# contents

## Main report
- Executive Summary: 2
- 1.0 Introduction and background: 10
- 2.0 Project actors: 14
- 3.0 Findings: 17
- 4.0 Actions: 18

## Appendices
- Appendix A – Literature Review & Bibliography: 24
- Appendix B – Online Survey: 32
- Appendix C – Workshop information: 41
- Appendix D – Key Project Actors: 48
Executive Summary

The Green Construction Board (GCB) commissioned Sweett Group to investigate the knowledge and skills challenges to deliver sustainable outcomes in the built environment. Low carbon and low energy outcomes for buildings and structures are needed to achieve the Government’s future Carbon Budgets.

This project has examined both the supply and demand sides of the knowledge and skills (K&S) for low energy/low carbon projects; as well as considering the challenges and barriers of the various actors in the Construction and Property sector.

Our research has included a comprehensive literature review, input from an external education specialist, an online survey, stakeholder workshops and in-depth interviews with supply side organisations.

The findings are split into three themes: key actors who have influence on outcomes, demand of knowledge & skills from industry and the supply of knowledge & skills.

1.0 Influencers

Who are they? Where are the biggest gaps? Who needs to know what?

All of the actors across a building’s lifecycle where assessed based on the research activities above. A group of project actors (highlighted in bold in the below table) were identified through the study to have the greatest influence over low carbon / energy outcomes.

Clients have the earliest and highest influence over low carbon / energy outcomes in the built environment

Quantity Surveyor project role can demonstrate the value of low carbon / low energy approaches and embed the metrics to set targets and measure outcomes.
Of the Key Actors - Who needs to know what?

**Investor / Fund Manager**
- Energy efficient / low carbon buildings command a higher premium / less risk than their peer group
- Impact on asset value and risk of targeting a low carbon / energy strategy

**Client / Developer**
- Engage your supply chain partners early in your decision making process, by setting targets for sustainable performance and measure performance
- Develop and implement a business plan that addresses environmental, social and economic aspects
- Up-skill your own competence on sustainability issues

**Asset Manager**
- Energy consumption profile of buildings within portfolio
- Options to improve energy efficiency during refurbishment / maintenance.
- Cost-benefit analysis of each energy saving option

**Architect**
- Principles of low carbon design and refurbishment
- Legislative standards, regulations and guidance (CfSH, BREEAM, etc)
- Goals for energy efficiency and measurement (KPIs)
- Products and materials
- The anticipated effects of climate change

**Quantity Surveyor**
- Whole-life / lifecycle costing
- How to cost, explain and influence sustainable interventions decisions
- BIM-based project delivery
- Current and future legislation and building control regulations
Where is the gap?

In order to identify the gaps in knowledge and skills relating to low carbon, the survey asked respondents to identify from all actors in a building’s life cycle those with the largest gaps in low carbon knowledge and skills.

Of the key factors identified in the study, Client/Developer and Investor/Fund Manager where seen has having the largest gaps in knowledge and skills.

45% of responses said
Client/Developers

4 of the 6 key influencers where in the top 5 of the surveyed professions with the largest gaps in knowledge and skills on low carbon/energy

- Current and future legislative & regulatory requirements
- Advantages and use of sustainable products and materials
- Trade-specific installation techniques that ensure sustainable outcomes
- Understanding for other trades, so holistic advice is given
- Knowledge-transfer techniques for domestic clients (i.e. how to run the equipment, maintenance regimes, etc)
2.0 Demand of Knowledge & Skills

What is the industry saying about demand? What are the barriers? What industry-wide factors are there?

“Generally although most people express an interest in the low carbon aspects of the design, they misunderstand it completely and unless it is mandatory if it is an additional expense on CAPEX it gets taken out during value engineering”

“BREEAM excellence is sought without too much thought for the actual management of the building once occupied carbon is not factored in. The emphasis is on energy because they understand this. Many on the delivery end are unclear about carbon because they don’t understand it”

“...energy and carbon is low on the priority list and is for ‘ticking boxes’ only”

“...in today’s market few clients other than those who have a policy of pursuing a green agenda require schemes to achieve the minimum standards and no more”

We identified a number of barriers facing the actors and preventing them from taking action on carbon and energy outcomes on their projects, these included:

<table>
<thead>
<tr>
<th>Actors</th>
<th>Barriers</th>
</tr>
</thead>
</table>
| Client / Developer     | • Insufficient time devoted to learning  
                          • Lack of data (e.g. benchmarks) to make informed decisions  
                          • Unsure what to ask for to deliver low carbon / energy buildings (i.e. target setting) which in turn restricts demand within the industry |
| Investor / Fund Manager| • No evidence of enhanced value premium / lower risk discount  
                          • Lack of understanding of the business case to invest in higher efficiency options |
| Asset Manager          | • Limited influence on low carbon/energy outcomes during the design stage of refurbishment/maintenance projects      
                          • Lack of understanding of the business case to invest in higher efficiency options  
                          • No consistent energy management approach  
                          • Lack of training for communication/ business case skills |
| Architect              | • Higher education teaching outdated or minimum current requirements  
                          • Ability to persuade client to adopt higher sustainability standards  
                          • Lack of understanding and ability to communicate the business case for low carbon to client |
| Quantity Surveyor      | • Disconnection between degree course content and RICS competencies  
                          • Current practice focuses more on capital costs and less on whole-life, which could produce better sustainable outcomes  
                          • Variable quality of CPD for sustainable outcomes  
                          • Sustainability is not mandatory past Level 1 APC (demonstrating knowledge)  
                          • Time to consider sustainability not factored into QS project role  
                          • Lack of comprehensive costs and impact on outcomes of sustainable technologies  
                          • Inadequate training on linking project costs to carbon / energy outcomes |
| Trade Contractor       | • Client knowledge (especially domestic clients) of rationale and business case (and sources of funding)  
                          • Funding for entry-level qualifications is scarce, hard to find and not focussed on green skills  
                          • For small contractors, training is considered unaffordable and as “wasted” time without income  
                          • Perception that specialist knowledge on sustainable techniques must be guarded, not shared, for commercial advantage  
                          • Sector is fragmented with many bodies, Sector Skills organisations and training providers  
                          • Gaps in knowledge of how different project trades or project roles fit together to achieve sustainable outcomes  
                          • Lack of skills for specifying and installing equipment such as smart meters, Building Management Systems, solar panels, heat pumps, CHP, district heating or cooling |
In addition to the actor-specific information, some high-level findings evolved from the investigation into the demand of knowledge and skills. These factors span the whole industry regardless of actor and education level and are shown below.

### The Business Case
- Low carbon / energy outcomes are not seen as essential to the construction industry and its market
- **Business Case information** and evidence is inconsistent and not widely available at key project decision points
- Business case for low carbon / energy outcomes must be better **incorporated at design stages**
- **Refurbishment and life cycle decision miss opportunities** for low carbon / low energy outcomes

### Metrics and responsibility
- **No consistent way to measure** carbon / energy outcomes
- Limited or no responsibility or **requirement to measure** carbon / energy

### 3.0 Supply of Knowledge & Skills

**Who is supplying the knowledge and skills? Where are the weaknesses in the supply of K&S?**

The landscape review of the current knowledge and skills supply was identified as coming from 8 main streams of education from school through to professional training. The below figure highlights 6 of the main streams our identified key actors come into contact with more frequently.

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**Key actor breakdown of education undertaken**

<table>
<thead>
<tr>
<th>Key Actor</th>
<th>Further Education</th>
<th>Higher Education</th>
<th>CPD</th>
<th>On-the-job training - Informal</th>
<th>On-the-job training - Formal</th>
<th>Professional Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client/ Developer</td>
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<tr>
<td>Investor/Fund Manager</td>
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<tr>
<td>Trade Contractor</td>
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<tr>
<td>Asset Manager</td>
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<tr>
<td>Architect</td>
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<tr>
<td>Quantity Surveyor</td>
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</tbody>
</table>

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Page 6 of 58
More than 60% of respondents had undertaken: Higher Education; CPD; On-the-job training (informal); On-the-job training (formal)

On-the-job informal training was the most undertaken form of education/training after school, whilst also having the greatest level of influence over their work.

The quality of education and training in all of these streams was consistently found to have gaps in their carbon and energy offerings. Evaluating the quality of the supply alongside this identification of where it is currently coming from allowed the study to present its key supply side findings.

**Key Findings**

**Education failure** means that content around low carbon /energy is inconsistently developed in a vacuum.

- There is little contact between the educational suppliers and the Industry demanding.
- There is little inter-discipline education where consistent content is used across different education departments (e.g. finance, engineering, energy, architecture)

**Lack of high quality sustainability education** for 14 to 19 year olds

Specific GCSE subjects lack course content with regards to sustainability in the built environment

- Design technology
- Geography
- Science
- Citizenship

**Variable quality of CPD**

Professional training is the least regulated supply of information and as a direct result leads to the greatest variability of quality.
### 4.0 Actions

Below is a summary of the key actions to improve the knowledge and skills of the Construction and Property sector with the proposed owners. Full details of the actions identified in this study are included in the main report.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Engage supply &amp; demand of knowledge and skills</strong>&lt;br&gt;● Develop an improved mechanism for engagement between supply and demand sectors. University and CPD providers need stronger links to industry</td>
<td>Professional bodies (RICS, ARB, RIBA), Sector Skills bodies, HE providers, FE institutions</td>
</tr>
<tr>
<td><strong>2. Business Case</strong>&lt;br&gt;● Define the business case for low energy / carbon and use this to drive demand&lt;br&gt;● Engage with Industry bodies to define and promote the business case&lt;br&gt;● Define and embed the business case in higher education&lt;br&gt;● Define and embed the business case in Professional Qualifications</td>
<td>Government, HE providers, FE institutions, RICS, CPD Providers</td>
</tr>
<tr>
<td><strong>3. Awareness</strong>&lt;br&gt;● Promote sustainability within schools and colleges&lt;br&gt;● Promote low carbon / energy training to Trades Contractors&lt;br&gt;● Sector Trade Bodies to increase awareness of green skills&lt;br&gt;● Set up a specific sector skills council for clients&lt;br&gt;● Government to act as best practice ‘client’</td>
<td>School Examination Boards, Government, Sector Skills</td>
</tr>
<tr>
<td><strong>4. Resources</strong>&lt;br&gt;● Develop high quality built environment sustainability lessons&lt;br&gt;● Produce high quality education resources&lt;br&gt;● Information Hub</td>
<td>School Examination Boards, Government, Sector Skills</td>
</tr>
<tr>
<td><strong>5. Professional Standards</strong>&lt;br&gt;● Embed low carbon / energy outcomes in each part of degree course&lt;br&gt;● Teach QS to become sustainability leader on projects&lt;br&gt;● Adjust skills training to cover low energy / carbon&lt;br&gt;● Professional bodies to promote Sustainability in QS learning&lt;br&gt;● Periodic re-accreditation of sustainability skills&lt;br&gt;● Implement a minimum CPD sustainability learning requirement&lt;br&gt;● Create mandatory, assessed CPD modules that focus on low carbon / energy outcomes&lt;br&gt;● Provide focussed Sustainability CPD for QS</td>
<td>Sector Skills bodies, HE providers, Professional bodies (RICS, ARB, RIBA), CPD Providers</td>
</tr>
<tr>
<td><strong>6. Measurement</strong>&lt;br&gt;● Consistent metrics&lt;br&gt;● Policy level measurement requirement</td>
<td>Government</td>
</tr>
</tbody>
</table>
1.0 Introduction and background

1.1 Overview

The built environment requires a comprehensive range of knowledge and skills if it is to meet the challenge of transitioning to a green economy and achieve Government ambitions for carbon reduction and more sustainable buildings. However, the knowledge and skills required to meet upcoming sustainability challenges are diverse and specialised. The current and aspiring workforce need support to understand how their role contributes to the delivery of low carbon outcomes and the specific knowledge, skills and tools required. It is therefore important to understand if the current learning needs of stakeholders are being met and what is required to meet future expectations. This is critical to future-proof the industry against rapidly changing demands and expectations.

The Green Construction Board (GCB) commissioned Sweett Group to investigate the knowledge and skills challenges to deliver sustainable outcomes in the built environment.

The project brief identified the following specific aims, summarised as follows:

- Map the current Knowledge & Skills landscape within the UK Construction & Property sector
- Identify the key challenges, barriers and critical issues up to 2025
- Recommend priority actions and responsibilities

The scope of the study was to include:

- ALL levels of education (14-19 to lifelong learning)
- ALL actors in the built environment lifecycle
- ALL phases of the built environment lifecycle
- ALL sectors of the industry (civil, domestic, non-domestic)
- ALL types of structures (new-build / existing)
- England, Scotland and Wales.

