet Revolution' design, the qr5 turbine, was specially developed to respond to the demand for turbines that worked well in environments close to people and buildings.

Over the course of Quiet Revolution's three-year involvement with the project, the company took more than a year and a half to conduct surveys and planning to determine the most efficient installation parameters necessary to overcome the challenges posed by the project. Computer modelling and testing with a single turbine installed on the roof took up the majority of the surveying stage, in which the effect of adjacent roof structures, average wind resources and vibrational effects were considered and suitable solutions developed.

The finished project involved the installation of eight qr5 wind turbines on the roof of the building (14 storeys up), running along one side of the 90m x 10m roof space and providing approximately 2500 kilowatt hours of electricity each. The biomass system also provides a complementary proportion of the buildings heat and power and, with the turbines, this combined micro-generation low-carbon energy solutions provides the power that substantially reduces energy bills for the residents providing for services in the common parts of the building, i.e. such as communal lighting and elevators.

Figure 9: The Merton Rule: Croydon City House Retrofit



6.6.3 Learning Outcomes

As one of the first projects of this kind in the UK, Quiet Revolution came up against a steep learning curve. The project put substantial practical pressure on performance. It provided an example to the industry for installing micro-wind technology in built-up areas and, more importantly, an example of installation in retrofitting projects in densely populated urban conditions with stringent constraints on space that was pre-determined and not chosen for the technology. As Stephen Crosher, a consultant engineer for Quiet Revolution who worked on the City House retrofit outlines, the project provided installers with an opportunity to:

- Gain an understanding of the wind resources available on high-rise buildings
- Further their understanding of methods available to mitigate the transference of vibration into installation buildings
- Improve their appreciation of the effects of surrounding obstructions on wind-turbine performance that is not of concern in lone-standing wind turbines
- Experience installation of multiple turbines into a small space while delivering an optimum performance from each.

7. Putting Results into Context

At a glimpse the message is simple: we live in a period of transitions. Both the responses from the London FE/HE sector and London SMEs in the construction and building services engineering in our sample, signalled and reflected the immaturity or an early growth in:

- Low-carbon technologies and consumer markets
- The development of education and training provision (not italics) required to up-skill the existing workforce and deliver the next generation of skilled trades' people.

Overall our findings highlighted:

- The significant disconnect between small businesses in the London construction and building services engineering sector in our sample and the education sector.

Given this, the constrained knowledge-transfer capacity of the FE and HE sector in low-carbon areas, exemplified by the overall results of this research, is reflective of the current regional (i.e. London area) and national context of the development of technologies and markets. These are currently marked by uncertainty due to a number of factors, for example:

- The unproven robustness of many of the low-carbon technologies/products coming into the market and a small manufacturer-led installer sector
- On-going policy developments (e.g. the Green Deal) The still too-recent impact of newly-introduced policy frameworks (e.g. Feed-in Tariffs)
- Uncertainty around originally planned local development initiatives, e.g. the skills initiatives of the *Green Enterprise District* in East London such as the Retrofit Academy and the Sustainable Skills Academy or even the development of the University Technical College originally considered to be housed in CEME (Centre for Engineering and Manufacturing Excellence) within the Thames Gateway
- Time-limited project-based knowledge-transfer initiatives in low-carbon technologies and construction leveraging some of the outputs of public works, e.g. such as the FLASH programme.

7.1 On the Demand Side: Immaturity of Markets and Technologies

- The technology markets and end-users' markets for low-carbon technologies in construction are still immature.

This immaturity of the market is reflected in the responses of our London SMEs' sample in Section 5, and in the greater focus of F/HEIs on solar technologies, rather than on a broader range of low carbon technologies and construction methods (see Section 4). Technological change is still intense and the variety of technologies coming on stream are not yet well understood by many of the SMEs in the construction and building services engineering sectors and its customers. Most appeared to be playing a waiting game for demand to rise and/or costs to fall. The results also showed that motivation for up-skilling was still quite low and that respondents tended to anticipate they would outsource to experts rather than train. However, they did not question where the experts would come from, or how these would be suddenly made available when demand kicked in.

Low carbon in the built environment is, therefore, a niche market of emerging knowledge and expertise is far from being integrated or mainstreamed into the traditional markets and the practices of SMEs in the construction and building services engineering sector. Responses from the sample of architects/designers indicated they also had difficulties in stimulating the uptake of low-carbon solutions by their clients. The findings of a recent report by the Energy Savings Trust corroborate this fact. Its results highlight regional discrepancies in market development, indicating that London has seen a particularly slow growth in the market for micro-generation technologies compared to other areas in the South East. There has been a range of concerns vis-à-vis the barriers affecting the adoption of these technologies. The Energy Saving Trust outlines some of the characteristics and barriers encountered by businesses in this emerging market in London, and I quote:

- Low number of MCS-certificated installers based in London versus the South East
- Limited impact of the Low-Carbon Buildings Programme in London
- Difficulties for recent market entrants to gain a foothold within the industry
- Installer concern regarding manufacturer-led training for micro-generation technologies
- Installer inability to remain independent within the sector, and free to install across a range of system and product types.

(Energy Saving Trust, 2010, p.12)

The immaturity of technology markets and sluggish demand is being compounded by uncertain early results generated by change in policy frameworks affecting technologies and end-user markets.

7.1.1 Policy and Technology Markets: the UK Feed-in Tariffs (FiTs) Scheme

The report notes that market developments in the capital have been dominated by solar thermal and solar PV technology, a trend reflected in the tendency of London F/HEIs, which are shown in **Section 4.3.2 (Table 8, page 55)**. This indicates that the F/HEIs are most likely to follow the trend of the market and increase their competencies and skills in solar-energy technology.

The growth in interest in solar technologies by the FE/HE sector is matched by the growth in uptake of the technologies (solar PV) stimulated by the introduction of the UK Feed-in Tariffs (FiTs) Scheme. The scheme was introduced in April 2010 to create incentives for small-scale, low-carbon electricity generation (i.e. less than 5 MWe) with the view to transforming the market for micro-generation technologies in a similar way that the Renewable Obligation was intended for the larger renewable market. However, the growth in uptake of this market segment in low-carbon technologies has to be put into context.

