SUSTAINABLE DESIGN GUIDELINES
FOR THE UNIVERSITY OF CAMBRIDGE
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EXECUTIVE SUMMARY

The University of Cambridge (UoC) has appointed Ivelina Grozeva, IARU Fellow in summer 2013 to review the existing Environmental Design Guidelines of the UoC, Version July 2008 and make recommendations for a new version of the guidelines. This report summarises the research undertaken over a period of 7 weeks as well as the conclusions and recommendations based on the gathered information and personal opinion created upon conducted meetings with key people and research in internal documentation as well as foreign practices. Contact has been established with external institutions and organizations where the UoC is participating member.

Difficulties have arisen from the long project duration and the low comparability of typology and scale of recently built projects. Furthermore, there has been an insufficient response from foreign institutions on their practices. The 7 weeks period has unfortunately proved rather short to receive feedback on some of the commissioned additional surveys as well as to oversee the experience with implementing the first bespoke sustainability framework for the Arup Building refurbishment in its construction and operational stages. Further research in these aspects should be conducted.

The layout of this report follows the approach of value engineering. It analyses the merits and weaknesses of the existing Design Guidelines as a tool to achieve the UoC goals and targets. Subsequently, it outlines the vision of what this tool should be, and the means to achieve this goal.

The report poses the following questions and then introduces alternatives to be considered:

- What is the tool? [How does it work? Who is involved?]
- What should it do? [What must it not do? What are the alternatives?]
- How should it get there? [What are the costs? Who is responsible? What are the necessary steps?]

Finally the report proposes a step-by-step approach to develop of a toolkit for sustainable design.
1. INTRODUCTION

The University of Cambridge is one of the world’s oldest universities and a leading academic centre. The University has recognized that in order to assert its role as a leading educator and example the University of Cambridge (UoC) should take greater responsibility towards the local, national and global community and have an overarching policy including all three aspects of sustainability - environmental, economic and social.

The University of Cambridge is looking to review and improve its existing environmental design guidelines because it has identified the stock of more than 300 buildings as the main consumers of energy and therefore the primary source of carbon emissions. Even the newer buildings across the estate, which have been designed to be more energy-efficient, have frequently fallen short of their expected performance.

Within the frame of the International Alliance of Research Universities (IARU) an IARU Fellow has been commissioned to look into the recent UoC building practice, to research existing documents from other universities and organizations and make recommendations on how the UoC could improve its Guidelines and strive for a holistic sustainable approach for its estate.
2. **What is it?**

The UoC Environmental Design Guidelines is a publicly available document and distributed as part of tender and contracting set of documents. It is a part of the University Guidance Documents which also address topics such as procurement, waste, travel and environmental management. Currently the Design and Construction Guidelines of Environmentally Sustainable New Buildings set targets and requirements for new developments and directly links to the University’s Environmental Policy and to a more detailed document on passive design and construction principles.

1 **Relation to other University Policies**

Initial research conducted has revealed the co-existence of several documents that at least partially relate to sustainability in the built environment.

The Estate Management Design and Standards Brief for University Services and Construction Works, Version January 2013 quotes in Part H (p.143) the current Environmental Policy of the UoC outlines energy conservation measures (p.108), specifically for refurbishment projects intended to improve their energy efficiency.

It also makes reference the Carbon Trust Recommendations on Energy Conservation as relevant guidance. Environmental Issues are the focus of Part E4 to E12 as well giving on some occasions very specific and restrictive recommendations on what designers should do and regulations they should comply with respecting natural and mechanical ventilation, space heating, thermal insulation, built fabric etc.

The Estate Management Technical Procedure Instructions for the Control and Implementation of Construction Related Works, Version August 2012 also promotes sustainability on pages 111-114 and also points to the guidance documents on building design and construction, purchasing, waste and environmental management or renewable energy.

Project Managers (PM) have cited the confusion arising from the existence of multiple documents, hosted in different locations, updated at different times, and pointing to different resources and responsible parties as a major reason why the current design guidelines are not being fully utilized by project managers and procurement. Both the University representatives and external parties contacted during this research indicated a strong preference for a single, current, comprehensive document on sustainability instead of the current system.