Education and training is required now to ensure the right future skills are in place, not just for those recently leaving school or university but also for existing professionals and trades-people. Further, clients need to understand the influence they have and how to set sustainability targets for their projects. In addition, they need certainty that their supply chains can meet and surpass their requirements to the desired quality and within the cost budget available.

It is important to remember that knowledge and skills can be acquired via many routes, including formal education, training, Continuing Professional Development (CPD) and informal on-the-job training. This project considered how each of these approaches could be deployed to address critical skills and knowledge gaps and where specific action needs to be undertaken.

1.2 Defining the outcome

The project brief asked that the research considered the gap in the knowledge and skills of ‘environmental sustainability’ in the built environment in relation to specific actors. Environmental sustainability covers a broad range of topics, including energy, water, waste and materials. In particular, energy and carbon is a key area from a policy, legislative and corporate perspective and the focus will become more intense as the Government aims to meet its carbon budgets. A substantial programme of work is required to hit these targets and the industry needs the right skills for all stakeholders involved at each stage of the built environment lifecycle. The GCB’s Low Carbon Routemap
sets out the policy actions to be implemented for the domestic, non-domestic and infrastructure sectors and the scope of this project and this report have been narrowed to support the ambition to achieve a low carbon outcome rather than environmental sustainability in its broadest sense. The focus of this report is therefore on the awareness and knowledge of low carbon / energy requirements rather than the skills needed to comply with environmental legislation (e.g. pollution, waste) and broader sustainability requirements (biodiversity etc).

Before commencing the project research activities, the term ‘low carbon’ was clearly defined to represent industry best practice as follows:

- Low whole life carbon – the combination of low embodied (or ‘capital’) carbon and ‘regulated’ operational carbon.
- Low energy consumption, measured primarily in kWh/m².
- Actual performance meeting design expectations – performance gap.
- Minimised unintended consequences and ‘re-bound effect’.
- User satisfaction.
- Effective handover and commissioning (e.g. soft landings).

The performance gap is a major issue that needs to be addressed, both for new build and retrofit. Addressing this gap can reduce emission “leakage”, reduce the carbon rebound effect, improve the returns from retrofit initiatives, reduce risk and give greater confidence to investors/owners. Faster reduction would also enable cumulative emissions of the built environment to be reduced (recommendation of the GCB Low Carbon Routemap for the UK Built Environment, 5 March, 2013).

Using this scope to define the emissions within the built environment, a baseline emissions profile was developed for the years 1990 to 2010. This analysis shows the built environment (as defined in the Routemap) was responsible for almost 210 MtCO₂e of emissions in 1990 and just over 190 MtCO₂e in 2010. The breakdown of these emissions in 2010 is shown in Figure 1.1.

**Figure 1.1: Breakdown of carbon emissions in the built environment (2010)**
1.3 Skills requirements to 2025

The GCB Low Carbon Routemap sets out the following key policy initiatives to achieve the Government’s future Carbon Budgets:

- Zero carbon for domestic (from 2016) and non-domestic (from 2019).
- CRC energy efficiency scheme (phase IV).
- Green Deal implementation.
- Smart metering roll-out 2014 to 2019.

These initiatives will dictate the upskilling required across the built environment between now and 2025 and will involve a variety of roles across the property lifecycle. For example, the target for zero carbon buildings will be achieved if clients, consultants, contractors and their supply chains have sufficient knowledge and skills in place and can work collaboratively to achieve the desired outcome.

1.4 Our approach

We looked at current and future training requirements / provision of the demand and supply side to investigate issues of market failure. Figure 1.2 below sets out the approach taken.

Figure 1.2: Approach to project

The following paragraphs look at aspects of our approach in greater detail.

1.5 Summary of our work

This project has examined both the supply and demand sides of the knowledge and skills for low energy/low carbon projects; as well as considering the challenges and barriers of the various actors in the Construction and Property sector. Our work gained wide input from industry stakeholders to help identify principal project actors, knowledge and skills gaps and barriers and priority actions. The main activities of this project are shown below with hyperlinks to the relevant section of the report.
**Literature review** – 130 papers, policies, and other documents reviewed containing information about the extent of knowledge and skills in relation to sustainable design and construction. We gained input from an external education specialist to help develop the actions to influence the knowledge and skills gained at school by all actors in the built environment. The overview analysis of the literature review and bibliography are shown in Appendix A.

**Web survey** – 269 responses across a wide variety of Built Environment roles and seniority. Questions helped to identify the actors with the greatest influence and the greatest knowledge and skills gaps. The results and analysis from the web survey are shown in Appendix B.

**Workshops** – two workshops (one internal and one external) with a total of 20 participants with experience of domestic and non-domestic projects, of small and large scale. The sessions helped to explore the challenges faced by the key actors involved in projects and identified the barriers to them taking action. Conclusions from the workshops such as, the key actors, the largest gaps and the potential actions to address these, helped inform this report and a summary of the outputs from the external workshop are shown in Appendix C.

**Consultation** – 25 depth interviews with supply side organisations to identify recommendations and test practicality of implementation.

Once actors were prioritised (those with high influence and large knowledge gaps), a detailed review was carried out to establish the drivers, knowledge and skills required and typical education route of each of the actor groups. This analysis led to a number of findings on the knowledge and skills of those actors at different levels of their education.

Other, more high-level findings evolved from the work, which span the whole industry regardless of actor and education level. In total, 5 key high-level findings have been identified, followed by 6 specific findings relating to each of the 6 priority actors.

From each of the findings, specific recommendations were developed to address the identified knowledge and skills gaps for the built environment as a whole and for specific project actors. These recommendations can be found in tabular format in section 4.0. This actions table will be a standalone document and it is hoped that this will be used by the GCB and other relevant stakeholders to implement effective changes to the industry.
2.0 Project actors

2.1 Identifying key actors

Based on the research activities undertaken as outlined in previous sections, a group of project actors were identified that were perceived to have the most influence over low carbon / energy outcomes and those with the greatest gaps in associated knowledge / skills. The table below summarises how the key actor group was identified from the research undertaken.

Figure 2.1: Identification of key actors

<table>
<thead>
<tr>
<th>Actor</th>
<th>Literature</th>
<th>Survey (Influence)</th>
<th>Survey (Gaps)</th>
<th>Workshop</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investor</td>
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<tr>
<td>Client</td>
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<tr>
<td>Developer</td>
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<tr>
<td>Asset manager</td>
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<td>Architect</td>
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<td>Building surveyor</td>
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<td>Quantity surveyor</td>
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<td>Town planner</td>
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<td>Building Services Engineer</td>
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<tr>
<td>Other engineer (e.g. Civil)</td>
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<td>Project manager</td>
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<td>Principal contractor</td>
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<td>Trade contractor</td>
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<tr>
<td>Manufacturer</td>
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<td>Facilities manager</td>
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<td>Agent</td>
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<td>Sustainability / environmental consultant</td>
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<tr>
<td>Other specialist consultant</td>
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<tr>
<td>Building performance evaluator</td>
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</table>

A review of each of the above highlighted actors follows in section 5 comprising a detailed examination of the required knowledge and skills for each role, associated knowledge and skills gaps, barriers and specific actions to address issue. This is preceded by a contextual look at the possible impact on CO₂ emissions from the built environment with reference to the GCB Low Carbon Routemap.
2.2 Quantifying the impact of different actors on CO₂ emissions

To address CO₂ in an effective manner it is important to target the actors who have the most influence (on low carbon / energy outcomes) and the biggest gaps in knowledge and skills.

To demonstrate the potential scale of impact, the survey results were used to notionally apportion the total domestic and non-domestic CO₂ emissions in 2010 between each actor. For example, the ‘client’ received most responses to the question of who had the largest influence over low carbon / energy outcomes and so the total CO₂ emissions of 184.6 MtCO₂ was apportioned accordingly.

The chart below shows the key actors have a notional influence on almost 50% of total emissions, therefore effective targeting of initiatives and actions to up-skill these groups will yield significant savings.

The scale of this reduction can be viewed in Figure 2.2 below in relation to the GCB Low Carbon Routemap 2010 and 2022 scenarios.

The position of the solid bubbles represents the current level of knowledge and influence the different actors have. The size of the solid bubble represents the influence the actor has on carbon emissions in 2010. The size of the transparent bubble represents the amount of carbon each actor should be responsible for in order to meet 2022 carbon targets. The position of the transparent bubble represents how much each actor will need to increase their knowledge and awareness in order to achieve the necessary carbon reduction. This has been based on subjective review\(^1\) and represents industry’s opinion of the ability to improve the knowledge + skills gap for each actor.

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\(^1\) The size and position of the bubbles are directly related to the knowledge / influence of each actor. This is based on the feedback from the survey, workshop and other engagement activities.
Figure 2.2: Estimated influence of each actor on carbon in 2010 and objective for 2022.
3.0 Findings

A detailed review was carried out on the prioritised actors (those with high influence and large knowledge gaps) in order to establish the drivers, knowledge and skills required and typical education route of each of the actor groups. This analysis led to a number of findings on the knowledge and skills of those actors at different levels of their education.

Other, more high-level findings evolved from the work, which span the whole industry regardless of actor and education level. In total, 5 key high-level findings have been identified, followed by 6 specific findings relating to each of the 6 priority actors.

<table>
<thead>
<tr>
<th>No.</th>
<th>Finding</th>
<th>Actor Affected</th>
<th>Target Education Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Market failure (supply side)</strong> means that educational content around low carbon / energy is inconsistently developed in a vacuum</td>
<td>All</td>
<td>Higher Education CPD</td>
</tr>
<tr>
<td>2</td>
<td><strong>Market failure (demand side)</strong> means that low carbon / energy outcomes are not seen as essential</td>
<td>All</td>
<td>Higher Education CPD, On-the-Job training (informal)</td>
</tr>
<tr>
<td>3</td>
<td><strong>No consistent way to measure</strong> carbon / energy outcomes</td>
<td>All</td>
<td>CPD, once measures are agreed</td>
</tr>
<tr>
<td>4</td>
<td>Limited or no responsibility or <strong>requirement to measure</strong> carbon / energy</td>
<td>All</td>
<td>CPD, once measures are agreed</td>
</tr>
<tr>
<td>5</td>
<td><strong>Lack of high quality sustainability education</strong> for 14 to 19 year olds Specific GCSE subjects lack course content with regards to sustainability in the built environment  - Design technology  - Geography  - Science  - Citizenship</td>
<td>All</td>
<td>School, Further Education</td>
</tr>
<tr>
<td>6</td>
<td><strong>Clients have the earliest and highest influence</strong> over low carbon / energy outcomes in the built environment</td>
<td>Client</td>
<td>CPD</td>
</tr>
<tr>
<td>7</td>
<td><strong>Business Case information and evidence is inconsistent</strong> and not widely available at key project decision points</td>
<td>Investor / Fund Manager</td>
<td>Higher Education Professional Qualifications CPD</td>
</tr>
<tr>
<td>8</td>
<td><strong>Business case for low carbon / energy outcomes must be better incorporated at design stages</strong></td>
<td>Architect</td>
<td>Higher Education Professional Qualifications CPD</td>
</tr>
<tr>
<td>9</td>
<td><strong>Refurbishment and life cycle decision miss opportunities</strong> for low carbon / low energy outcomes because the business case is not well understood</td>
<td>Asset Manager</td>
<td>Higher Education Professional Qualifications CPD</td>
</tr>
<tr>
<td>10</td>
<td><strong>Quantity Surveyor project role can demonstrate the value of low carbon / low energy approaches and embed the metrics to set targets and measure outcomes</strong></td>
<td>Quantity Surveyor</td>
<td>Higher Education Professional Qualifications CPD</td>
</tr>
<tr>
<td>11</td>
<td><strong>Small Trades Contractors have high levels of influence in the domestic sector</strong></td>
<td>Trades Contractor</td>
<td>Further Education Professional Qualifications CPD</td>
</tr>
</tbody>
</table>
### 4.0 Actions

Figure 4.1 below summarises the actions arising from our analysis of the project actors as well as overarching issues for action that emerged during our research including stakeholder engagement, landscape review, and steering group input. These actions have been grouped by themes and listed with details of their owner and the impact such action would have. More information regarding the actors and the specific knowledge and skills barriers and gaps can be found in Appendix D.