In its response to the Government consultation on feed-in tariffs, DECC stated:

> *"It is expected that by 2020 the scheme will support more than 750,000 small-scale low-carbon electricity installations and will have saved seven million tonnes of carbon dioxide."*
> ***(DECC, p.5, February 2010).***

Table 20 below gives a summary of the impact Feed-in Tariffs have had on technology adoption to end September 2010. According to research conducted by AEA Technology, in the first six months of the scheme to September 2010, 43.96 MWe of capacity have been installed across a total number of 11,359 installations in England and Wales ***(AEA, October 2010)***.

As AEA Technology pointed out, 'if the current level of installations is apportioned against the expected total number of installations mentioned by DECC in its response to the government consultation on the Feed-In Tariffs Scheme, then it is quite clear the first six months have only delivered 1.5% of DECC's expectations so far.' Given that the Feed-In Tariffs are likely to become less generous as the years progress, a bias towards early market growth should have been expected to ensure a share of the greatest return on investment. This does not appear to have materialised.

These observations reinforce the signs of some uncertainty as to demand and/or market growth for micro-generation technologies and the risk this constitute for achieving targets attached to the low carbon agenda.

Capacity of Micro-generation Registered Under the Feed-in Tariffs Scheme to September 2010 — **Table 20**

Technology	Capacity (MWe)	Market Segment
Solar PV	26.3	99.5% domestic retrofit
Wind Power	10.6	15% Commercial & 84% Domestic
Micro CHP	0.005	Not known
Micro Hydro	7.00	Not known
Anaerobic Digestion	0	

Note: the scale of micro-hydro is on average 13.5 kWe each. ***Source AEA Technology, October 2010***

While policy has had a positive impact in stimulating some growth in environmental technologies, the signals are still those of a market in its infancy.

7.1.2 Policy and Consumer Demand: The Green Deal and the Consumer Perspective

Businesses in our sample also reported there was insufficient demand from their clients for low-carbon solutions. This reported sluggishness in market demand was validated by concerns about the lack of clarity and some uncertainty regarding new legislation - The Green Deal - and by signs of faltering consumer awareness and commitment to the low-carbon agenda.

The Green Deal

This government programme proposes to improve energy efficiency by providing an *"innovative financing mechanism"* ***(DECC, 2010)*** that will relieve consumers from up-front capital costs of improvements to their home and enable them to pay back these costs through their energy bills.

The implementation of the Green Deal in the autumn of 2012 is raising expectations for increased demand among professional bodies and trade associations in the construction and building services engineering sector. This was highlighted by research in the preparation of the case study on the FLASH Programme (section 6.3). The Federation of Master Builders (FMB), one of the lead partners of the FLASH programme's networks of targeted SMEs, highlights the significance of the Green Deal as a motivator for engaging in this KT initiative:

> *"The government's "Green Deal" could be the biggest work provider that has ever existed for Small- and Medium-Sized Enterprises (SMEs) in the building industry, creating contracts worth millions of Pounds. The 26 million existing homes in the UK will nearly all require extensive retrofit work for the country to meet the 2050 emission targets agreed by the government. This market is estimated to be worth £300-400 billion and FMB will give you the expertise to allow you to be the first to the door."*
>
> ***(Federation of Master Builders, FLASH Programme introduction, available on http://www.fmb.org.uk/about-fmb/fmb-regions/london/flash)***

The question is, will the impact of the Green Deal meet expectations? And, if it does, how will the skills gap be closed to meet the demand it is expected to generate?

Let's first review some of the issues related to the Green Deal's expected impact on demand.

From the consumers' perspective, the terms and conditions of the Green Deal are still currently probably too vague to be able to make a difference. The conditions for approval of projects under the programme are couched into a 'golden rule' for project approval, which postulates that:

> *"...expected savings in typical properties consuming a normal amount of energy must be equal to, or greater than, the cost of the measure."*
>
> ***(DECC, 2010, p.6)***

Doubts have been raised about the effectiveness of this legislation in stimulating demand in some of the hard-to-penetrate sections of the property stock. London has a vast privately-owned home sector, which includes a substantial and growing privately-rented sector. The watchdog 'Consumer Focus' specifically highlighted the challenges posed by the Privately Rented Sector (PRS):

> *"The PRS also has the highest incidence of 'excess cold' of all housing tenures. Over 400,000 private rental homes – 15 per cent of the total – are classified as a Category 1 'excess cold' hazard under the Housing, Health and Rating System (HHSRS)."*
>
> ***(Consumer Focus, 2010, p.3)***

It is expected that under the Green Deal, the privately rented sector will not be under pressure to comply and many will evade taking action. Under the current terms of the Green Deal, the drive for the uptake of low-carbon solutions to improve the energy efficiency of these dwellings will depend on the tenants asking the landlord to commit to the scheme and on the landlord responding positively to the tenants' request. It will also depend on the tenants paying for the cost on their energy bill. In London, the cost of privately rented accommodation has rocketed in the last decade and families in rented accommodations have recently seen cuts in their entitlement to housing support. One might be concerned that with rising energy prices, tenants may be reluctant to risk further costs they might be ill-equipped to finance. Many tenants may have insufficient incentives to seek approval for retrofitting works from their landlords in properties where there is uncertainty in the conditions and the length of their tenancy, which, under the term of assured short hold tenancy agreements, can be as short as six months.

Finally, there are still many unknown factors e.g. the eligibility criteria attached to retrofitting work that can be undertaken under the Green Deal, and the technicalities these criteria will entail. The Green Deal's secondary legislation is only due to come into consultation in the autumn of 2011 and the detailed industry guidance to be prepared in the spring of 2012 for the first Green Deal project to come through in the autumn of 2012. ***(Green Deal Timeline, DECC, 2010)***

Consumer Awareness and Doubtful Commitment to Low Carbon

Consumer awareness and commitment to the low-carbon agenda is also of some concern. Faltering consumer awareness can have a significant impact on demand in another large section of the owner-occupiers' market. In an article published in March 2011, the watchdog Consumer Focus reported some of their research findings. The latter showed that:

> *"Energy Performance Certificates that should help people cut their bills are having no influence on four out of five homebuyers who see them".*

Private owner-occupiers' commitment to upgrading their properties to make energy efficiency gains is still dependent on a combined mix of awareness and fear of the cost implications that such measures may have. The latter might or might not be remedied by packages under the Green Deal as consumers are also generally put off by the complexities of legislation and eligibility clauses which, on the whole, tend to accompany them. Many do not find sufficient justification in taking personal action, when facing what they may view as inconsistent decision-making in government or industry, for example, the commissioning of an additional airport runway that will create conditions for a new source of increased carbon-dioxide emissions.