2 **Comprehensiveness**

Although the UoC states its commitment to all three aspects of sustainability, the current Design Guidelines address extensively solely environmental issues and briefly mention the positive effect whole life cost analysis and integration might have for the UoC in terms of financial savings.
Aspects of social inclusiveness, quality of open public spaces design etc. remain fully untouched. So do heritage issues and other cultural aspects involved in designing the build environment that also comprise a major part of the high aspirations of the UoC to contribute to society through the pursuit of education, learning, and research at the highest international levels of excellence (see further: http://www.admin.cam.ac.uk/carbon/projects/why_reduce.html)

3 Design Philosophy

In the current guidelines, the chapter on design philosophy attempts to address the university’s broader policy on the built environment. The design philosophy chapter however mostly addresses specific design approaches such as passive design measures. What it does not provide is a clear, short and targeted statement on what buildings the university is pursuing to achieve its high aspirations.

A strong, clear statement on the design philosophy should link the design guidelines to the core values and mission of the University and address a holistic approach incorporating environmental, social and economic aspects.

Integrated passive design is only one of many approaches that may or may not be applicable to a certain design depending on the project. This level of recommendation is too specific to define a broader design philosophy.

4 Relevance of information and criteria

The section concerning building regulations currently cites outdated information. While this is an understandable error, it raises the question of the appropriateness of including detailed regulatory information in the guidelines at all. These regulations are constantly changing and designers and contractors are legally obliged to be aware and in compliance with all current regulations therefore it may not be necessary to include the specific regulations in the guidelines. Furthermore, the presence of outdated, irrelevant information in the guidelines compromises the credibility of the entire policy. The policy should avoid being overly prescriptive and instead seek to promote excellence and innovation.

5 Policy on BREEAM

The UoC Design Guidelines currently require for any new university building above 1000 m² to undergo a BREEAM (Building Research Establishment Environmental Assessment Model) assessment “with a target to achieve a rating of ‘Excellent’ with a minimum rating of ‘Very Good’ in cases where there are good and explicit reasons why an excellent rating could not be achieved”. Similarly, it requires an EcoHomes assessment for residential development of over 10 dwellings with a targeted rating of ‘Excellent’ and a minimum rating of ‘Very Good’.

As the summary to the right shows, since 2006, the year BREEAM was introduced in the UoC, more than 40% of all major university projects (currently above £1 Million) have been new builds. The quite substantial rest of 59.2% is still comprised of refurbishment or extension projects to which BREEAM did not have a solution until recently (BREEAM for Refurbishments is currently being developed). Some of the extension projects could be easily counted to the new builds given their size. Currently 60% of the new builds have a BREEAM certificate. If extension and refurbishment projects were to be counted as new builds the percentage of BREEAM assessed buildings would drop substantially.
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| Number of New Builds from Total | 20/49 | 40.80% | Number of BREEAM rated buildings/Total New | 12/20 | 60% |

MAJOR PROJECTS LIST SINCE 2006 (SOURCE: TABLE BASED ON BUILDING COMMITTEE PAPERS, CAPITAL PROJECT REPORTS)
The first very obvious problem with the applicability of BREEAM for the university’s purposes seems to be the ‘back door’ approach that breeds inconsistency and confusion into what the UoC policy on BREEAM is.

Another observation became obvious during research that not one but various versions of BREEAM (i.e. BREEAM 2008 Office, BREEAM Bespoke, BREEAM 2011 for HE, or BREEAM 2008 Shell&Core as in the case of the Sports Centre Phase 1) have been used according to project type which hinders comparability. Moreover, requirements to achieve an excellent rating have been constantly rising, so a BREEAM building rated ‘Excellent’ several years ago might score only ‘Very Good’ if it were to be reassessed today.

The internally wide spread opinion on BREEAM is that it produces a lot of unnecessary paperwork for evidence documentation which in itself generates cost that cannot be properly allocated to project’s costs and contractors’ commitments.