**Figure 4.1 Overall actions**

<table>
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<tr>
<th>Action</th>
<th>Actor</th>
<th>Education level</th>
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<tbody>
<tr>
<td><strong>Engage supply &amp; demand of knowledge and skills</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Develop an improved mechanism for engagement between supply and demand sectors. University and CPD providers need stronger links to industry. University and CPD teaching of low carbon / energy outcomes must be integrated – embedded information – not in a silo.</td>
<td>All</td>
<td>Higher Education CPD</td>
<td>• Professional bodies (RICS, Architects Registration Board, RIBA, Sector Skills bodies) • HE providers • FE institutions • Apprenticeship bodies</td>
</tr>
<tr>
<td><strong>Business Case</strong></td>
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<tr>
<td>2</td>
<td>Define the business case for low energy / carbon and use this to drive demand: Ensure actors understand the business case for low energy / carbon outcomes. Suggested routes: • Mentoring project teams &amp; soft engagement • Embed low c/e into company policy • Voluntary agreement &amp; campaign • Information Hub – signposting to training, knowledge sharing and evidence base • Support / provide practical, project-focused training resources to staff / supply chain linked to metrics</td>
<td>All</td>
<td>Higher Education CPD On-the-job training (informal)</td>
<td>• Government</td>
</tr>
<tr>
<td>3</td>
<td>Engage with industry bodies to define and promote the business case:</td>
<td>Client Investor Professional Qualification CPD</td>
<td>Higher Education</td>
<td>• Government • Higher Education Providers • RICS • CPD Providers</td>
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<td>Action</td>
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<tr>
<td>4 Define and embed the business case in higher education:</td>
<td>Investor / Fund Manager, Asset Managers</td>
<td>Higher Education</td>
<td>Higher Education Providers</td>
<td>Development of investment asset class for projects with high levels of carbon / energy interventions. Investment returns encourage more Investors / Fund Managers to gain knowledge in low carbon / energy for competitive advantage. Business case for low carbon / energy becomes more compelling to clients as the ability of advisors increases. Understanding of the business case allows projects to take advantage of opportunities in the refurbishment and life cycle decisions to deliver low carbon / energy outcomes. A step-change in carbon / energy outcomes as generational transitions occur.</td>
</tr>
<tr>
<td>5 Define and embed the business case in Professional Qualifications:</td>
<td>Investor / Fund Manager</td>
<td>Professional Qualification</td>
<td>RICS</td>
<td>Understanding of the business case allows projects to take advantage of opportunities in the refurbishment and life cycle decisions to deliver low carbon / energy outcomes.</td>
</tr>
<tr>
<td>6 Promote sustainability within schools and colleges: Create a higher profile for sustainability and the built environment in schools and colleges.</td>
<td>All</td>
<td>School Further Education</td>
<td>Ofsted Examination boards</td>
<td>Students would see the construction industry as part of the solution to achieving sustainability. Engage the next generation in a more sustainable future for the industry. Students see the construction industry as part of the solution to the problem of climate change. A step-change in carbon / energy outcomes as generational transitions occur. From the BTEC those at all levels of the industry would have an understanding of sustainability. Reliable, high quality resources for education of 14 to 16 year olds including for specific GCSE courses such as: Design Technology, Geography, Science and Citizenship.</td>
</tr>
<tr>
<td>7 Promote low carbon / energy training to Trades Contractors:</td>
<td>Trades Contractors</td>
<td>Further Education Professional Qualification CPD</td>
<td>Government</td>
<td>Trades contractors become conversant and fluent with the business case for carbon / energy issues and can present these to clients. Actions for low carbon / energy outcomes that a trades contractor can undertake within their specialty become the default approach. Wider benefits begin to emerge when contractors link their default approaches on projects. Takes advantage of the high levels of influence trade contractors have in the domestic sector.</td>
</tr>
<tr>
<td>8 Sector Trade Bodies to increase awareness of green skills: Carry out an awareness campaign of green skills and the commercial opportunities in popular magazines or merchants (e.g. Screwfix catalogue, events at wholesale merchants, etc)</td>
<td>Trades Contractors</td>
<td>Further Ed. Professional Qualification CPD</td>
<td>Sector Skills Bodies</td>
<td>Low carbon / energy considerations become a default consideration for all small trades projects.</td>
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<td>Action</td>
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<tr>
<td><strong>9</strong> Set up a specific sector skills council for clients&lt;br&gt;Recommended by previous studies</td>
<td>Client</td>
<td>CPD</td>
<td>Sector Skills Bodies</td>
<td>• Engagement and dialogue helps to hone the key issues in the business case and focuses development of evidence in this direction&lt;br&gt;• Low carbon / energy knowledge helps client to develop commercial advantage</td>
</tr>
<tr>
<td><strong>10</strong> Government to act as best practice ‘client’&lt;br&gt;• Set and achieve minimum standards to lead by example&lt;br&gt;• Promote best practice&lt;br&gt;• Adopt whole life approach to carbon and cost</td>
<td>Client</td>
<td>CPD</td>
<td>Government</td>
<td>• Successful projects encourage clients to incorporate low carbon / energy approaches as a required minimum in new projects&lt;br&gt;• Engagement and dialogue helps to hone the key business case issues and focuses development of evidence in this direction</td>
</tr>
</tbody>
</table>

**Resources**

**11** Develop high quality built environment sustainability lessons<br>Develop a series of high quality lessons focused on sustainability and the built environment. This should include a focus on the learning opportunity at a time when schools have their own building projects. Lessons should be promoted to schools through commercial websites, local authorities and other commissioning bodies as well as through social media (e.g. as demonstrated during the London 2012 Olympic games with the same principle adopted for Cross Rail and HS2). Produce examples of best practice from a small number of schools focused on the built environment to be promoted and published by Ofsted and replicated by other schools. <br>

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<tbody>
<tr>
<td>Client</td>
<td>School Further Education</td>
<td>Ofsted Examination boards</td>
<td>Industry bodies and organisations</td>
<td>• High quality materials on sustainability would be used by teachers across all schools. Websites like TES Connect and TeachIT have over 600,000 lessons and are visited by thousands of teachers each week.&lt;br&gt;• Built environment careers attract a more diverse cohort with higher levels of base knowledge of carbon / energy issues&lt;br&gt;• Gradual increase of projects with minimal and latterly, higher, levels of carbon / energy outcomes as influence of cohort increases</td>
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</table>

**12** Produce high quality education resources<br>Industry bodies and organisations in the built environment should be encouraged to produce high quality education materials for use in schools. Appropriate organisations include: RIBA (Sustainability Hub), Ellen Macarthur, Foundation, Green Construction Board, Constructing Excellence, Institute of Civil Engineers, Trade Associations (e.g. Federation of Master Builders), Construction Industry Council, Centre for Alternative Technology, 3rd sector bodies and Universities. Illustrate that many roles within the built environment influence sustainable outcomes and are available to people with different interests and qualifications. Link having low carbon / energy skills to job prospects via vocational or academic routes.<br>

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<th>Action</th>
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</thead>
<tbody>
<tr>
<td>Client</td>
<td>School Further Education</td>
<td>Industry bodies and organisations</td>
<td>Government</td>
<td>• Consolidated information helps convince clients of need to incorporate low carbon / energy measures&lt;br&gt;• Engagement and dialogue helps to hone the key issues in the business case and focuses development of evidence in this direction&lt;br&gt;• Successful projects encourage clients to incorporate low carbon / energy approaches as a required minimum in new projects</td>
</tr>
</tbody>
</table>

**13** Information Hub:<br>Establish an ‘Information Hub’ to ensure that relevant information is readily available and cover topics such as:<br>• Impact of current and proposed legislation<br>• Relevant technical, management, soft skills training<br>• Data sources/evidence base<br>• Establishing the business for action and consideration of whole life costing principles<br>• Best practice case studies / lessons learnt

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<tr>
<td>Client</td>
<td>CPD</td>
<td>Government</td>
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<td>Action</td>
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<tr>
<td><strong>14.</strong> Embed low carbon / energy outcomes in each part of degree course: Introduce specific modules on business case, metrics and post project evaluation for low carbon outcomes. Soft skills to concentrate on: Leadership, Management, Communication, Negotiation, Influencing</td>
<td>Architect</td>
<td>Higher Education</td>
<td>Higher Education Providers</td>
<td>Specialist professionals emerge for low carbon / energy refurbishment projects. Gradual increase of projects with minimal (and latterly, higher) levels of carbon / energy outcomes as influence of cohort increases. Creative solutions for low carbon / energy design emerge. A step-change in carbon / energy outcomes as generational transitions occur.</td>
</tr>
<tr>
<td><strong>15.</strong> Teach QS to become sustainability leader on projects: Degree courses must adjust focus of QS courses to guide students on how the QS can be a project leader in encouraging sustainable methods / materials through, for example: Making the business case via a building economics focus on whole-life costing (see also Asset Managers recommendation) Linking carbon and energy to whole-life costs Establishing outcome metrics for asset performance, based on materials and construction method Soft skills to concentrate on: Communication, Negotiation, Team working, Collaboration, Professional writing, Environmental awareness.</td>
<td>Quantity Surveyor</td>
<td>Higher Education</td>
<td>Higher Education Providers</td>
<td>Quantity Surveyors become involved at early project stages and influence the business case, carbon / energy metrics and measurement and outcomes. QS role expands to lead and co-ordinate cost effective carbon / energy measures from all project team members.</td>
</tr>
<tr>
<td><strong>16.</strong> Adjust skills training to cover low energy / carbon: Education / training providers or Built Environment Sector Skills Councils and Awarding Organisations should: Update relevant knowledge and competence qualifications (within current QCF/SCQF/CQFW frameworks) related to construction and building services engineering to include low carbon/energy learning outcomes. Offer specialist apprenticeships for low carbon / energy skills Achieve a better connection of supply and demand issues via national skills strategies Implement a skills component to be included in any built environment project to increase competency</td>
<td>Trades Contractor</td>
<td>Further Education Professional Qualification CPD</td>
<td>Sector Skills bodies</td>
<td>Specialist role of Domestic Project Carbon / Energy Integrator emerges. Specialist Apprenticeships help Small Trades Contractors to engage with Principal Contractors and win work. Take advantage of the high levels of influence trade contractors have in the domestic sector.</td>
</tr>
<tr>
<td><strong>17.</strong> Professional bodies to promote Sustainability in QS learning: RICS - mandatory sustainability to APC Level 2 (knowledge and application) Raise awareness of the role QS’ can play in delivering more cost effective, sustainable projects Promote Sustainability skills as a ‘value add’ not a distraction from main bulk of work</td>
<td>Quantity Surveyor</td>
<td>Professional Qualification</td>
<td>RICS</td>
<td>Low carbon / energy issues are built in as-standard to project procurement and commercial negotiations. Detailed evidence on costs of low carbon / energy materials, construction methods and outcomes is gathered for Information Hub, future business cases and improvements in the sector.</td>
</tr>
<tr>
<td><strong>18.</strong> Periodic re-accreditation of sustainability skills: Professional qualifications (RIBA) Soft skills to concentrate on: Leadership, Management, Communication, Negotiation, Influencing</td>
<td>Architect</td>
<td>Professional Qualification</td>
<td>Higher Education Providers</td>
<td>RIBA</td>
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<td>Action</td>
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<tr>
<td>19. Implement a minimum CPD sustainability learning requirement:</td>
<td>Investor/ Fund Manager</td>
<td>CPD</td>
<td>RICS, BIFM</td>
<td>Investors and Asset Managers see compelling arguments for financial gains in projects with low carbon / energy elements, CPD helps existing practitioners to develop ways to discuss and convince clients to incorporate low carbon / energy measures, Creative solutions for low carbon / energy design emerge, A step-change in carbon / energy outcomes as generational transitions occur.</td>
</tr>
<tr>
<td>RICS &amp; BIFM to set a minimum requirement for CPD learning to include sustainability, specifically, the low carbon business case. Content could include:</td>
<td>RICS</td>
<td>BIFM</td>
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<td>• Whole life cycle costing</td>
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<td>• Return – financial and non-financial</td>
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<tr>
<td>20. Create mandatory, assessed CPD modules that focus on low carbon / energy outcomes:</td>
<td>Architect</td>
<td>CPD Professional Qualification</td>
<td>Higher Education Providers, CPD Providers, RICS, BIFM</td>
<td>Additional techniques and evidence are developed to support the refurbishment business case, Business case for low carbon / energy becomes more compelling to clients as the ability of advisors increases, CPD helps existing practitioners to develop ways to discuss and convince clients to incorporate low carbon / energy measures, Specialist professionals emerge for low carbon / energy refurbishment projects, Gradual increase of projects with minimal (and latterly, higher) levels of carbon / energy outcomes as influence of cohort increases.</td>
</tr>
<tr>
<td>• RICS – FM competency Level 2 Sustainability to be a mandatory competency for FM and Commercial Property APC and to specifically teach the low carbon business case (see outline content below)</td>
<td>RICS</td>
<td>BIFM</td>
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<tr>
<td>• BIFM – Low carbon business case education a mandatory requirement at all BIFM qualification levels</td>
<td>BIFM</td>
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<tr>
<td>Soft skills to concentrate on: Leadership, Management, Communication, Negotiation, Influencing</td>
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<tr>
<td>21. Provide Sustainability CPD for QS:</td>
<td>Quantity Surveyor</td>
<td>CPD</td>
<td>CPD Providers</td>
<td>Quantity Surveyors become involved at early project stages and influence the business case, carbon / energy metrics and measurement and outcomes, QS role expands to lead and co-ordinate cost effective carbon / energy measures from all project team members, Low carbon / energy issues are built in as-standard to project procurement and commercial negotiations.</td>
</tr>
<tr>
<td>• Develop specific, short-length, assessed, courses to assist a newly qualified QS to bridge the gap between knowledge and practice</td>
<td>Quantity Surveyor</td>
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<tr>
<td>• Develop short seminar sessions focused on funding mechanisms for sustainable construction</td>
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**Measurement**