7.2 On the Supply-side: Knowledge Transfer in F/HEIs and the Transition to Low-carbon Solutions

Our research shows the F/HEIs' commitment to the low-carbon agenda and knowledge transfer is certainly there, at least by way of intention, as it was not really validated in the wider website and course prospectus searches. Translating this commitment into workable, consistent initiatives and enduring dynamic strategies of engagement with communities and businesses, however, is a lot more difficult.

Responses in the F/HEIs survey showed, for example, that four out of nine FE colleges mentioned that they found it difficult to integrate low carbon into the curriculum. Colleges that decided not to respond appeared to be particularly reluctant to discuss the low-carbon agenda. One respondent, during a telephone follow-up call, commented that our survey was too low carbon and eventually declined to complete it.

From a total of 27 London FE colleges, ten showed some signs of making a transition to delivering some vocational courses with relevant low-carbon content in construction and building services engineering by April 2011. Interestingly, this number corresponds to the number of FE respondents to our survey.

There wasn't evidence of any significant gearing up to delivering short courses and training on a scale to match the needs for the up-skilling of the existing workforce in low carbon technologies and construction methods **(see Table 17 on page 19)**.

Existing competencies and skills, and intentions in acquiring further competencies and skills in low carbon technologies in both F/HEIs followed mainly the growth and the expected increase in demand for solar technologies **(Tables 7 and 8, pages 54 and 55)**.

The Further Education sector appears to be particularly affected by the climate of uncertainty in demand, the transition to a new qualification framework, the process of development and accreditation of new courses and the qualifications it will be expected to deliver to support the transition to a low-carbon skills agenda. Our findings suggest this impact is amplified by the fact that:

- Relationships between industry and the education sector, particularly the Further Education sector, are not yet fit to generate the knowledge-transfer processes required to support the innovation and sustained knowledge transfer processes required for the mainstreaming of low carbon construction and building services engineering
- The model of engagement of FE colleges with the community and industry is still fundamentally one in which colleges are:
  - 'delivery channels' for courses and qualifications rather than engaged in technology innovation

- Focused on delivering vocational courses but not geared to provide customised training responsive to the needs of businesses and the up-skilling of a large existing workforce
- Maintaining arms-length relationships with the business community driven by an employer engagement process that seeks to deliver apprenticeships
- Market followers and not market leaders in technologies.

- Initiatives in knowledge transfer undertaken by the HE sector are prone to fragmentation and discontinuities due to the project-based nature of the work and funding streams.

7.2.1 Policy and the Knowledge-Transfer Context in FE/HE Sector

Since 2008, substantial changes have been taking place in the institutional landscape and policy drivers surrounding the skills sector. A reorganisation of the Sector Skills Councils (SSCs) as employer-led organisations, under the leadership of the Department of Business, Innovation and Skills (BIS), has been accompanied by the gradual commissioning of the National Skills Academies.

In the construction and building services engineering sector, there have been recent developments that will hopefully provide a stronger impetus and better physical and partnership infrastructure to support knowledge transfer in the London Boroughs. In the last week of January 2010, the Construction Skills NSA Training Centre opened its new premises at Becton Park in East London with (financial) support from JCB, LSC (SFA) and the LDA. Much of the impetus in knowledge transfer was generated by public works as, for example, this Academy's projects included participation in initiatives under the Building for Schools Programme (Newham BSF, Lewisham BSF and Southwark BSF), the development of the Olympic sites and social housing schemes in Kings Cross and Camden.

Our case study (Section 6.1) on the ***National Skills Academy for Environmental Technologies*** at the College of North West London also points to the recent nature of development in creating the knowledge centre and knowledge-transfer networks intended to stimulate and support the low carbon agenda in the construction and building services engineering sector. This NSA was commissioned early in 2011. The case study illustrates its drivers and missions but it is still too premature to evaluate its impact in reaching the large number of London small and micro employers depicted in our sample and in harnessing their commitment to making the low-carbon agenda a reality.

Therefore, to date, the drive for knowledge transfer and the low-carbon agenda has been driven by large, mostly public-funded, flagship projects. The model cannot be applied to fragmented smaller retrofit projects that need to be undertaken across the capital to move to a low-carbon future. Additionally, the impact of these urban initiatives in driving and achieving the learning, skills and low-carbon planned outcomes is still debatable. In the case of the London Olympic site, this certainly did not meet the originally planned renewable energy target. Darren Johnson, Chairman of the London Assembly's Environment Committee, pointed out with regret that the Olympic Park would only produce 9% of its energy use from renewables compared to the originally planned 20%. ***(Renewable Energy Magazine, last accessed online on 19 April 2011).***

The transition to embedding low carbon into courses and qualifications has also come in the midst of policy changes. In November 2010, the government's Skills for Sustainable Growth announced a radical reform of adult learning and skills to continue throughout the rest of the current parliament. From January 2011, the existing National Qualification Framework (NQF) has been replaced by the new Qualification & Credit Framework (QCF) after a long transition period that started with a first QCF set of tests and trials between 2006 and 2008. Our research shows very little evidence of vocational courses appearing under the new regime in college prospectus until late March/early April 2011. The courses have been slow to develop and come on stream. Added to this, there is the lingering uncertainty as regard to the introduction of FE loans from 2013/2014 to cover the cost of courses at intermediate and higher level skills ***(see DECC, December 2010, p.6)***. This level of systemic change and institutional reorganisation creates a deep climate of uncertainty that does not favour foresight and commitment in endeavours and relationship building.

As shown in our review of education and training in section 4.4.3, many of the QCF courses with relevant low-carbon technology content listed on the LAD are very recent and only about to be operationalised. Some college course advice telephone lines were not able to give information on the QCF status of their courses without referring to more senior management.