Upon enquiry a more detailed cost analysis has been undertaken by Davis Langdon though a complicated task unless separate cost tracking is done from the beginning of a project. Existing calculations on the Alison Richard Building though provide a premium of £490’050 on construction costs for achieving ‘Excellent’ over and above the baseline shell and core office. Should the measures contributing to carbon reduction be excluded the additional cost would drop to £161’500 and amount to 1.5% of net construction cost.

In the case of Chemical Engineering & Biotechnology the savings made in regard to reducing the BREEAM Target from ‘Excellent’ to ‘Very Good’ amount to £265’400 of project cost or an estimated £225’500 on construction cost (0.6% of net construction cost). These savings were then further invested into carbon reduction measures.

Although a more detailed report encompassing further buildings from the Estate would give a much more precise idea of the actual costs of BREEAM (and their break down into construction and fit-out costs, consultancy fees, etc. as well as their development upon late stage changes) these two examples confirm the general estimate of BREEAM accounting for added cost of 1/4 to 1/2 of a million Pounds.

On BREEAM

BREEAM (Building Regulation Environment and Energy Assessment Method) is one of the leading tools in environmental assessment and rating of buildings. Launched in 1990, it has since been adapted to the regulations in many countries worldwide and has been applied to more than 250,000 buildings worldwide. There are various schemes according to building categories and use. Scheme versions of special interest to the University of Cambridge are BREEAM for Higher Education (HE) 2011, BREEAM for Data Centres as well as BREEAM for Refurbishments, the latest is currently developed and is likely to be launched in 2013. BRE has consolidated most of its different schemes into one document BREEAM 2011 covering most of the building types except from ... responding to demand of unification and ease of use from users.

The BREEAM Certification requires the appointment of a licenced BREEAM Assessor and Adviser as early as possible and latest at Design Stage C of a new built project to guide stakeholders through the required steps and evidence required for achieving the targeted rating and make recommendations. Apart from the final post-construction assessment BREEAM provides for an In-Use assessment one year after completion.
On several occasions achieving BREEAM ‘Very Good’ has been perceived as a real struggle to collect evidence and deal with all the paperwork. In contrast to that in the case of the Sports Centre Phase 1 it was the second stage contractor that was motivated by being so close to an excellent score that they performed better than they were contracted. During the interview they were pleased to announce, it is also in their own interest to excel in terms of sustainability. In this case the additional cost constituted only in added work hours spent on evidence gathering. Therefore the opinion was defended that if a project has been set out in a sustainable manner from its initiation a BREEAM ‘Excellent’ rating should be fairly easy to achieve. Respectively, in design and construction of the Sports Centre were declared of marginal importance to the project (such as a transport chart attached to the wall) and not substantial improvements to the performance of the building.

The view of external consultants and contractors on BREEAM flows into a general consent that BREEAM as an already firmly established tool within the construction industry. Therefore it does not constitute a major effort and is something that will be complied with according to a clients wishes. An already very sensitivised industry with ‘green’ principles as part of the company’s policy would perform accordingly to maintain their image. Though this might not be enough to ensure best practice.

The most commonly stated reason for not undertaking BREEAM Assessment is that the standards are inapplicable to the type of building. The main reason on the other hand for not targeting BREEAM ‘Excellent’ is that the building could not have achieved excellent score. Despite the fact that a BREEAM scheme for Data Centres was available at the time design of the UoC Data Centre commenced, assessment was not pursued. A project with that high energy consumption was not expected to perform excellent or to comply with the 10% renewables rate required by Town Planning, it has been decided to invest the money improvements on energy efficiency and carbon reduction. The project currently has its own environmental sustainability strategy.

The conclusion could be drawn that the BREEAM policy is not the as strictly monitored and consistent as to secure a standard.

To the external observer BREEAM might not occur as beneficial to the future projects of the University since it provides back doors to avoid the required assessment. More worryingly BREEAM allows great flexibility for advisors or contractors to choose whether they target a certain credit or not according to current time or cost limitations.