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<tr>
<td>22. Consistent metrics:</td>
<td>All</td>
<td>CPD, once measures are agreed</td>
<td>Government</td>
<td>Meaningful measurement of operational and embodied carbon / energy, Meaningful assessment of carbon / energy trends becomes possible, Targeted policy level interventions are developed, Eliminates confusion over multiple metrics of carbon / energy.</td>
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<tr>
<td>Develop industry-wide metrics for the consistent measurement of operational and embodied carbon and energy:</td>
<td>All</td>
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<tr>
<td>• Compulsory reporting</td>
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<tr>
<td>• Supported by tools and training</td>
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<tr>
<td>• Suggest: kWh per m² but this needs confirmation</td>
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<tr>
<td>23. Policy level measurement requirement:</td>
<td>All</td>
<td>CPD, once measures are agreed</td>
<td>Government</td>
<td>Meaningful measurement of operational and embodied carbon / energy, Meaningful assessment of carbon / energy trends, Wide engagement between government, industry and academia to agree metrics and mechanisms, Effective interventions to encourage lower carbon / energy outcomes are achieved with less government expenditure, Places responsibility of low carbon / energy outcomes onto the industry.</td>
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<tr>
<td>Implement a policy level requirement for the consistent metric to be measured and reported:</td>
<td>All</td>
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<td>• by asset owner</td>
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<td>• to establish baseline</td>
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<td>• for an annual return</td>
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<td>• with an escalating fine for non-compliance</td>
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1. AQA (Assessment and Qualifications Alliance), CIE (University of Cambridge International Examinations), CCEA (Council for the Curriculum, Examinations & Assessment), Edexcel (Pearson Edexcel as of April 2013), ICAAE (International Curriculum and Assessment Agency Examinations), OCR (Oxford, Cambridge and RSA Examinations), WJEC (Welsh J joint Education Committee)
Appendices
1.1 Introduction

We reviewed more than 130 papers, policies, and other documents containing information about the extent of knowledge and skills in relation to sustainable design and construction. We extracted all relevant information and analysed this against the following dimensions:

- Built environment lifecycle stages
- Key project actors
- Education / training levels
- Information on supply or demand for education / training.

At a high level, a great deal of information, recommendations and action plans exist for producing low carbon / energy outcomes in the built environment from diverse authors as government, industry and academia. Information and evidence on knowledge, skills, gaps and barriers is less consistent and appears to be an emerging topic for study.

One strong finding arose from our analysis: gaps and barriers for clients is not a well-covered issue. While clients may rely on other project actors (such as architects) to produce low carbon / energy outcomes, it is likely that specifically addressing this area could produce informed clients whose projects attain better results.

1.2 Literature Review Summary

Below is a short summary of the key points from the Literature Review carried out.

**Demand**

**Demand for Sustainability**

There is currently a market failure in terms of delivering sustainable buildings (31). This is largely because there is a widespread view that energy efficient buildings are more expensive to construct (which is often but not always the case) (4). There are also a number of misconceptions about what sustainable buildings actually look like (28), as well as a lack of knowledge and skills required to deliver these outcomes effectively (22).

There is an increasing demand for sustainable working practices (1). This is set to continue as technology progresses and the market matures, meaning that cost implications are likely to reduce (31). It is important to establish ways of proactively anticipating and reacting to changing demand for training (32).

In order to improve the demand from organisations for employees/consultants to have the knowledge and skills to deliver low carbon/energy, the following are required:

- Policy and fiscal measures from government (31)
- Awareness of the importance and potential benefits of integrating low carbon skills into their businesses needs to be integrated, in order to change behaviour (31)
- Industry needs to be supported in making decisions – information needs to be made available (31)

**Demand for Education**

In a GBC survey in 2011, 20% of professionals stated that they were required to undertake sustainability training for their job. Almost all of the others expressed a strong interest in doing so. The most requested topic was management of resources, including carbon and energy (2).
**Current Knowledge and Skills**

Only 11% of employers in a survey conducted in 2011 stated that their employees have all the skills required to support the green agenda. 46% felt they had most, 41% some and 2% none. (1)

**Higher Education**

In many HE institutions, sustainability issues are treated like add-ons. This leads to students who think that sustainability is important but do not apply their knowledge and the tools currently available to assist them in achieving sustainability outcomes (15).

Students in many construction-related courses currently do not have enough engagement with other related courses. They are also not taught enough about other roles, so students lack an understanding of the overall construction process (4).

Some universities are not teaching students sustainability from up-to-date sources. Energy conservation topics, for example, still often refer to 2002 Building Regulations as their most recent source (4).

Generally there is not enough emphasis on retrofit knowledge in skills in degree courses (3).

- Arup forecasts show that there will be a shortage of sustainable development specialists in the future (17)

**Barriers**

**To achieving sustainable outcomes:**

- Skills and knowledge gaps (3)
- Insufficient information, advice and guidance for employers and consumers on sustainable technologies etc and their potential implications (3) (17). For example, it can be difficult to obtain up-to-date and precise evaluations of energy savings associated with new technologies (7)
- Fragmented policy, policy ‘U-turns’ and lack of an overarching coherent UK strategy in relation to green skills and jobs (has dented confidence within industry; concerns there is no longevity in the green agenda are preventing investment into training) (3)
- Organisational culture and risk aversion (17) (31)

**To organisations effectively up-skilling workforce:**

- Gaps in training provision (e.g. in relation to emerging technologies) and concerns around unaccredited and unregulated training courses (3)
- Resource constraints (time and money) (3) (17)
- Lack of awareness of skills needs and how to address them (18). Need to help employers have an awareness of the opportunities and their needs, so that they can start demanding these of training providers (31)
- Fast-developing area – skills need constantly updating (7)
- Organisational risk aversion, particularly in relation to labour turnover and risk of staff poaching (18)

**To integrating sustainability into university courses:**

- Insufficient amounts of reference material in the industry (4)
- Focus of research on narrow subject areas (4)
- Lack of involvement of professional bodies in driving change (11)
- Resistance from academic staff and lack of knowledge on their part (11) (21)
- Student backgrounds and preconceptions. Can be changed – education is generally perceived to be the most important factor in forming attitudes (11)
- Lack of communication between HE and industry (11) (23)
- Already-crowded curricula (14) (21)
**Current Provision**

There is not much literature on the current provision.

- The skills system has a greater focus on lower level skills (18). There is more government finance available for these.
- Funding mechanisms are often geared towards longer qualifications (32)
- There are good practice guides out there e.g. Housing Forum’s guide to improving sustainability in the housing and construction industry
- RICS has launched a campaign to heighten awareness and actual working knowledge of sustainability amongst their members due to the crucial role they play in shaping the built environment (31) [http://www.rics.org/Global/Building%20Control%20Journal/Sustainability_and_commercial_property_valuation_1st_edition_13072012_dw1.pdf](http://www.rics.org/Global/Building%20Control%20Journal/Sustainability_and_commercial_property_valuation_1st_edition_13072012_dw1.pdf)

**Gaps – Specific Skills Required**

Technical skills include:

- Energy monitoring, assessment and management
- Installation skills including:
  - ground and air source heat pumps;
  - solar thermal and solar PV
  - energy recovery, energy efficient cooling and shallow geothermal systems
  - biomass, combined heat and power and wind turbines
- Knowledge of policy and legislation
- Heat loss
- Air quality, air tightness and ventilation requirements within buildings (4) (20) (31).
- Knowledge of the range of energy efficiency measures, their relative benefits and their suitability for different building fabrics and ages
- Quality assurance specifically in relation to energy efficiency materials, measures and procedures;
- Refurbishment – identification of work to building elements which would make maximum impact (31)
- BIM as a tool to measure energy efficiency

Soft Skills (17): - all exist, just need to alter how they are utilised in order to ensure changes can be responded to (31) (32)

- Project management (17) (19) (22) (31) (32)
- Stakeholder management
- Leadership (17) (18) (31) (32)
- Teamwork (17) (19)
- Making things happen
- Conflict resolution
- Influencing and ‘selling’ (to stimulate demand for energy saving measures)

Also need:

- Assessing and addressing market conditions, funding and other constraints (17)
- Working in integrated teams (22)
- Understanding and awareness of the importance and potential benefits of integrating skills into organisation – crucial. Needs to be holistic and in-depth. Affects the way organisations think and operate on a day-to-day basis. Required in order to stimulate demand for skills and more effective skills implementation. (32)

Technical Skills can be grouped into subject areas (e.g. green infrastructure), procedures (e.g. sustainability appraisals) and specialist skills (e.g. GIS) (17)
Future

- The ‘upstream’ roles in a supply chain have the greatest opportunity to influence what is built, and the ‘downstream’ roles have responsibility for the success or failure of the end product (20). Education should focus on soft skills for the former and technical skills for the latter.

Future Shape of Sustainability Education

- Education needs to be holistic, interdisciplinary and focused on generic skills rather than specific (11) (14) (20) (2b). It must cover relationships with other professions. It must explore relationships between environmental, cultural, economic and social impacts of construction.
- Needs to be flexible to better suit the needs of the industry (16) and respond to changing educational needs (31)
- Need to promote education better, to ensure that employers and stakeholders can find out what training is required and how this can be accessed. (3)
- Need focus on longer term operation of buildings and their environmental impact during their lifecycle (10)

Blue collar workers:

- Should refine and expand existing courses rather than creating new ones. (3)
- Need to be more accredited courses to ensure high quality workmanship taught. (3) (16)
- Needs to be practical rather than theoretical. On-site is good. (3)

CPD

- Professional bodies should be encouraged to ensure that members keep up to date with technical and specialist skills (17). Accreditation should potentially be linked to regular CPD (16)
- Short courses are strongly preferred by professionals (17). Funding mechanisms are often geared towards longer qualifications (32)

Higher Education (& FE)

- Need to teach the principles of sustainability and then give students the skills to utilise their soft skills and follow changing requirements, technologies etc (14). Many specifics are likely to be out of date before students leave university, as it’s such a rapidly evolving field.
- All FE and HE courses should have more education about elements of the construction process not directly relevant (5)
- Should get students to do multi-disciplinary projects during course to encourage this way of working (11) (14)
- Use action learning (problem solving – discussing, planning, resolving and taking action) to encourage students to question and reflect (14)
- Integrate sustainability into all elements of all courses (14)
- Need to change culture, of both university staff and students (14)

Should incorporate the following:

- Understand the importance of life-cycle costing when evaluating systems
- Roles of all members of the project team in incorporating sustainability into the project

Schools

- More emphasis on STEM (science technology engineering mathematics) subjects to create a more competent foundation for the development of technical expertise (5) (31)
- Need to change attitudes about the attractiveness of STEM subjects and the opportunities these can lead to (31)
- Need more information on careers and low carbon (5)
- The sustainability/energy efficiency agenda should be taught in schools (16)
OTHER

Sustainable Procurement

- Sustainable procurement (development of more sustainable supply chains) can reduce risk, ensure customers receive value for money and reduce the impacts of supply chains on the environment. (1) (31) (32)
- Effective sustainable procurement requires managers to have better communication, tendering, procurement and contract management skills. (1)
- Best thing is for buildings to be procured in a way in which contractors are also responsible for ongoing maintenance (4) (28)
- Projects have suffered from lack of knowledge in low carbon procurement (6)
- The government engaging in low carbon procurement can also help increase the demand for low carbon goods and increase the emphasis on low carbon (31)
- Need to re-write procurement code to incorporate sustainability (32)

How to Integrate Sustainability into HE (more info in (14))

- Need to change culture, of both university staff and students (14)
- Need to get senior buy-in (14) (21)
- Used academic champions to engage with staff (14)
- Ensured sufficient resourcing so staff could work on integration (14)
- Did module audits to work out where integration could occur (14)
- Need to tailor to HE institution (21)
- Addition of non-compulsory elective module (21)
- Encourage universities to collaborate and share ideas (21) (23)

In addition to improving knowledge and skills:

- Need clearer definition of sustainability terminology (16)
- Need clear, reliable information on the actual energy and carbon performance of recently constructed or refurbished buildings, to establish benchmarks and standards (17)

Regional Differences (17)

- There is a general lack of reliable information relating to skills issues on a regional basis
- There are greater skills gaps in the North East, North West, Yorkshire and East Midlands than in the East, South East, London and South West. Greatest gaps in NW, Y & EM. Reflects the fact that demand for people is driven by patterns of public expenditure and presence of high profile projects
- In volume home building there is a good degree of workforce mobility and this can solve regional limitations when demand is high (31)
- There is a general oversupply of contractors and building trades (31)
- Wales has a more demanding timeframe with regards to low carbon targets (31)

REFERENCES

(1) Sector Skills Assessment - Real Estate and FM
(2) Sustainability Training and Education Market Research
(3) Build Up Skills 2020 Roadmap and Action Plan
(4) Engineering a Low Carbon Built Environment
(5) Low Carbon Construction - IGT (innovation and growth team)
(6) Building for the future: Sustainable Construction and Refurbishment on the Government Estate
(7) What is Stopping Sustainable Building in England?
(8) Skills for a New Economy - A Paradigm Shift in Education and Learning to Ensure Future Economic Success
(9) Sustainability of Construction Education
(10) Government Response to the Low Carbon Construction Innovation and Growth Team
1.3 Schools Research

**Addressing education for 14 to 19 year olds** — we gained input from an external education specialist to help develop the actions to influence the knowledge and skills gained at school by all actors in the built environment.