Delivery of apprenticeships is not currently a viable proposition as an isolated strategy for supporting the mainstreaming of low-carbon technologies and construction methods as the target must extend within the remit of lifelong learning projects.

Institutional and policy changes, a transformation in markets and environmental pressures (in the form of carbon targets) carry multiple sets of drivers and expectations that will require a change in individual mind-sets and organisational culture, in other words leadership.

8. Recommendations

The implementation of the low-carbon agenda is still in early growth and, therefore, government policy has an essential role to play in supporting the development of its markets and the networks and partnerships to support knowledge transfer between F/HEIs and the large number of London SMEs in the London construction and building services engineering sector.

Policy

There is a need to increase policy incentives to stimulate the mainstreaming of low-carbon technologies and low-carbon construction and support demand for low carbon solutions in retrofitting of buildings. Our findings would suggest there is a need for:

- A co-ordinated strategic approach to policy design and implementation between central and regional governments
- A clarification of forthcoming legislation (e.g. Green Deal)
- The preparation of a communication strategy to deliver clear concise messages to the wider public on opportunities with easy-to-use information.

Policy initiatives, such as the Green Deal, will require flexibility to enable effective implementation in varied local contexts.

As indicated in Section 7.1.2 the privately rented sector is a source of concern. Most of the dwellings in this sector are unlikely to be tackled as part of existing initiative. There is no regulatory pressure to ensure that private landlords take appropriate measures to meet minimum energy efficiency standards. It is unrealistic to leave it to the tenant to demand energy efficiency improvements and motivate retrofitting of the dwellings they occupy.

- Alternative and/or additional regulatory measures should be considered to ensure compliance to energy efficiency standards in the (London) privately rented sector to remedy the potential shortcomings of the Green Deal.

There have been a number of reports and recommendations emerging from the Energy Savings Trust that highlight barriers to the development of the market for micro-generation technologies that should be taken into consideration.

FE Sector

There is a need for an effective sustained knowledge-transfer strategy to take on the challenges of up-skilling the existing workforce in the construction and building services engineering sector to mainstream low-carbon solutions in the sector.

Arms-length, ad hoc interaction with businesses will not create the conditions to develop the dynamic knowledge transfer competencies and capabilities required to engage in the process of innovation required to support the sector to make a transition to a low-carbon future.

FE institutions need to adopt a new model of engagement based on long-term dynamic strategic relationships and partnership building with local businesses and the community focused on delivering strategic solutions. This change of strategic orientation required is highlighted in the MITIE case study.

Therefore, the leadership position required to support the mainstreaming of low carbon in this sector, will require:

- A shift from the arms-length traditional model of engagement to a strategic community and customer-oriented model fit for the mixed economy in which it now has to operate. This includes:
  - Developing an engagement process based on dynamic, long-term strategic relationships

with businesses to deliver customised training solutions, as well as engage in innovation
- Shift from being a 'channel of delivery' for courses and qualifications to becoming engaged in knowledge transfer to inform the design and development of new courses and qualifications. In the case of low-carbon technologies and the construction sector, an approach to industry/employers' engagement primarily focused on apprenticeships will yield only limited opportunities particularly with SMEs in this sector
- Taking a pro-active role in technology development whenever possible and opting for a leadership rather than a market follower position
- Supporting low-carbon environmental awareness raising programmes in the communities.

HE Sector

- Overcome the fragmentations of initiatives and discontinuities between projects
- Ensure project-to-project learning to optimise efforts and investment in current project-based initiatives that are still dominating the development of the low-carbon market in the construction and building services engineering sector
- Feedback experiences of knowledge transfer to policy-makers
- Develop Life Long learning network that are sector based and task focused
- Establishing continuity and progression between FE and HE.

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Annex 1 – Case Study Templates

POWERING EDUCATION : ENRICHING LIVES

Skills for Climate Change

Case Study Template

The Skills for Climate Change programme is seeking examples of good practice as well as lessons learned from issues encountered in knowledge-transfer activities between Further Education/Higher Education institutions and businesses in the construction and building services engineering sector, to support these businesses to achieve the level and quality of knowledge and skills required to meet the challenges of low-carbon construction.

We need a housing stock fit for the demands of tomorrow. The vast majority of the buildings we have today will still be with us in 2050. Yet the UK has committed to a reduction of 80% on CO_2 emissions against 1990s levels. What we have to achieve in less than a decade is phenomenal. There is much pressure on businesses in the construction and building services engineering sector to deliver stringent targets in making an ageing housing stock fit for the demand of a low, if not zero, carbon future.

We want to hear about your experience. We need to share our learning process.

Email: michelle.medhat@thenef.org.uk.
Tel: 0208 7863677

Creation details *All fields are mandatory.*

Author	
London Borough	
Date Completed	
Name of Company or FE/HE Institution	
Low-carbon construction / building services engineering	
Word count (minimum - 400, maximum - 1500)	
Have all materials (i.e. the case study, images and supporting files of evidence) been copyright cleared via a signed permission form? (If yes, enter the number of permission forms that have been submitted with this case study, along with the names of the individuals from the institution who have signed them.)	
File names of images submitted to accompany this case study and copyright information	
File names of supporting files of evidence submitted with this case study and copyright	
Case study title	<institution's name here>: <title here>
Summary (Enter summary of case study – one paragraph of approximately 80 words)	
About <institution's name here>	
The challenge (what was the aim of this knowledge-transfer activity or the difficulty that you were aiming to overcome by engaging in this activity?)	
The activity	
The outcomes	
The impact (This should ideally include advice and tips for other companies, providers/institutions.)	
Useful links	
Links to related case studies	
Disclaimer	*The Skills for Climate Change programme may refer to specific products, processes or services. Such references are examples and are not endorsements or recommendations and should not be used for product endorsement purposes.*

NEWHAM COLLEGE LONDON

MAYOR OF LONDON

London Capital Colleges

European Union
European Social Fund
Investing in jobs and skills

Annex 2 – Case Templates Written Permission Form

POWERING EDUCATION : ENRICHING LIVES

Skills for Climate Change

Written Permission Form

Case study ref: _____

Thank you for agreeing to help with this case study.

We need your permission in order for us to use and save any material produced from your participation in this research project (e.g. photographs, audio recordings, video recordings).