A thorough research in the available BREEAM Assessment reports or Pre-assessment documents where a post-construction report does not yet exist, have shown that assessment and targeting of certain credits is highly dependent on the BREEAM advisor. When considered improbable to achieve, a previously targeted criteria often ends up being dismissed. The competence and loyalty of BREEAM certified advisors to the UoC has also been questioned in the course of research. Similar observation applies to criteria contradicting with the client’s wish. In such cases points of BREEAM will end up not being targeted (such as natural ventilation in the fitness rooms of the Sports Centre normally requiring mechanical ventilation) and other not relevant to the project credits would have to be targeted for the sake of achieving ‘Excellent which turns the whole assessment into a scoring game.'
A BSRIA report on the Value of BREEAM (Parker, James, 2012) summarizes the user experience that BREEAM Assessment would contribute to improvement in the quality of design and construction to a varying extent; however as many as 89% of users would admit that with a different frequency (always, frequently, sometimes) they have targeted credits that do not add value to the project as a whole but lead to a better score.

Despite the fact that minimum requirements exist for buildings of higher education to achieve excellent rating these do not necessarily coincide with the UoC high aspirations and stated mission. Energy efficiency criteria as well as criteria on materials’ embodied carbon and responsible sourcing still perform to average standards even though they comprise an important target of the UoC (see more detailed report on individual buildings in Annex B).

BREEAM 2011 HE has a minimum requirement of 6/15 credits for reduction of CO₂ emissions and installation of sub-metering for energy monitoring. However these requirements concern the carbon emissions produced by the building itself and do not cover accumulated (Scope 1 to 3) emissions’ reduction to secure the goals stated in the Carbon Reduction Management Plan, signed off by the UoC in 2009 and targeting a reduction in carbon emissions of 34% of 2005 baseline until 2020.

For research intensive facilities it is a crucial factor to have energy efficient cold storage laboratory systems and equipment. These are not mandatory credits according to BREEAM but they would account for most of the post construction energy consumption and running costs.

The pollution section does not foresee any mandatory achievements. Pollution and waste are however taken into consideration by contractors and consultants in most cases to a sufficient level of 8 to 9 out of 10 credits achievable. Therefore it is questionable to what extent BREEAM is simply certifying an already established practice or is triggering improvement as suggested by BRE.

Innovation credits are mostly limited to the appointment of sustainable procurement and responsible construction practices. Other strategies and innovation options remain unexploited mostly due to time factor and lack of connection between industries and research conducted at the UoC.

5 Quality Maintenance and User Involvement

The current Guidelines exhaust the topic of high-quality and long-life buildings design and procurement as promoted by the UoC with a brief sentence on the existence of Post Construction Reports and Post Occupancy Evaluation - the first one delivered upon project completion and the second one - three years after the building has been occupied.

Profound research in project documentation has revealed repetition of data from PCRs transferred to POEs. The main concern raised also during interviews was that PCRs and POEs are both done by the same project manager and design team and therefore tend to be repetitive and not neutral. Moreover there is not a suitable way to collect users’ opinion and data. The actual performance therefore tends to be evaluated objectively since parties tend to be mild. If survey was to be done by an independent body, they might be
### On PCRs and POEs

The PCR (Post Completion Report) is a report delivered to the Building Committee by the Project Manager and delivered upon completion of the project. It includes all basic project data. A paragraph on sustainability can be traced back into PCRs from 2011, thus not being as exhaustive in the cases where the building has no exceptional energy performance or has not adopted any special carbon reduction measures.

The Post Occupancy Evaluation (POE) is a follow-up from the PCR done typically 3 years after completion. The current situation though reveals the lack of objective opinions and exhaustiveness of the reports. The same team that was involved in design and construction would undertake the review three years after completion which makes it a quite repetitive paperwork exercise instead of a useful tool to facilitate improvement through lessons learned.