The findings have been based on a review of existing research and government reports and an examination of the current most commonly used syllabi on construction and the built environment. A small number of students, teachers and lecturers in a range of educational settings have been interviewed. The sample may not be fully representative and points towards the need for further research.

A key recommendation from the primary research was to improve the understanding of sustainability in the construction industry and built environment amongst 14 to 19 year olds through the formal education system. Sustainability as a generic subject has been considered in this context rather than specifically focusing on low carbon and energy.

The findings and recommendations applicable to secondary education are shown in the actions table in section 6.

1.4 Bibliography

Academy for Sustainable Communities, 2007. *Mind the Skills Gap: The skills we need for sustainable communities*, s.l.: APSE.


Jones Lang LaSalle, 2012. *A Tale of Two Buildings: Are EPCs a true indicator of energy efficiency?*, s.l.: s.n.


Appendix B – Online Survey

2.1 Survey objectives and development

The purpose of the survey was to gather opinions about knowledge and skills in the industry, and to understand where stakeholders think there are gaps or barriers which are preventing the built environment from using less energy and reducing carbon.

The survey was drafted through consultation with the GCB and created using Survey Monkey. This online tool allowed us to design an effective survey and easily disseminate a hyperlink to contacts in order to gather responses effectively. The survey was active for one month between 4th July and 5th August 2013. We distributed the survey across industry. Contacts were requested to forward on the link to others in order to extend our reach across the industry. We utilised social media platforms, such as Twitter and LinkedIn, in order to reach a wide range of additional respondents. As a result, a total of 269 responses to the survey were recorded.

Our analysis of the key issues from the survey follows in the remainder of this section.

2.2 How representative is this sample? Who were the respondents?

Question 1 - Which sector do you work in primarily?

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>24%</td>
</tr>
<tr>
<td>Non-Residential</td>
<td>22%</td>
</tr>
<tr>
<td>Residential</td>
<td>20%</td>
</tr>
<tr>
<td>Resi and Non-Resi</td>
<td>15%</td>
</tr>
<tr>
<td>Education</td>
<td>9%</td>
</tr>
<tr>
<td>All sectors</td>
<td>3%</td>
</tr>
<tr>
<td>Public sector</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
</tr>
</tbody>
</table>

Commentary

- There was an even balance between respondents working in residential and non-residential sectors with fewer in infrastructure.
- The survey reached supply and demand (of knowledge and skills) across the different sectors outlined above: of those who specified ‘Other’ sectors, many respondents worked in the education/training sector, or in cross-sector roles.
- A small number (less than 10) respondents also highlighted they worked in the public sector.
**Question 2 - How would you describe your job function?**

![Job Function Pie Chart]

**Commentary**
- Quantity surveyors, Architects, Manufacturers, Contractors, Investors / Fund managers and Education / Research and those in the Public Sector were well represented.
- Responses from Agents, Civil Engineers, Planners and Asset Managers were less well represented.
- Of those who answered ‘Other’, there were a significant number in education, training or research and the public sector.

**Question 3 – What level are you in your organisation?**

![Organisational Level Pie Chart]

**Commentary**
- There was a good coverage of organisational seniority levels.
- Trainees and Students were least represented in the sample.
- The majority of responses came from manager/associate level and senior professional/professional level (31% of the total).
Question 5 - Which of the following does your work primarily involve?

Commentary

- In line with the UK’s building stock, the largest proportion of respondents identified that their primary work involves existing buildings.
- Those that chose ‘Other’ often specified their work spanned all building types.
- Education and training was also a frequent ‘Other’ response.

2.3 Establishing and prioritising the gaps in knowledge and skills

Questions 6, 7, 8, 9, 10

In order to prioritise the gaps in knowledge and skills relating to low carbon, the survey asked respondents to identify the actors with the largest gaps in low carbon knowledge and skills, in addition to those actors with the most influence over the low carbon / energy outcomes. The responses are set out in the figure below:
Commentary

- The project actor identified with the greatest level of influence, and also the greatest knowledge / skills gaps was the Client.
- Developers and Investors/Fund Managers were also identified as having a high influence and a larger knowledge / skills gap.
- Trade Contractors and Agents were seen to have a moderate to large gap in knowledge and skills. They were perceived to have a lower influence on the low carbon/energy outcomes of a project. Discussion in the workshop stressed their influence in domestic projects.
- Other roles that were identified as being influential are: Local Government, end users and energy companies. The additional roles identified with knowledge and skills gaps are Government, tradesmen, end users and policy makers.
The survey asked which actors had the highest influence on low carbon outcomes and which actors have the biggest knowledge and skills gaps. Figure 6.1 below shows analysis of this question in relation to the project role of the survey respondent. It shows that from the perspective of most project roles, the project actors in the early stages are considered most influential and in need of better knowledge / skills.

**Figure 6.1: Identifying perceived level of influence and actors with gaps in knowledge and skills**

<table>
<thead>
<tr>
<th>Respondent category</th>
<th>Project Actor(s) with Highest Influence</th>
<th>Project actor(s) with Biggest K/S Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>Client</td>
<td>Client Developer</td>
</tr>
<tr>
<td>Investor / Fund Manager</td>
<td>Investor / Fund Manager</td>
<td>Investor / Fund Manager Asset Manager</td>
</tr>
<tr>
<td>Architect</td>
<td>Client Architect</td>
<td>Client Developer</td>
</tr>
<tr>
<td>Trade Contractor</td>
<td>Architect Principal Contractor</td>
<td>Client Developer</td>
</tr>
<tr>
<td>Other Surveyor (QS etc)</td>
<td>Client</td>
<td>Client</td>
</tr>
</tbody>
</table>

2.4 **Project experience**

*Questions 11, 12, 13, 14, 15*

We asked respondents whether carbon and energy were considered on their most recent project. Overall, nearly half (45%) said 'A Lot' and a similar amount (43%) said 'A Little'. Only 5% of respondents said that during their last project carbon and energy were not considered at all. The remainder (7%) did not know.

**Question 12- At what point in the lifecycle was carbon and energy reduction first considered?**

Respondents with projects where carbon and energy were considered were asked where in the project lifecycle this took place.
Commentary

- The pattern of responses indicated that carbon and energy were considered at the feasibility and design stages in the lifecycle. This points to Clients and design team actors as pivotal in affecting outcomes for carbon and energy.

**Question 13- was the carbon and energy performance measured during and/or after the project?**

Commentary

- About 30% of respondents who answered this question stated that carbon and energy performance was measured during and/or after the project. This points to an area where further knowledge or skills may have tangible results.
2.5 Training, Education and Resources

Questions 16, 18

Commentary

- Respondents were asked to indicate which types of education / training they had taken, which had the most influence over their work and which had the largest knowledge gaps regarding low carbon/energy. They were not restricted in how much information they could choose for this question. Perhaps predictably, informal on-the-job training was identified as having the largest influence, and school, the least influence. This could reflect the length of time since respondents working in the sector were in school, as well as the relative unimportance of green issues within education when these respondents were pupils. Informal On-the-job training tends to be project-specific and focussed around knowledge transfer from more, to less-experienced team members. For this reason, it is likely that Formal On-the-job training is the more productive route to reach respondents for knowledge to “trickle-down”.

- Overall, the types of Education with the largest knowledge gaps were felt to be: Formal On-the-Job training, and Professional Qualifications. This is in line with the higher level of professional-level respondents. The table below summarises the survey responses for selected project actors. It points to several types of training needing improvement because of their influence on the project role (for example, CPD).

Figure 6.2: Identifying perceived types of training with most influence and where the largest gaps lie

<table>
<thead>
<tr>
<th>Respondent category</th>
<th>Type(s) of training with most influence</th>
<th>Type(s) of training with greatest gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>CPD, On-the-Job (Informal)</td>
<td>No consensus</td>
</tr>
<tr>
<td>Investor / Fund Manager</td>
<td>On-the-Job (Informal)</td>
<td>School, Higher Education</td>
</tr>
<tr>
<td>Architect</td>
<td>CPD</td>
<td>CPD</td>
</tr>
<tr>
<td>Trade Contractor</td>
<td>On-the-Job (Informal)</td>
<td>Professional Qualification, On-the-Job (Informal)</td>
</tr>
<tr>
<td>Other Surveyor (QS etc)</td>
<td>On-the-Job (Informal)</td>
<td>Professional Qualification, On-the-Job (Formal &amp; Informal)</td>
</tr>
<tr>
<td>Developer</td>
<td>Professional Qualification, On-the-Job (Informal)</td>
<td>On-the-Job (Formal)</td>
</tr>
</tbody>
</table>
2.6 Barriers

What are the barriers to you improving your knowledge and skills relating to low carbon/energy?

We asked respondents to identify the barriers that are restricting or preventing them from improving their knowledge and skills relating to low carbon and low energy. We asked them to select all the barriers that apply to them from a list of 8. Additional barriers identified included ‘lack of applicable information’ or ‘too much choice’ which both confuse the market.

Barriers to improving low carbon / energy knowledge and skills

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Percentage of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are no barriers</td>
<td>20%</td>
</tr>
<tr>
<td>I don't know where to access relevant info</td>
<td>10%</td>
</tr>
<tr>
<td>I don't know what would be most useful</td>
<td>20%</td>
</tr>
<tr>
<td>Training is too costly</td>
<td>30%</td>
</tr>
<tr>
<td>Not enough time</td>
<td>40%</td>
</tr>
<tr>
<td>Does not interest me</td>
<td>5%</td>
</tr>
<tr>
<td>No demand from employer</td>
<td>30%</td>
</tr>
<tr>
<td>No demand from client</td>
<td>40%</td>
</tr>
</tbody>
</table>

Commentary

- ‘Not enough time’ was identified as the biggest barrier by Clients with only one respondent saying there are no barriers.
- Investors highlighted ‘not enough time’ as a barrier to training. Two respondents stated there were no barriers.
- The majority of trade contractors surveyed said ‘training is too costly’.
- Other surveyors stated ‘no demand from client’ as the major barrier with ‘training is too costly’ and ‘I don’t know where to look’.

2.7 Recommendations

Question 19 - What are the most effective ways of giving you the knowledge and skills that you need?

Key themes

- Online resources such as websites, e-learning, webinars and podcasts were identified by many respondents as the most effective way of gaining the knowledge and skills that they need. The caveats noted in relation to online learning were that staff should feel able to access online resources during work hours and, where practical work is required, online resources are not sufficient on their own.
- Practical examples, face-to-face training and discussions and case studies.
- Lectures with case studies.
A mix of all methods was suggested by many in order to communicate both the knowledge and skills required and to cater for different learning preferences.

- A central resource or website which holds resources, case studies, training etc.
- Any form as long as it is accredited for CPD
- Not podcasts, need written material and often interaction.
- Assessed CPD
- Follow up – some responses stated that there needs to be a follow up to ensure information has been retained and is up to date.