Please confirm your agreement to the following questions by inserting your initials in the boxes:

1. I have understood the information that I have been given about this case study.	
2. I agree to be interviewed as part of the case study and to have this used by the Skills for Climate Change programme and the New Engineering Foundation	
3. I agree to be videoed, recorded and/or photographed as part of the project and to this material being used to create a case study for the Skills for Climate Change Programme.	
4. I agree to allow the content supplied in support of this case study to be used in the production of a London Knowledge Transfer Directory to be distributed to businesses in the construction and building services engineering sector. Copyright of these materials will remain with myself (or my organisation).	
5. I agree that any materials produced (e.g. images, video and audio recordings) showing my participation in this project can be used in materials published by partners from the Skills for Climate Change programme.	
6. I agree that any material produced from my participation in this research project will become copyright of the New Engineering Foundation and I understand this could be used in its publicity material and future publications.	

Please indicate which of the following personal details (if any) you allow to be used in any published material by inserting your initials in the boxes:

Your full name	
Your job role	
Your email address	
The name of the institution you work for	

Name: _____

Signed: _____ Date: _____

Annex 3 – Knowledge-transfer Process Checklist

The knowledge-transfer checklist provides a basic framework for those who wish to reflect on, or wish to guide, their first steps in setting up a knowledge transfer initiative.

1. Knowledge transfer initiative • The challenge: name and description
2. Assessment of need • Evidence suggesting need for KT initiative
3. Capacity building goal(s) • How does this initiative/programme relate to a partnership's or a network's mission using their individual and collective resources and expertise, to advance (a) high quality, co-ordinated KT programme(s)?
4. Intended outcome(s) • What outcomes does the initiative intend to achieve in the short and long term? • Who are the intended beneficiaries of the KT initiative or programme?

Initiative
Purpose Establishing a consensus on the intention and goals of the initiative will guide the development of the content, the method of delivery and the way in which the initiative is evaluated. For example, tacit knowledge is likely to require more 'face–to–face' interaction; a knowledge-transfer initiative that drives an innovation process (product or process), will require partnership building and a close technology exchange/working process.
1. Exchange driven: is the initiative focused on sharing explicit knowledge or providing information?
2. Innovation driven: is the initiative focused on sharing and developing knowledge, on the transfer of tacit knowledge, and/or on innovation in implementation by the intended audience?
Adoption readiness How transferable and adoption-ready is the content of the initiative in order to create opportunities to customise the way in which it will be shared? Addressing the specific needs and experiences of the audience enhances receptiveness to the content, increasing the likelihood of the mobilisation and utilisation of its knowledge content.
3. Compatibility: how compatible is the content (e.g. information, ideas, innovation) with current values, beliefs and practices?
4. Relative advantage: will the audience view the content as better than current practice? In what way?
5. Degree of complexity: will the audience find it easy to put to use the information and knowledge provided in this initiative? What are the likely barriers to acquisition, absorption and utilisation of this knowledge?
6. Demonstrability: Have the benefits of the innovation been demonstrated? (examples etc)
7. Degree of risk: what are the risks and how will risk associated with adoption of new knowledge be mitigated?
8. Scope for innovation: Is there opportunity for the adopter to 'innovate' to meet specific needs?

Target Audience(s)
Target audience(s) can have a fairly wide range of previous knowledge and experience operating in a variety of contexts in which they will aim to apply the information and knowledge imparted in the initiative. Audiences may demonstrate varying degrees of openness to change and innovation, as well as a varying willingness and ability to adopt new knowledge. Audiences depending on their tendencies/learning types will have different requirements to acquire, absorb and operationalise the information and knowledge presented to them. Audiences will also vary in their stages of the decision-making process related to the adoption of new knowledge (technology) and processes. The decision stage of the audience will matter for the content and the delivery method so that it is non-threatening and developmentally appropriate
1. Targeted audiences: who are they?
2. Adopter types: Is (are) the audience(s) eager to try new ideas, open to change, willing to take risks, well-networked and innovative (i.e. more likely to be early adopters)? Conversely, who is cautious, risk-averse, more of a 'follower'? Who is resistant to change, who may resist and/or oppose new knowledge and ideas?
3. Learning types: is (are) the targeted audience(s) more likely to learn by sharing experience, learn by observation, or through conceptualisation (with analytical orientation to learning) or active experimentation (practical application of ideas – hands-on activities)?
4. Modes of interaction: is (are) the targeted audience(s) likely to require face-to-face contact, seek opportunities for mutual learning (working together), or networked interactions (opportunities to sustain information and exchange) etc?
5. Stage in decision-making: Is (are) the targeted audience(s) only seeking information not yet aware of the content at all or are holding incorrect or out-dated information? Have audience members already made a conscious decision to adopt the information/knowledge/ideas and engage in change and innovation? Are audience members ready to move to take on the practicalities of implementation and innovation? Are audience members already using new knowledge and innovating, adapting new knowledge and skills?

Organisational & Inter-Organisational Context
The organisational context sets the stage for the process of knowledge transfer, the acquisition, absorption and implementation (use) of new knowledge and skills. Partnership/network-building to support the knowledge transfer process requires careful consideration to ensure commitment, diversity and complementarity of resources and efforts.
1. Clear vision and a strategy: outcomes-focused.
2. Commitment, diversity and complementarity: engineered diversity in network membership or in choice of partners to ensure commitment, stimulate variety and complementarity in competencies and skills required to respond to projects requirement and audiences needs in order to reach desired outcomes.
3. Leadership: clear leadership for the partnership/network and in the partnership member organisations (project owners).
4. Action plan: a detailed plan of action with goals and intentions and allocated responsibilities.
5. Risk assessment: contingencies.
6. Committed resources: Human resources, technical resources and financial support are adequate to support knowledge-transfer initiative and follow up.
7. Documentation and communication strategy: Documentation and dissemination processes are in place to communicate with audience and sponsors/stakeholders (if and when applicable).
8. Monitoring: Key performance indicators agreed and in place to report project progress.
9. Evaluation