### How Suitable is BREEAM for the UoC?

**Positive Sides**
- Easy comparability and market recognition
- Constantly increasing standards increase quality and challenge industries
- Frequently updated and currently adapting to various specific types of buildings (Higher Education, Data Centres, etc.)
- Provides quantification of environmental quality
- It provides supplementary tools such as Green Lease Agreement and Green Buildings Guide for the operational stages (these seldomly get applied in the UoC practice though)

**Negative Sides**
- Did not cover refurbishments and extensions so far
- It credits ‘good intentions’ without demanding implementation
- It credits only practice it recognises in its scheme
- Involvement limited to planning team & advisor
- It is not transparent to others and targeted points are dependent on team and advisor
- Not relevant points get targeted for the rating
- It is a post-construction confirmation but does not cover the whole life-cycle of a building
- It is a valid PR tool but does not necessarily produce more sustainable buildings

### 6 Connection to Education, Research and other Academic Activities

In a presentation given by the Director of Estate Management in front of the GULF Panel, the engagement of the UoC is clearly stated to foster and learn from the discoveries of research conducted at the UoC that deals with energy efficiency and the built environment. Nonetheless, the Design Guidelines are not engaging in any form with research for innovation, but in the long term a better integration into building practice will be pursued (see further ISCN-GULF Presentation).
ON THE ARUP SUSTAINABILITY FRAMEWORK

The Bespoke Sustainability Framework was developed for the alteration and refurbishment project of the Arup Building on New Museums Site Campus. It was developed during Design Stage C and will be pursued into construction stage. It also envisions tools to evaluate the project after the building has been delivered to its new occupants which will allow better monitoring by Sustainability Champions during its operational stage.

The Arup Sustainability Framework is a tool tailored to the refurbishment project and has set a precedent for the University of Cambridge. Because of the project’s size and the uniqueness of the building and refurbishment project, it was determined that developing a Bespoke Sustainability Framework would be appropriate also due to the lack of a BREEAM scheme to assess refurbishments.

The current estimate of the cost of developing the framework is £15,000 or approximately 0.12% of the total capital cost so far. It is unlikely to exceed 1% by the end of the project and comprises of the consultation fee. The Framework provides additional value, however, beyond simply making the building more sustainable. The Framework has sparked the engagement of a wide range of stakeholders which is expected to continue to benefit the University in the long-term. It sets realistic goals, consults all participants and then responds adjusting deadlines and targets. There is a high degree of overlap between the framework and BREEAM, and a BREEAM Assessor has acknowledged that the Arup Building would likely have achieved a ‘Very Good’ if it had been assessed at Stage C. Despite this there are valid concerns about adopting a bespoke approach. For one, it should be easy to perform excellent in categories the client has set and monitors themselves and which targets are frequently adjusted, the reality shows that the targets are even overhauled in certain areas. It is certainly beneficial that the sustainability advisor has preserved their independence by staying contracted on the client’s side in Stage 2 of the development. That means that the process of goal setting and their commissioning are procedurally separated. Focus groups also play their role as an additional voice and overseeing body to the whole process.

It is beneficial that the users are very environmentally sensitive and engaged. Prestige and positive PR are a motivation to excell. Pressure is placed on the contractor rather by the users and not by the client.

Upon asking the Sustainability Advisors, they find a Bespoke Framework for new developments might not be as efficient as an established BREEAM scheme is. It is though likely to be as successful given the future users are known and involved from the very beginning. Addressing the actual users and their predicted real loads makes a more precise estimate of the future energy consumption. Users and maintenance engagement is also likely to increase the chances that a building will be not only efficiently built but also smartly operated. Pressure from colleagues and other teams can motivate better environmental performance in areas such as recycling or energy conservation.

HOW SUITABLE IS A BESPOKE FRAMEWORK FOR THE UoC?

**Positive Sides**

- Engages stakeholders at an early stage
- Secures on-going engagement & compliance by giving parties a voice and herewith responsibilities
- Identifies project specific targets and weighs them flexibly
- The final goal is a sustainable building for all which relieves the pressure to achieve a score
- Focuses on the users’ feedback and future operation in acting preventively
- It is based on BREEAM, but focuses more on coordination and involvement of parties
- User-friendly & Social related
- Covers also refurbishments and extensions

**Negative Sides**

- Credibility concerns (Setting the targets yourself, you are likely to achieve them & excell)
- It is highly project tailored (It can be applied only after having been revised and abstracted)
- High level of involvement and environmental consciousness of all stakeholders as a prerequisite
- Risk of insufficient involvement of users in the future
- Untested practice for the UoC (Pilot Project)
If BREEAM is the tool to assess how sustainable a building is, then it should be fairly straightforward endeavor to compare buildings based on the number of credits each building received. Despite the challenge, that BREEAM Schemes have evolved with time and requirements have changed, certain conclusions can be made after surveying the BREEAM sections which deal with energy and carbon footprints.