**Question 20 - Do you have any suggestions as to how knowledge and skills within the construction industry could be improved? What actions should be undertaken? What would have the greatest impact?**

- Increase the number of training courses, lower the cost and make them more accessible.
- Provide case studies.
- Increase the knowledge of consequences of not delivering a low carbon / low energy building.
- A central delivery point as far as representative bodies are concerned. Common pooling of information to bring together a meaningful resource. Crowd sourcing solutions. Have a knowledge hub.
- Clear strategy from government, regulation.
- Cross disciplinary accreditation, minimum sustainability specific CPD hours
- Educate from school level
- Shift the focus from carbon to energy.
Appendix C – Workshop information

An external workshop comprising a wide range of industry and public sector stakeholders was held on Thursday 18th July 2013. The purpose of the workshop was to discuss the barriers to low carbon/energy outcomes and how improving knowledge and skills could address this.

The aims of this workshop were to:

- Provide an overview of our initial scoping research;
- Feedback and discuss survey results;
- Identify the barriers to low carbon / energy outcomes;
- Explore which project actors have most influence over low carbon / energy outcomes;
- Discuss how improving the knowledge and skills could address these gaps.

Through a series of exercises as a whole group and in sub-groups, the attendees provided their thoughts on the knowledge and skills gaps based on their own experience. The delegates were then asked to consider the best routes of delivery for sustainability information through education and specifically what information is required for each project actor or stakeholder.

3.1 Detailed outputs of the workshop

The workshop comprised four sections / exercises.

| Exercise 1. | Key influencers & their knowledge & skills |
| Exercise 2. | Prioritisation of technical and soft skills |
| Exercise 3. | Consider the best education or training intervention points |
| Exercise 4. | Group discussion |

A summary of the feedback from each exercise is included under each of the headings below.

**Exercise 1: Key influencers & their knowledge & skills**

Delegates were split into groups and asked to discuss project actors and the level of influence each has on low carbon/energy outcomes. They then considered each project actor’s level of knowledge and skills and plotted them on a four-box matrix of Influence (low to high) vs. Level of Low Carbon/Energy Knowledge.

We wanted to identify those project actors identified in the low knowledge and high influence quadrant, as the key areas for further focus. Although there was a significant level of debate around some of the project actors, the ones most frequently placed to this quadrant across the different groups were:

- Client
- Other surveyors e.g. Quantity Surveyors
- Agent
- Investor
- Developer
- Trade contractor
- Other engineer e.g. Civil Engineer
- Asset Manager
- Architect

---

2 Attendee list shown at the end of this section
Delegates felt an actor’s influence level was dependent on the size and nature of the project and that it was hard to generalise in such a varied industry. Also, it was noted that a lack of motivation to deliver low carbon and low energy outcomes can undermine sustainability knowledge and skills.

The diagram below shows the general consensus picture of the project actors.

**Figure 1: Actor Map: Level of Influence v. Knowledge**

Some groups identified that the influence level is dependent on the size and nature of the project. It was also considered that within any particular actor group, there will be some that have high levels of knowledge regarding sustainability and some that do not, and therefore to generalise within the industry is difficult. One group considered that although an actor may have a high level of sustainability knowledge, their motivation to have an influence on low carbon/energy outcomes is lacking and therefore their knowledge is undermined.
Exercise 2: The Key Skills Required

For the second exercise, the room was divided into groups consisting of those who have a greater level of expertise in domestic or the non-domestic/infrastructure sector. A selection of actors that were identified as most influential but with the least knowledge was chosen to take forward as key areas to investigate.

The delegates were asked to discuss the three or four actors with the greatest influence and largest knowledge and skills gaps and identify both the technical and soft knowledge and skills required. A summary of the feedback is as follows:

- Clients require technical skills such as understanding of low carbon/energy ratings and opportunities, whole life costing and benchmarking in order to set requirements for a project (i.e. how much energy should/will I use per m²?). Soft skills for clients included understanding of implications, communication of low carbon/energy requirements and the motivation to change.
- Quantity Surveyors will require a range of technical skills including understanding of the implications of value engineering, life cycle and whole life costing. Soft skills identified included a cultural shift to change the industry to look at whole life cost not just capital cost and communication of the risks of not choosing more sustainable outcomes. Agents will require technical skills such as the business case for (and knowledge of) sustainable features and accurate valuation of sustainable buildings. Communication of the benefits and opportunities within low carbon/energy buildings is a key soft skill for agents.
- Developers will have similar technical requirements to Clients with a key focus on the ability to transfer/translate the low carbon/energy features to value. Key soft skills for Developers are leadership, influencing the industry at policy level and communicating the value of low carbon/energy features to the occupier and fund managers.

The outputs of this exercise were captured in a grid format and all three groups looked at the Client as a key influencer.

Table 1 - Group A Domestic, exercise 2

<table>
<thead>
<tr>
<th>Group A: Domestic</th>
<th>Actor1 – Clients</th>
<th>Actor 2- Independent/Trade Contractors</th>
<th>Actor 3- Estate Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Knowledge and Skills</td>
<td>● General awareness to maximise energy efficiency during works (e.g. when having a bathroom replaced, think about what could be done at the same time)&lt;br&gt;● General awareness to maximise energy efficiency during works (i.e.)&lt;br&gt;● Understanding of ratings on buildings introduced in January.&lt;br&gt;● Identify opportunities for introducing low energy and carbon measures</td>
<td>● Real life building performance (useable buildings)&lt;br&gt;● Change building regulations – tighter</td>
<td>● Knowledge of low energy/carbon features&lt;br&gt;● Understanding of potential for introduction of low energy/carbon measures for future buyers</td>
</tr>
<tr>
<td>Soft (Non-technical) Knowledge and Skills</td>
<td>● Motivate to change&lt;br&gt;● Create demand&lt;br&gt;● Confidence in supply chain / better service</td>
<td>● Quality&lt;br&gt;● Understood of feedback loops&lt;br&gt;● Holistic views (consequence of works)&lt;br&gt;● Keep/complete Log books (although depends on quality of the information recorded)</td>
<td>● Communicate benefits / highlight opportunities from low carbon/energy buildings</td>
</tr>
</tbody>
</table>
### Table 2- Group B Non-domestic, exercise 2

<table>
<thead>
<tr>
<th>Group B: Non-domestic</th>
<th>Actor 1 – Client/ Occupier</th>
<th>Actor 2 – Quantity Surveyor</th>
<th>Actor 3 – Developer</th>
<th>Actor 4 – Investor/ Fund Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical Knowledge and Skills</strong></td>
<td>Whole life costing</td>
<td>As with client</td>
<td>As with client</td>
<td>As with client</td>
</tr>
<tr>
<td></td>
<td>Building performance. Post occupancy performance evaluations</td>
<td>Understand implications of value engineering</td>
<td>Transfer/ translate to value</td>
<td>Information to show sustainable buildings increase rental value</td>
</tr>
<tr>
<td></td>
<td>N.B. Considered that there is a lack of information that these actors require</td>
<td></td>
<td></td>
<td>Understand the client / occupiers CSR agendas</td>
</tr>
<tr>
<td></td>
<td>How much will/should I use per m²?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Benchmarks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soft (Non-technical) Knowledge and Skills</strong></td>
<td>Understand implications of decisions</td>
<td>Need to undergo a cultural shift to change the industry to look at whole life cost not just capital cost.</td>
<td>Communicate value of sustainability to the occupier &amp; fund manager</td>
<td>Be understanding, flexible and receptive</td>
</tr>
<tr>
<td></td>
<td>What, in terms of sustainability do you want? Communicate what you want.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Financial- whole life costing. Consider short v long term. At the moment focussed on capital costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Target setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relate embodied to operational; carbon implications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3- Group C Non domestic, exercise 2

<table>
<thead>
<tr>
<th>Group C: Non-domestic</th>
<th>Actor 1 - Client</th>
<th>Actor 2 - Developer</th>
<th>Actor 3 - QS</th>
<th>Actor 4 - Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical Knowledge and Skills</strong></td>
<td>Benefits realisation and definition (Quantitative)</td>
<td>Setting requirements</td>
<td>Lifecycle and whole life costing and evaluation of (and risks of not) looking for sustainable outcomes</td>
<td>Business cases</td>
</tr>
<tr>
<td></td>
<td>Setting requirements for energy/carbon outcomes (i.e. &quot;the parameters I require from project&quot;)</td>
<td></td>
<td>Cost- benefit analysis (quantitative)</td>
<td>Valuation of sustainable buildings – BVS</td>
</tr>
<tr>
<td></td>
<td>Defining success criteria</td>
<td></td>
<td>Understand the impacts and timing of legislation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Turn QS into ‘building economists’</td>
<td></td>
</tr>
</tbody>
</table>
Exercise 3: Consideration of the best education or training intervention points

In the same groups, the delegates were asked to discuss the education and training provision for the actors addressed in the previous exercise. The aim of this was to draw out which interventions can deliver the technical and soft skills required by that actor as identified in exercise 2. Delegates were encouraged to think of best practice examples in education and training that they have come across.

Tables 4, 5 and 6 show the groups’ responses. The green shading indicates areas of education that are required for that particular actor. The key points are summarised below.

- For clients, it was difficult to identify the best delivery method for information since there is not a typical education route. In this instance it often comes down to on-the job.
- It is necessary to differentiate between informed client and non-informed client with regards to sustainability. The route to deliver knowledge and skills will differ between these.
- Overall, school, apprenticeships, further education and higher education were grouped and identified as less effective for specific knowledge and skills, but vital to deliver basic understanding and awareness.

Table 4: Group A domestic, exercise 3

<table>
<thead>
<tr>
<th>Group A- domestic</th>
<th>Clients</th>
<th>Contractor</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-the-job training-informal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-the-job training-formal</td>
<td></td>
<td></td>
<td>▪ The problem is it is expensive-includes cost of course and loss of time/earnings</td>
</tr>
<tr>
<td>CPD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Qualification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Further Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apprenticeship</td>
<td></td>
<td></td>
<td>▪ Currently de-skilling ▪ Need to improve technical understanding ▪ Understand when to call the expert</td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5: Group B, exercise 3

<table>
<thead>
<tr>
<th>Group B - Domestic</th>
<th>Client</th>
<th>Investor/ QS/ Developer (Architects need to know this too)</th>
<th>Notes</th>
</tr>
</thead>
</table>
| On-the-job training-informal | ▪ Practical experience  
▪ Discussions | | ▪ Necessary to differentiate between informed client and non-informed client.  
▪ How a client receives information is dependent on the type of client.  
▪ Research is needed to provide the evidence/case studies to back up the theory taught at all stages and through all routes. |
| On-the-job training-formal | ▪ Advisors | ▪ Required | |
| CPD | ▪ Face to face interaction.  
▪ Provide base level of knowledge. | ▪ Required | |
| Professional Qualification | ▪ Requires continual content development. | ▪ Required | |
| Higher Education | | | |
| Further Education | | | |
| Apprenticeship | | | |
| School | ▪ Set basic level of understanding around the reasons at this stage. | | |

Table 6: Group C, exercise 3

<table>
<thead>
<tr>
<th>Group C</th>
<th>QS</th>
<th>Agent</th>
<th>Notes</th>
</tr>
</thead>
</table>
| On-the-job training-informal | ▪ Journals  
▪ Super-users | | ▪ Requirements carry across from QS to Agent.  
▪ Need collaboration between actors. |
| On-the-job training-formal | ▪ Make them have forums/ work together across disciplines.  
▪ Educate each actor on how their roles affect sustainability outcomes and how cooperation can equal client benefits. | | |
| CPD | ▪ Ask for my CPD proof and periodic re-assessment and training.  
▪ Audit projects for environmental skills e.g. ‘considerate constructors’. | | |
| Professional Qualification | ▪ Fitness to practice certificates.  
▪ Chartered building economist. | | |
| Higher Education | ▪ A QS character in a soap opera- this would generate awareness of the issues.  
Generic messages to convey:  
▪ If you choose sustainable outcome skills, you will get a job.  
▪ Built environment has a huge impact on the planet. | | |
Exercise 4: Group Discussion

The final exercise for the workshop was a group discussion with all attendees to identify the top priority actions for addressing the knowledge and skills gaps within the construction industry. The aim of this was to come up with some key actions related to particular actors and how to deliver these. Suggestions which were mentioned were as follows:

- Stimulate demand for sustainability education - Government and Industry
- Consider post occupancy performance standards and collate information on post-occupancy performance and costs.
- Industry needs to take ownership of operational performance.
- Set minimum standards, legislation.
- Manufacturers need a business case to supply the products which deliver low carbon/energy outcomes.
- Share risk - understand how the total risk is split between roles along the supply chain and throughout the lifecycle of a building.
- Building ‘MOT’ to show all players who had an input into the performance of a certain building.
- Should be educated to think about how people are using the building.
- Change fee structures - client should consider operational and performance related costs as well as capital costs when paying designers, contractors and operators.
- Proactive low carbon education may be dependent on the demand for it.
- All parties need to understand impact of change over long term.
- Use best practice and advertise this to the industry. Share knowledge of what worked and what didn’t work.
- Promote use of Carbon Buzz and use this to help set standards to meet.
- Designers require a better understanding of building use, which they should feed into the design.
- Air tightness training - contractors should look at building performance at a point in the construction where you can make a change.
- Teach supply chain sustainability in schools.
- Radically overhaul investment in jobs and skills.
- Stop de-skilling and up-skill.