Annex 4: Table 5

Competences and Skills in Low-carbon Technologies and Building Methods					Table 5
Combined results for FE/HE Institutions	**Not something we do**	**Basic knowledge and skills insufficient for delivering business services & courses**	**Elementary level of competencies and teaching skills to deliver some KT activities & courses**	**Good level of competencies and teaching skills to engage in most KT activities & training**	**We are expert in this field and can fully engage in all KT activities**
Energy sources: Solar thermal	3	1	2	1	7
Energy sources: Heat pumps	4	1	1	2	5
Energy sources: Micro-hydro generation	5	1	1	3	3
Energy sources: Solar photovoltaic	3	1	1	1	6
Energy sources: Micro-wind generation	4	1	1	4	2
Legislation/ standards: BREEAM certification and the Energy Act 2008	3	1	2	7	1
Legislation/ standards: Building Regulations	2	2	2	5	3
Legislation/ standards: Code for Sustainable Homes	4	1	1	7	1
Energy use reduction: Low-energy appliances	3	1	3	4	2
Energy use reduction: Low-Energy lighting	4	2	1	4	2
Energy use reduction: Design for solar gain	5	1	2	3	2
Energy use reduction: Mechanical heat recovery	5	2	1	2	2
Energy loss reduction: Achieving air tightness	6	1	1	2	1
Energy loss reduction: Insulation techniques and methods	4	1	3	4	1
Energy loss reduction: Water recycling	2	2	1	5	3

Annex 4: Table 6

Current Low-carbon Competencies and Teaching Skills in HE					Table 6
Current competencies in HE	**Not something we do**	**Basic knowledge and skills insufficient for delivering business services & courses**	**Elementary level of competencies and teaching skills to deliver some KT activities & courses**	**Good level of competencies and teaching skills to engage in most KT activities & training**	**We are expert in this field and can fully engage in all KT activities**
Energy sources: Solar thermal	1	0	0	0	5
Legislation/ standards: Building regulations	0	2	1	2	1
Energy loss reduction: Water recycling	0	1	0	3	1
Energy sources: Solar photovoltaic	1	0	0	0	4
Legislation/ standards: BREEAM certification and the Energy Act 2008	0	1	1	4	0
Energy sources: Heat pumps	1	1	0	0	3
Legislation/ standards: Code for Sustainable Homes	1	1	0	4	0
Energy use reduction: Low-energy appliances	0	1	1	2	2
Energy sources: Micro-hydro generation	1	0	0	2	3
Energy use reduction: Low-Energy lighting	1	1	0	1	2
Energy sources: Micro-wind generation	1	0	0	2	2
Energy loss reduction: Insulation techniques and methods	1	1	0	2	1
Energy use reduction: Design for solar gain	1	1	0	2	2
Energy use reduction: Mechanical heat recovery	1	1	0	1	2
Energy loss reduction: Achieving air tightness	1	1	0	1	1

Annex 4: Table 7

Current Low-carbon Competencies and Teaching Skills in FE					Table 7
	Not something we do	Basic knowledge and skills insufficient for delivering business services & courses	Elementary level of competencies and teaching skills to deliver some KT activities & courses	Good level of competencies and teaching skills to engage in most KT activities & training	We are expert in this field and can fully engage in all KT activities
Energy Sources: Solar thermal	2	1	1	1	2
Legislation/ standards: Building regulations	2	0	1	3	2
Energy loss reduction: Water recycling	2	1	1	2	2
Energy sources: Solar photovoltaic	2	1	1	1	2
Legislation/ standards: BREEAM certification and the Energy Act 2008	3	0	1	3	1
Energy sources: Heat pumps	3	0	1	2	2
Legislation/ standards: Code for Sustainable Homes	3	0	1	3	1
Energy use reduction: Low-energy appliances	3	0	2	2	0
Energy sources: Micro-hydro generation	4	1	1	1	0
Energy use reduction: Low-energy lighting	3	1	1	3	0
Energy sources: Micro-wind generation	3	1	1	2	0
Energy loss reduction: Insulation techniques and methods	3	0	3	2	0
Energy use reduction: Design for solar gain	4	0	2	1	0
Energy use reduction: Mechanical heat recovery	4	1	1	1	0
Energy loss reduction: Achieving air tightness	5	0	1	1	0

Annex 4: Table 8

Expected Progression in Acquiring Knowledge and Resources in Low-carbon Technologies and Sustainable Construction					Table 8
Combined results for FE/HE institutions	No intention to acquire competencies in this area	Buying in competencies and teaching capabilities to deliver courses & services on an ad hoc basis	Intend to recruit staff to increase competencies & teaching capabilities	Have competencies & teaching skills but need help to develop services & courses	Have competencies and building partnerships with industry to develop services & courses
Energy sources: Solar photovoltaic	3	2	5	2	3
Energy sources: Solar thermal	3	2	4	2	3
Energy loss reduction: Water recycling	3	3	3	3	2
Energy sources: Heat pumps	3	2	3	2	3
Energy use reduction: Mechanical heat recovery	3	3	3	2	2
Energy loss reduction: Insulation techniques and method	4	2	3	2	1
Energy use reduction: Low energy lighting	4	2	3	2	1
Energy use reduction: Low energy appliances	4	2	3	2	1
Energy Sources: Micro-hydro generation	5	2	3	2	1
Energy loss reduction: Achieving air tightness	5	1	3	2	1
Legislation/ standards: Building regulations	4	1	1	3	2
Legislation/ standards: Code for Sustainable Homes	4	1	1	3	2
Energy Sources: Micro-wind generation	5	2	1	3	1
Energy use reduction: Design for solar gain	4	2	2	2	1
Legislation/ standards: BREEAM certification and the Energy Act 2008	4	2	1	2	3