**BREEAM Performance in Relevant Categories (Source: BREEAM Reports and Assessment Papers)**

A brief comparison of some of the recent BREEAM rated UoC projects reveals that even buildings rated ‘Very Good’ or ‘Excellent’ and expected to perform accordingly, score average in the sections that directly relate to energy efficiency and carbon emissions. In the carbon emissions reduction section a building would **achieve an ‘Excellent’ rating if it scored 8 to 10 credits out of a possible 15. Buildings rated ‘Very Good’ would score even lower.** Despite the fact that the University has a stated policy to **reinvest savings into carbon reduction measures if rating drops to ‘Very Good’ the buildings do not score better in the category.**

**BREEAM Performance in Relevant Categories (Source: BREEAM Reports and Assessment Papers)**

A closer look into credits scored in the Materials and Pollution sections reveals the embodied carbon and future operational emissions have been a very low priority. Since materials as well as sustainable IT Solutions and Lab Equipment become a topic at a much later stage of construction they **are the ones most likely to get sacrificed when cost savings need to be made.** Material sourcing and choice of equipment and fit-out then lay in the hands of the contractor and not necessarily coincide with the initial design plans nor with the carbon reduction goals of the University.
This situation is counter productive to improving overall building performance. It would be wiser to pursue a more ‘preventative’ approach rather than treating symptoms once problem manifest during the operational stage. Reduction of responsibly sourced materials and insulation from the Green Guide A/A+ Rating does reduce the cost for consultants and contractors time and also increases the flexibility of supply chain (direct cost savings) but in the long term the building is also likely to miss CO₂ targets and hinder progress toward the University’s energy efficiency goals.

A cost survey undertaken for the Chemical Engineering and Biotechnology Building identifies measures for CO₂ emissions reduction as the largest potential area for cost saving should the targeted rating be reduced to ‘Very Good’. Those also seem to be the ones that get cut first when it comes to cost saving.

<table>
<thead>
<tr>
<th>BUILDING</th>
<th>IFM</th>
<th>HAUSER</th>
<th>SAINSBURY</th>
<th>KAVLI</th>
<th>ALISON</th>
<th>MSM</th>
<th>SPORTS</th>
<th>ASTROPHYS</th>
<th>CEB</th>
<th>MAX</th>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
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<td>Excellent</td>
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<td>Excellent</td>
<td>Very Good</td>
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</tr>
<tr>
<td>Lab Fume Cupboards</td>
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<td>N/A</td>
<td>2</td>
<td>N/A</td>
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<td>1</td>
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<td>N/A</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

BREEAM PERFORMANCE IN RELEVANT CATEGORIES (SOURCE: BREEAM REPORTS AND ASSESSMENT PAPERS)

A further frustration for participants comes with the rigidity of BREEAM and its failure to recognise generally good and sustainable design simply because it does not fall into any category. Functional requirements of the building (for example special requirements for lab spaces or sports areas) would often preclude the possibility of achieving an ‘Excellent’ score in certain categories such as natural ventilation.

A more tailored approach that addresses specific project requirements could be more advantageous were all stakeholders to be involved in setting realistic targets.
The UoC Environmental Design Guidelines are currently not facilitating the construction of sustainable buildings. The Guidelines cover only New Build Projects and address solely the environmental side of sustainability. Co-existence of several relevant documents causes confusion. The growth rate of the Estate with currently approx. £ 300 Million Capital Projects Cost (as in May/June 2013 Report) however requires a stricter and more consistent approach to all three aspects of sustainability which should be consistently applied to all major projects (not only the 40% of projects which are new builds). Without stricter standards the university is unlikely to achieve its high energy and carbon reduction targets. The university should therefore issue and clear and consistent policy as to whether BREEAM Assessments will be targeted and which framework will be used.