List of attendees

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angelika Pongo</td>
<td>Costain</td>
</tr>
<tr>
<td>Anna Bellamy</td>
<td>Sweett Group</td>
</tr>
<tr>
<td>Charlie Law</td>
<td>BAM / UKCG</td>
</tr>
<tr>
<td>Elizabeth Greenhill</td>
<td>Sweett Group</td>
</tr>
<tr>
<td>Gavin Killip</td>
<td>University of Oxford</td>
</tr>
<tr>
<td>Heidi Barnard</td>
<td>Saint Gobain</td>
</tr>
<tr>
<td>Hugh Bantin</td>
<td>Sweett Group</td>
</tr>
<tr>
<td>Hugh Mulcahey</td>
<td>Concerto Partners</td>
</tr>
<tr>
<td>Karla Damba</td>
<td>Sweett Group</td>
</tr>
<tr>
<td>Louise Greenhalgh</td>
<td>Sweett Group</td>
</tr>
<tr>
<td>Malcolm Francis</td>
<td></td>
</tr>
<tr>
<td>Mike Moseley</td>
<td>REHAU</td>
</tr>
<tr>
<td>Patrick Smith</td>
<td>Kotuku</td>
</tr>
<tr>
<td>Richard Quartermaine</td>
<td>Sweett Group</td>
</tr>
<tr>
<td>Sarah Malleson</td>
<td>Travis Perkins (SBS)</td>
</tr>
<tr>
<td>Simon Harris</td>
<td>Sweett Group</td>
</tr>
</tbody>
</table>
Appendix D – Key Project Actors

Information and analysis from the literature review, web survey, workshop and consultations led to identifying the knowledge / skills gaps and actions for key project actors. Figure 8.1 below sets out the recommended next steps for the following project actors:

<table>
<thead>
<tr>
<th>Client</th>
<th>Investor / fund manager</th>
<th>Asset manager</th>
<th>Architect</th>
<th>Quantity Surveyor</th>
<th>Trades contractor</th>
</tr>
</thead>
</table>

Figure 8.1: Actor specific gaps, barriers and actions

<table>
<thead>
<tr>
<th>Description</th>
<th>Drivers</th>
<th>Ability to influence and impact on outcome</th>
<th>Knowledge and skills required</th>
<th>Typical educational background</th>
<th>Current barriers and gaps in K&amp;S</th>
<th>Recommendations / Actions to achieve barriers and gaps</th>
</tr>
</thead>
</table>
| Client      | Value for money comprising a balance between:  
  • Cost – budgets, investment, development appraisals, return on investment  
  • Time – construction period, ownership / occupation period  
  • Quality - function / fit for purpose / asset maintenance, adaptability, flexibility, future-proofed | Key decision maker therefore most significant influence over project outcomes including energy/CO₂, Influence over supply chain through:  
  • Project brief  
  • Employer’s requirements  
  • Contracts and appointments | Construction Clients’ Group (CCG) lists the following actions in relation to sustainability:  
  • Engage your supply chain partners early in your decision making process  
  • Measure and benchmark performance of supply chain partners  
  • Develop and implement a business case and plan that addresses environmental, social | There is no set education route to become a construction client. Often reached via the core construction professional disciplines (architect, project manager, surveyor).  
  Survey indicated that 80% of clients have undertaken on-the-job informal training and 60% CPD a range of topics Most influential to their work was CPD 40% | Barriers  
  • Insufficient time devoted to learning  
  • Lack of data (e.g. benchmarks) to make informed decisions  
  • Unsure what to ask for to deliver low carbon / energy buildings (i.e. target setting) which in turn restricts demand within the industry | Establish an ‘Information Hub’ to cover:  
  • Impact of current and proposed legislation  
  • Relevant technical, management, soft skills training  
  • Data sources/evidence base  
  • Establishing the business for action and consideration of whole life costing principles  
  • Best practice case |
<table>
<thead>
<tr>
<th>Description</th>
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<th>Recommendations / Actions to achieve barriers and gaps</th>
</tr>
</thead>
</table>
| Who:                 | • Commercial property companies / landlords                            | domestic buildings) and 39% of embodied and operational emissions from the built environment (non-domestic and infrastructure sectors). | and economic aspects and on the job informal training 40%. This suggests the key way to target clients is once they are in a job role. No single education route can be deduced as having the largest gaps. |                               |                                | Gaps:  
  - Misunderstand or unaware of legislation  
  - Lack knowledge of solutions available  
  - Taking action (financial / business) or perceive cost is too high  
  - Whole life costing often not adopted where relevant to do so  
  - Limited use of post occupancy evaluations to assess actual building performance  
  
Recommendations / Actions to achieve barriers and gaps:  
Engage with industry bodies to define and promote the business case for energy efficient buildings  
- Investment Property Databank  
- Investment Property Forum  
- British Property Federation  
- British Council for Offices  
- British Council of Shopping Centres  
- Higher Education Funding Council for England  
- International Sustainability Alliance  

Government to act as best practice ‘client’:  
- Set and achieve minimum standards to lead by example  
- Promote best practice  
- Adopt whole life approach to carbon and cost.  

Set up a specific sector skills council for clients  
- Recommended by previous studies  

Other considerations:  
- Meeting regulatory standards  
- Reputation / Corporate Social Responsibility objectives  
- User / stakeholder / shareholder satisfaction  

Clients are influenced by their advisors and supply chain.  
Frequent clients are responsible for the greater part of the value of construction work—about 60% by value. However, at any one time about 95% of the industry’s customers are one-off or occasional clients.  

Success in construction projects is driven by the knowledge and skills of the client. Frequent clients are more likely to have invested in their capacity to fulfil their role, thus delivering benefits both for themselves and their contractors. Infrequent or inexperienced clients are less likely to have an understanding of the construction sector and the importance of their influence. This poses greater risks for the delivery of their projects.  

The CCG emphasises that “Sustainability is critical to the whole life performance of any built asset and its future operation.” The client needs to be clear and consistent about its needs from the outset.  

For developers, informal on-the-job training was most influential (100%) followed by having a professional qualification (50%). Formal on-the-job training was identified by 50% as having the largest gaps in improving low carbon / energy knowledge or skills.  

• Investment decision maker – makes the decision to invest  
• Senior responsible owner – high level project ownership  
• Project sponsor – interface between client and supply chain (e.g. Development Manager, Estates Manager etc.)
<table>
<thead>
<tr>
<th>Description</th>
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<th>Current barriers and gaps in K&amp;S</th>
<th>Recommendations / Actions to achieve barriers and gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investor / Fund manager</td>
<td>• Return on investment</td>
<td>• Return on investment</td>
<td>• Energy efficient / low carbon buildings command a higher premium / less risk than their peer group</td>
<td>Higher education:</td>
<td>• No evidence of enhanced value premium / lower risk discount</td>
<td>Engage with industry bodies to promote the business case for energy efficient buildings</td>
</tr>
<tr>
<td></td>
<td>• Increase capital value</td>
<td>• Increase capital value</td>
<td>• Impact on asset value and risk of targeting a low carbon / energy strategy</td>
<td></td>
<td>• Lack of understanding of the business case to invest in higher efficiency options</td>
<td>• Association of Real Estate Funds</td>
</tr>
<tr>
<td></td>
<td>• Maximising ongoing returns and minimising risk from investment properties at the portfolio level</td>
<td>• Maximising ongoing returns and minimising risk from investment properties at the portfolio level</td>
<td>• First and second property or real estate degrees contain modules on real estate investment / fund management</td>
<td></td>
<td>• No evidence of enhanced value premium / lower risk discount</td>
<td>• Investment Property Databank</td>
</tr>
<tr>
<td></td>
<td>• Portfolio performance analysis</td>
<td>• Portfolio performance analysis</td>
<td>• Energy efficient / low carbon buildings command a higher premium / less risk than their peer group</td>
<td></td>
<td>• No evidence of enhanced value premium / lower risk discount</td>
<td>• Investment Property Forum</td>
</tr>
<tr>
<td></td>
<td>• Pension funds</td>
<td>• Pension funds</td>
<td>• Impact on asset value and risk of targeting a low carbon / energy strategy</td>
<td></td>
<td>• No evidence of enhanced value premium / lower risk discount</td>
<td>• British Property Federation</td>
</tr>
<tr>
<td></td>
<td>• Life assurance institutions</td>
<td>• Life assurance institutions</td>
<td>• First and second property or real estate degrees contain modules on real estate investment / fund management</td>
<td></td>
<td>• Lack of understanding of the business case to invest in higher efficiency options</td>
<td>• International Sustainability Alliance</td>
</tr>
<tr>
<td></td>
<td>• Property companies</td>
<td>• Property companies</td>
<td>• Many courses contain optional sustainability education.</td>
<td></td>
<td>• Higher education:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Private wealth</td>
<td>• Private wealth</td>
<td>• Professional body / qualifications:</td>
<td></td>
<td>• No evidence of enhanced value premium / lower risk discount</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• RICS – All ‘Assessment of Professional Competence’ (APC) routes require Level 1 Sustainability which provides basic understanding only; to gain professional qualification; key routes include Commercial Property</td>
<td></td>
<td>• Professional body / qualifications:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Commercial Property – No specific reference to business case, financial appraisal, LCC etc</td>
<td></td>
<td>• Professional body / qualifications:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• RICS – Sustainability to be a mandatory competency Commercial Property APC and to specifically teach the low carbon business case (see outline content below)</td>
<td></td>
<td>• Professional body / qualifications:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CPD providers</td>
<td></td>
<td>• Professional body / qualifications:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• RICS - CPD provided through the CPD Foundation; includes ‘Demonstrating the low carbon/energy business case’ and ‘Sustainability Does Not Cost the Earth - Occupiers and Energy Efficiency’; 9,000 Chartered Surveyors working in the Real</td>
<td></td>
<td>• Professional body / qualifications:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CPD providers</td>
<td></td>
<td>• Professional body / qualifications:</td>
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<td></td>
<td></td>
<td></td>
<td>• RICS - CPD provided through the CPD Foundation; includes ‘Demonstrating the low carbon/energy business case’ and ‘Sustainability Does Not Cost the Earth - Occupiers and Energy Efficiency’; 9,000 Chartered Surveyors working in the Real</td>
<td></td>
<td>• Professional body / qualifications:</td>
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<tr>
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<td>Drivers</td>
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</tbody>
</table>
| Asset manager | • Supervises an owner’s real estate assets from a strategic perspective for commercial property and strategic management of public sector and residential buildings.  
• Provides strategic asset advice rather than day-to-day property operations.  
• Relevant services which influence low carbon outcomes are:  
  – Planning and monitoring regular maintenance and refurbishment  
  – Appointing and monitoring project contractors  
  – Appointing and supervising technical advisors, agents, lawyers  
• Identifying, acquiring and maximising return from investment properties for least cost  
• Performance analysis  
• Adding value through re-positioning assets  
• Minimising risk  
• Preparing Asset and Facilities Management Plans  
• Energy efficiency of operation  
• Sustainable procurement  
• Management of operational waste and recycling | • Employed across the whole of the non-domestic building stock and social housing on behalf of social landlords.  
• Oversees cyclical refurbishment, maintenance and replacement of plant within buildings which is a key opportunity to improve energy efficiency.  
• Key decision maker and influencer because identifies assets which need improvement and makes recommendations to clients.  
• Engages with technical advisors (i.e. design teams) and setting project requirements for principle and trade contractors.  
• Responsible for whole portfolios rather than just specific buildings so can influence a greater | Real estate and facilities management sector skills needed to support the green agenda in addressing:  
Energy monitoring and management  
Energy assessment skills  
Project management skills  
Installation and retrofitting skills  
Data collection skills  
Occupant behaviour (e.g. waste / energy management)  
Asset manager specific areas:  
Energy consumption profile of buildings within portfolio  
Options to improve energy efficiency during refurbishment / planned | Higher education:  
• First and second property or real estate degrees contain modules on asset management  
• Foundation Degree in Facilities services  
• Many courses contain optional sustainability education.  
Higher level Apprenticeship in FM at level 4&5  
Apprenticeship in FM Professional body / qualifications:  
RICS – All ‘Assessment of Professional Competence’ (APC) routes require Level 1 Sustainability which provides basic understanding only; to gain professional qualification; key routes | • Limited influence on low carbon/energy outcomes during the design stage of refurbishment/ maintenance projects  
• Lack of understanding of the business case to invest in higher efficiency options  
• No consistent energy management approach  
• Lack of training for communication/ business case skills | Higher education:  
• Embed ‘business case for energy efficiency’ across all core / mandatory modules or provide a stand-alone core / mandatory module.  
Professional bodies:  
RICS – FM competency Level 2 Sustainability to be a mandatory competency for FM and Commercial Property  
APC and to specifically teach the low carbon business case (see outline content below)  
BIFM – Low carbon business case education a mandatory requirement at all BIFM qualification levels |