Annex 4: Table 14

Educational and Training Services Offered to Young Learners, Adult Learners and Businesses Seeking to Up-Skill their Workforce							Table 14
	Total number of ticks for this subject	CPD	e-learning	Short courses	Work-based learning (including apprentice-ships)	Academic courses	Vocational courses
Energy sources: Solar thermal	24	5	3	4	0	5	7
Energy sources: Solar photovoltaic	23	4	4	3	0	5	7
Energy sources: Heat pumps	22	4	3	4	0	5	6
Energy sources: Micro-wind generation	20	4	3	3	0	5	5
Energy sources: Micro-hydro generation	12	2	1	0	0	5	4
Energy loss reduc-tion: Achieving air tightness	19	4	3	2	0	5	5
Energy loss reduc-tion: Insulation techniques and methods	21	4	3	2	0	5	7
Energy loss reduction: Water recycling	20	5	2	2	1	6	4
Energy use reduc-tion: Low-energy lighting	17	4	2	1	0	5	5
Energy use reduc-tion: Low-energy appliances	16	3	2	1	0	5	5
Energy use reduc-tion: Design for solar gain	12	2	1	0	0	5	4
Energy use reduc-tion: Mechanical heat recovery	16	3	2	1	0	5	5
Legislation/stand-ards: Building Regulations	21	3	2	3	0	5	8
Legislation/stand-ards: Code for Sus-tainable Homes	18	3	2	2	0	5	6
Legislation/stand-ards: BREEAM cer-tification and the Energy Act 2008	17	3	2	2	0	5	5
Total number of ticks for this course type		53	35	30	1	76	83

Annex 4: Table 15

Educational and Training Services Offered by FE Colleges in Low carbon							Table 15
	Total FE Ticks	CPD	e-learning	Short courses	Work-based learning (including apprentice-ships)	Academic courses (PhD, MSc/ MA/MPhil/ BSc/BA)	Vocational courses
Energy sources: Solar thermal	14	3	2	4	0	0	5
Energy sources: Solar photovoltaic	13	3	2	3	0	0	5
Energy sources: Heat pumps	13	3	2	4	0	0	4
Energy Sources: Micro-wind generation	11	3	2	3	0	0	3
Energy Sources: Micro-hydro generation	3	1	0	0	0	0	2
Energy loss reduc-tion: Achieving air tightness	10	3	2	2	0	0	3
Energy loss reduc-tion: Insulation techniques and methods	12	3	2	2	0	0	5
Energy loss reduction: Water recycling	7	3	1	1	0	0	2
Energy use reduc-tion: Low-energy lighting	8	3	1	1	0	0	3
Energy use reduc-tion: Low-energy appliances	7	2	1	1	0	0	3
Energy use reduc-tion: Design for solar gain	3	1	0	0	0	0	2
Energy use reduc-tion: Mechanical heat recovery	7	2	1	1	0	0	3
Legislation/stand-ards: building regulations	12	2	1	3	0	0	6
Legislation/stand-ards: Code for Sus-tainable Homes	9	2	1	2	0	0	4
Legislation/stand-ards: BREEAM cer-tification and the Energy Act 2008	9	2	1	2	0	0	4
	Total FE Ticks	36	19	29	0	0	54

FE-HE College's Vocational Courses with at Least One Unit Targeted at Low-carbon Construction and a Building Services Engineering Area of Knowledge and Skill

Table 18

College	Course Title	Level	Duration	Relevant Content	Date (if given)	Awarding Body
Barking and Dagenham	BTEC Higher National Certificate in Construction	5	2 years: one day or two evenings per weekand a short Saturday block	Environmental Science	Sep 2011	Edexcel
	BTEC National Certificate Construction	4	Part time 2 years for 1 day per week	Construction and the Environment	Sep 2011	Edexcel
	First Diploma in Built Environment	2	1 year, full time	Construction Technology and Design	Sep 2011	Edexcel
	National Diploma in Construction	3	Full-time for 3.5 days a week	Construction Science and Materials	Sep 2011	Edexcel
	National Award in Construction	3	Part time 1 year for 1 day per week	Construction and the Environment	Sep 2011	Edexcel
Bromley	Extended Diploma in Construction & the Built Environment	3	2 years, 3 days a week	Construction and the Environment	Sep 2011	Edexcel
	Diploma in the Built Environment	3	2 years, 1 day a week	Construction and the Environment	Sep 2011	Edexcel
City of Westminster	National Certificate in Building Services Engineering (Electrical Installation)	3	2 years (approximately 10 hours, 1 day a week)	Sustainable Construction	Sep 2011	Edexcel
	National Certificate in Building Services Engineering (HVAC)	3	2 years (approximately 10 hours, 1 day a week)	Sustainable Construction	01/09/2011	Edexcel
	National Certificate in Civil Engineering	3	2 Years	Construction and the Environment	Sep 2011	Edexcel
Epping Forest	Diploma in Construction	2	1 year	Sustainability in the construction industry	Sep 2011	Edexcel
Havering	Diploma in Construction	3	72 Weeks	Construction and the environment, science and materials in construction; construction technology and design in construction; building technology in construction	Sep 2011	Edexcel
Kensington and Chelsea College	Certificate in Construction	1	6 weeks	Environmental awareness unit	Nov 2011	Edexcel
Lambeth	Construction and the Built Environment: OCNLR Access to Higher Education Diploma	Higher Education Diploma	1 year, 14 hours a week	Construction techniques and sustainability unit	Sep 2011	OCNLR

College	Course Title	Level	Duration	Relevant Content	Date (if given)	Awarding Body
Lewisham	HNC Building Studies	Higher national Certificate	2 years, 7.5 hours a week	Construction technology & environmental design unit	Sep 2011	Edexcel
	Extended in Diploma Construction	3	36 weeks, 13 hours a week	Sustainable construction unit	Sep 2011	Edexcel QCF
	Diploma in Construction	3	36 weeks, 8 per week	Sustainable construction unit	Sep 2011	Edexcel
	Subsidiary Diploma in Construction	3	36 weeks, 8 hours a week	Sustainable construction unit	Sep 2011	Edexcel QCF
	Construction and Built Environment 14 - 16	Higher Diploma	36 weeks, 6 hours per week	Sustainability unit	Sep 2011	City and Guilds
South Thames	Construction	4	2 years, full time	Includes environmental science and building science	Sep 2011	Edexcel
	BTEC National Certificate in Construction	3	Full time	Includes construction and the environment	05/09/2011	Edexcel
	Plumbing - Heating & Ventilation Installation	2		Includes rain-water harvesting	05/09/2011	City and Guilds
Richmond-Upon- Thames	Access to Building Services Engineering	1	1 year, full time	Includes environmental awareness, building services engineering science as mandatory units	Sep-11	City and Guilds QCF
	Construction and the Built Environment	4	2 years, 1 day a week	Includes environmental impact of construction projects	14-Sep-11	Edexcel
	Construction and the Built Environment	3	2 years, 1 day a week	Includes sustainable construction	16-Sep-10	Edexcel
	Construction and the Built Environment	3	2 years, full time	Includes science and materials in construction	Sep-11	Edexcel
	Electrical and Electronic Engineering	4	2 years, 1 day a week	Includes advantages and disadvantages of alternating [sic] energy sources	14-Sep-10	Edexcel
	Mechanical Engineering Diploma	3	2 years, 1 day a week	Includes environmental and sustainability requirements	16-Sep-10	Edexcel
	Operations and Maintenance Engineering BTEC Diploma - Level 3	3	2 years, 1 day a week	Includes environmental and sustainability requirements	16-Sep-10	Edexcel

QCF Qualifications Applicable to Low-carbon Technologies, Energy Efficiency and Sustainable Construction Listed in the Learning Aims Database (LAD) — **Table 19**

Title	Awarding Body	Level	Start Date	Course Duration (Hours)	SSAs
Certificate in Energy Advice (Home)	ABBE	3	01-Sep-10	282	5.2 Building and Construction
Award in Energy Advice (Renewables)	ABBE	4	01-Apr-11	40	7.3 Service Enterprises
Award in Sustainability and the Renewables Industry	ABC	2	01-Sep-10	30	3.4 Environmental Conservation
Certificate in Sustainable Energy	ABC	2	01-Sep-10	165	3.4 Environmental Conservation
Award in Converting Biomass into Fuel and Energy	ABC	2	01-Sep-10	55	3.4 Environmental Conservation
Award in Sustainable Energy	ABC	3	01-Oct-09	60	3.4 Environmental Conservation
Certificate in Sustainable Energy	ABC	3	01-Oct-09	160	3.4 Environmental Conservation
Diploma in Sustainable Energy	ABC	3	01-Oct-09	280	3.4 Environmental Conservation
Award in Converting Wind into Energy	ABC	2	01-Sep-10	75	3.4 Environmental Conservation
Diploma In Electrical Power Engineering – Wind-Turbine Maintenance (Technical Knowledge)	City & Guilds	3	01-Feb-11	581	4.1 Engineering
Award in the Installation and Maintenance of Water Harvesting and Re-use Systems	City & Guilds	3	01-Nov-10	95	5.2 Building and Construction
Award in the Installation of Water Harvesting and Re-use Systems	City & Guilds	3	01-Nov-10	65	5.2 Building and Construction
Award In Energy Awareness	City & Guilds	3	01-May-11	28	7.3 Service Enterprises
Award In Renewable Energy in the Home	City & Guilds	3	01-May-11	30	7.3 Service Enterprises

Title	Awarding Body	Level	Start Date	Course Duration (Hours)	SSAs
NVQ Diploma in Electrical Power Engineering - Wind Turbine Operations and Maintenance	City & Guilds	3	01-Feb-11	408	4.1 Engineering
Award in the Installation and Maintenance of Heat-Pumps Systems (Non-refrigerant Circuits)	City & Guilds	3	01-Nov-10	95	5.2 Building and Construction
Award in the Installation and Maintenance of Solar Thermal Hot-Water Systems	City & Guilds	3	01-Nov-10	95	5.2 Building and Construction
Award in the Installation of Solar Thermal Hot-Water Systems	City & Guilds	3	01-Nov-10	65	5.2 Building and Construction
NVQ Diploma in Electrical Power Engineering – Wind-Turbine Operations and Maintenance	City & Guilds	2	01-Feb-11	452	4.1 Engineering
Award in the Installation of Heat-Pumps Systems (Non-refrigerant Circuits)	City & Guilds	3	01-Nov-10	65	5.2 Building and Construction
Award in the Installation and Maintenance of Small-Scale Solar Photovoltaic Systems	City & Guilds	3	01-Nov-10	95	5.2 Building and Construction
Award in the Installation of Small-Scale Solar Photovoltaic Systems	City & Guilds	3	01-Nov-10	65	5.2 Building and Construction
Award in the Installation of Water Harvesting and Re-use Systems	EAL	3	01-Nov-10	65	5.2 Building and Construction
Award in the Installation and Maintenance of Water Harvesting and Re-use Systems	EAL	3	01-Nov-10	95	5.2 Building and Construction
Award in the Installation of Heat-Pump Systems (Non-refrigerant Circuits)	EAL	3	01-Nov-10	65	5.2 Building and Construction
Award in the Installation of Small-Scale Solar Photovoltaic Systems	EAL	3	01-Nov-10	65	5.2 Building and Construction
Award in the Installation and Maintenance of Small-Scale Solar Photovoltaic Systems	EAL	3	01-Nov-10	95	5.2 Building and Construction
Award in the Installation and Maintenance of Solar Thermal Hot-Water Systems	EAL	3	01-Nov-10		5.2 Building and Construction

Title	Awarding Body	Level	Start Date	Course Duration (Hours)	SSAs
Award in the Installation of Solar Thermal Hot-Water Systems	EAL	3	01-Nov-10	65	5.2 Building and Construction
Award in Water Efficiency in the Workplace	Edexcel	2	01-Feb-11	12	15.3 Business Management
Award in Controlling Resource Efficiency (Water)	Edexcel	3	01-Feb-11	60	15.3 Business Management
Award in Managing Resource Efficiency (Water)	Edexcel	4	01-Feb-11	60	15.3 Business Management
Award in Managing Resource Efficiency (Energy)	Edexcel	4	01-Feb-11	60	15.3 Business Management
Award in Energy Efficiency in the Workplace	Edexcel	2	01-Feb-11	12	15.3 Business Management
Award in Controlling Resource Efficiency (Energy)	Edexcel	3	01-Feb-11	60	15.3 Business Management
NVQ Diploma for the Installation of Photovoltaic Panels	GQA	2	01-Apr-11	178 Min- 243 Max	5.2 Building and Construction
Award in Sustainable Concrete	MPQC	4	01-Aug-10	27	4.2 Manufacturing Technologies
Award in Sustainable Development	NCFE	1	01-Mar-10	40	14.1 Foundations for Learning and Life

With thanks to:

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