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<table>
<thead>
<tr>
<th>Description</th>
<th>Drivers</th>
<th>Ability to influence and impact on outcome</th>
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<th>Recommendations / Actions to achieve barriers and gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>etc</td>
<td></td>
<td>proportion of CO$_2$ emissions compared with property managers</td>
<td>maintenance.</td>
<td>include Commercial Property and Facilities Management</td>
<td>CPD:</td>
<td>• RICS &amp; BIFM to set a minimum requirement for CPD learning to include sustainability, specifically, the low carbon business case.</td>
</tr>
<tr>
<td>− Defining individual property business plans</td>
<td></td>
<td>• Impact building use and influence understanding of building/energy management</td>
<td>• Relative energy savings of potential measures.</td>
<td>FM — Level 2 Sustainability competency includes life cycle costing and capital cost and value engineering exercises</td>
<td>Specific low carbon business case learning across higher education courses, professional qualifications and CPD seminars to include:</td>
<td></td>
</tr>
<tr>
<td>• Are part of the 'managers/senior professionals' and 'professional occupations' groups which account for 20% of real estate and facilities management sector in 2010$^4$</td>
<td></td>
<td>• Oversee a holistic approach to sustainable retrofit</td>
<td>• Cost-benefit analysis of each energy saving option</td>
<td>• Commercial Property — No specific reference to business case, financial appraisal, LCC etc</td>
<td>• Energy consumption in the built environment</td>
<td></td>
</tr>
<tr>
<td>Facilities and energy managers will fulfil the asset management role in smaller organisations.</td>
<td></td>
<td>• Meet upcoming legislation such as Energy Savings Opportunities Scheme (ESOS)</td>
<td>• Impact on asset value and risk</td>
<td>• Sustainability is included for all BIFM qualifications but on an optional basis.</td>
<td>• Energy / carbon metrics</td>
<td></td>
</tr>
<tr>
<td>They may also subcontract this role through large FM providers who could offer other energy management services and achieve greater impact.</td>
<td></td>
<td></td>
<td>• When to act</td>
<td>• Improvement options</td>
<td>• Measurement</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Description</th>
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</tr>
</thead>
</table>
| Architect   | • Acts as the leader of the design team  
   • Helps client to define requirements and transform these into a physical asset  
   • Identifies constraints, inputs to option appraisals and feasibility  
   • Develops design, advises on materials selection, space plans, interior design and fit-out  
   • Provides construction drawings and specifications  
   • Oversees construction to ensure it complies with design  
   • May deal with planning applications and building warrants | • Architect Registration Board is the statutory regulator, with 34,500 registered  
   • 58,000 Architects (self-identified) in the UK (Q2, 2013)  
   • Approximately 40,000 individual members of The Royal Institute of British Architects / Royal Incorporation of Architects in Scotland (RIBA/RIAS) members in the UK (RIBA), although this is not required to practice as an architect | • The anticipated effects of climate change  
   • Principles of low carbon design and refurbishment  
   • Legislative standards and regulations  
   • BIM  
   • Building physics, services and systems  
   • Goals for energy efficiency and measurement (KPIs)  
   • Products and materials  
   • Sector-specific standards or guidance such as BREEAM/LEED, Code for Sustainable Homes, CIBSE Energy Efficiency in Buildings Guide F, Passive House, etc | Higher education: three-part course of study (c.70 UK institutions);  
   • Three-year full time undergraduate degree course with work experience  
   • Continuation of study with two-year full time degree course and practical experience  
   • Two years of (paid) practical experience with a qualifying examination  
   • Professional body / qualification: All architects must be registered with the ARB, and have arrived at an approved study route  
   • CPD — self assessed, self awarded 100 points via:  
     • At least 35 hours of CPD per year (free to choose exact details), which must include:  
     • At least 17 structured hours  
     • At least 20 hours on core curriculum (which includes sustainable architecture)  
     • Activities which include self-reflection | • Higher education teaching outdated or minimum current requirements  
   • Ability to persuade client to adopt higher sustainability standards  
   • Understanding and communicating the business case for low carbon to client  
   • Liaison with the building services engineer to comply with Part L of the Building Regs (carbon emissions)  
   • Building physics and the effect of building systems on sustainable outcomes  
   • Leading an integrated team for low carbon / energy outcomes  
   • Post occupancy evaluation | Higher education: embed low carbon / energy outcomes in each part of degree course. Introduce specific modules on business case, metrics and post project evaluation for low carbon outcomes. Some institutions have begun to take this top down approach and others should learn from them.  
   Professional qualifications: RIBA: periodic reaccreditation of sustainability skills  
   CPD: compulsory, assessed modules that focus on low carbon / energy outcomes  
   Soft skills to concentrate on:  
   • Leadership  
   • Management  
   • Communication  
   • Negotiation  
   • Influencing |
<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| Quantity Surveyor | - Involved client and / or contractor-side  
- Provides advice on project capital costs, procurement and lifecycle costs.  
- Assists with tendering and contract negotiations  
- Monitors project spend  
- Although evolving since the mid-1800s, QS only been a recognised professional route since the early 1970s | - Affordability  
- Cost control  
- Cost reduction  
- Value | - 39,000 persons employed as Quantity Surveyors in the UK (Q2, 2013)  
- Works across sectors and in wide range of non-domestic projects. Likely to be involved on large-scale domestic new-build or refurbishment projects  
- Moderate influence: limited role, but the client pays attention to QS advice because it’s about cost  
- QSs often price Sustainability as a lump sum as opposed to providing a breakdown for specific items. This makes it harder for the project team to visualise how money is allocated and the associated benefits. | - Economics of sustainable construction  
- Whole-life / lifecycle costing  
- How to cost, explain and influence sustainable interventions decisions  
- BIM-based project delivery  
- Current and future legislation and building control regulations  
- Construction methods and their cost | Higher education:  
- Quantity Surveying degree (c.28 UK institutions) or via other first degree plus postgraduate conversion course | Degree courses must adjust focus of QS courses to guide students on how the QS can be a project leader in encouraging sustainable methods / materials through, for example:  
- Making the business case via a building economics focus on whole-life costing (see also Asset Managers recommendation)  
-Linking carbon and energy to whole-life costs  
- Establishing outcome metrics for asset performance, based on materials and construction method  
-Soft skills to concentrate on:  
- Communication  
- Negotiation  
- Team working  
- Collaboration  
- Professional writing  
- Environmental awareness  
-Professional bodies:  
- RICS - mandatory sustainability to APC Level 2 (knowledge and application)  
- Raise awareness of the role QoS can play in delivering more cost  |

Opportunities for this role:  
- Focus client on cost-effective sustainable outcomes  
- Link carbon / energy to project costs  
- Advise client on funding mechanisms for sustainable construction methods  
- Building an evidence base for the business case - costs of sustainability  

Barriers:  
- Disconnection between degree course content and RICS competencies  
- Current practice focuses more on capital costs and less on whole-life, which could produce better sustainable outcomes  
- Variable quality of CPD for sustainable outcomes  
- Sustainability is not mandatory past Level 1 APC (demonstrating knowledge)  
- Time to consider sustainability not factored into QS project role  

Gaps:  
- No standard threshold benchmark competency to achieve a QS degree or qualification  
- Costs and impact on outcomes of sustainable technologies are not comprehensive  
- Inadequate training on linking project costs to carbon / energy outcomes  

Professional body / qualifications:  
- RICS or CIOB accredited  
- RICS requires 20 hours of CPD per year (10 of which must be formal)  
- No specific requirement for sustainability CPD  

Professional bodies:  
- RICS - mandatory sustainability to APC Level 2 (knowledge and application)  
- RICS - mandatory sustainability to APC Level 2 (knowledge and application)  
- Raise awareness of the role QoS can play in delivering more cost
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| Trades contractor | • Independent, mostly SME businesses including sole traders, working directly to a client or subcontracted to a Principal Contractor. Widespread industry specialisation, with business focussing on specific occupations (e.g. roofing, piling, steel erection, solid wall insulation, electrical, plumbing, solar panel installation etc.) but also with an extensive network of general building companies. Frequently deployed as subcontractor on commercial or new-build domestic | • Cost-effective delivery  
• Meeting deadlines  
• Access to contract opportunities  
• Competitive advantage through specialist knowledge  
• Achieving corporate sustainability objectives | • 1.03 million persons employed in Construction and Building and Finishing Trades and related occupations (Q2, 2013)  
• Domestic projects – significant influence, especially for refurbishment and small scale new-build  
• Non-domestic / civil projects – stage of involvement results in lower influence over design or approach of other project roles  
• Non-domestic / civil projects – stage of involvement results in lower over sustainability measures adopted or outcomes sought  
• Non-domestic / civil | • Current and future legislative & regulatory requirements  
• Business case arguments for domestic projects  
• Advantages and use of sustainable products and materials  
• Sector-specific standards or guidance such as BREEAM/LEED, Code for Sustainable Homes, CIBSE Energy Efficiency in Buildings Guide F, PassivHaus, etc  
• Trade-specific installation techniques that ensure sustainable outcomes (e.g. air tightness, etc)  
• Understanding of sustainable techniques | Further Education to gain NVQ / SVQ / BTEC vocational qualifications to achieve National Occupational Standards (NOS)  
Three levels of Apprenticeships (via further education or direct route):  
• Intermediate  
• Advanced  
• Higher | Barriers:  
• Client knowledge (especially domestic clients) of rationale and business case  
• Funding for entry-level qualifications is scarce, hard to find and not focussed on green skills  
• For small contractors, training is considered unaffordable and as ‘wasted’ time without income  
• De-skilling in the industry for lower costs  
• Perception that specialist knowledge on sustainable techniques must be guarded, not shared, for commercial advantage  
After completing main qualification, there are myriad trade bodies and livery companies for updating skills, accessing | GCB:  
• Co-ordinate a National Skills Policy to offer holistic approach to training, funding and qualifications focussed on low carbon / energy outcomes  
• Lobby for incentives to participate in training  
Education / training providers or Built Environment Sector Skills Councils and Awarding Organisations:  
• Update relevant knowledge and competence qualifications (within current QCF/SCQF/CQFW frameworks) related to effective, sustainable projects  
• Promote Sustainability skills as a ‘value add’ not a distraction from main bulk of work  
CPD:  
• Develop specific, short-length, assessed, courses to assist a newly qualified QS to bridge the gap between knowledge and practice  
• Develop short seminar sessions focused on funding mechanisms for sustainable construction |
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<td>projects • Frequently directly appointed by the client for domestic projects</td>
<td>projects – moderate influence over outcomes through proper techniques</td>
<td>for other trades, so holistic advice is given • Funding sources for domestic improvements • Knowledge-transfer techniques for domestic clients (i.e. how to run the equipment, maintenance regimes, etc) • Understanding of outcome measures • Role of supply chain in delivering sustainability</td>
<td>funding for training and/or ensuring compliance with regulatory changes Periodic training to update skills in line with legislative requirements for those in regulated professions, such as electricians, gas installers, plumbers, etc or for general health and safety updates</td>
<td>funding • Less coverage of retrofit • Sector is fragmented with many bodies, Sector Skills organisations, training providers and overseeing organisations</td>
<td>• Offer specialist apprenticeships for low carbon / energy skills • Better connection of supply and demand issues via national skills strategies • Skills component included in any built environment project to increase competency</td>
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<td></td>
<td>Opportunities for this role: • Incorporate sustainable practice in business-as-usual • Gain USP or commercial advantage with successful sustainable techniques • Sole trader / independent small business owners can act as a Green Building Integrator for domestic projects to ensure that the most sustainable outcome across all trades is achieved</td>
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<td>Sector Trade Bodies: • Awareness campaign of green skills and the commercial opportunities in popular magazines or merchants (e.g. Screwfix catalogue, events at wholesale merchants, etc)</td>
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