CONCLUSIONS

FURTHER RESEARCH REQUIRED:

- Commission a more precise cost analysis of recently completed projects that focuses on the cost to achieve BREEAM ‘Excellent’ and the corresponding environmental performance of the University Estates

- Prepare a simple table overview of the absolute CO₂ emissions and energy consumption for all the new builds of the Estates and trace back the environmental performance of BREEAM ‘Excellent’, ‘Very Good’ Buildings or a Bespoke Framework.

- Commission an early stage separate cost tracking for BREEAM related consultants’ fees, improvements to building fabric and equipment, etc., for all new projects of the UoC

- Revise the policy to determine whether floor area or capital cost are the right measure or rather more the expected footprint, whether a project should target a BREEAM ‘Excellent’

- Explore the feasibility of creating a position for an University internal BREEAM/Sustainability Advisor (cost involved, existing practice at other universities, etc.)

Who?

Cost Surveyors
Energy Manager
Maintenance
Cost Surveyors
Environment & Energy Section
Focus Groups for the Environmental Policy Review
Environment & Energy Section
3. **WHAT SHOULD IT BE?**

This part of the report deals with the aspirations for the Design Guidelines as a tool that should facilitate sustainable practice throughout the Estates of the University of Cambridge. The following recommendations on how the tool should perform and on the content of it have been developed after researching other universities’ practices, other existing framework documents and after speaking with internal and external experts. These recommendations also reflect the personal view of the writer and could be further expanded.

1. **Congruent with other University policies**

   The Design Guidelines should be simultaneously a self-sufficient tool and yet link to other relevant University policies (such as Environmental Policy, Waste & Water Policies, etc.). Redundancy should be kept to a minimum and responsible parties should be clearly delineated.

2. **Holistic approach / Comprehensiveness**

   The new Design Guidelines should include all three aspects of sustainability - environmental, social and economic, and should recognize their equal importance.

3. **Estate Wide Approach**

   The guidelines should encourage widespread engagement in sustainability matters and tailor engagement strategies to the scale and type of project (refurbishment, new build, extension, fit-out, etc.).

4. **Full Life Cycle Approach & Future Adaptation**

   The Design Guidelines should include all project stages from the feasibility study to operational stage or even demolition. They should engage all stakeholders, clearly delineate responsibilities and inform the process of project development at any point. They should also highlight sustainability in any future changes of occupancy or adaptations of the building.

5. **Secure pioneering role of the University of Cambridge**

   The aspirations of the UoC to lead by example in sustainability matters should be clearly stated. It should also promote networking with other institutions and universities. The Design Guidelines should motivate innovation in being more descriptive about what the university hopes to achieve, rather than simply defining the minimum requirements.

6. **Flexibility of use**

   The Design Guidelines should be written in a way that makes them easy to understand and use by all stakeholders. They should clearly outline responsibilities and timeframes for involvement. User-friendliness should be a high priority in order to encourage engagement in the rather convoluted building process. Simplicity will make them useful at different levels of detail and output.

7. **High adaptability of the framework**

   The Framework should be as flexible as possible to adapt to future requirements and higher targets without compromising the integrity of the document.
8. Transparency for credibility

Transparency in how the UoC is dealing with sustainability issues has to be a high priority in order to garner credibility with external audiences and to also meet the expectations of university staff and students. The Design Guidelines could be an engaging and powerful PR tool for the UoC for their external appearance and for setting an example to trigger behavioral change and educate the public.

9. Networking

The Design Guidelines should build upon existing good practice and enhance it instead of developing new and untested schemes. Learning from the experience of others and sharing progress is a good way forward.

10. Design and Operation as a common target

The Design Guidelines shall recognise the fact that building envelope cannot be separated from the actual use. In order to minimize the University’s environmental footprint the Guidelines must also apply beyond the design phase and confront building occupancy as well. The Guidelines should envision tools to secure all actors would have a continued commitment to the Estates.

11. Centrally coordinated to ensure information dissemination

Because of the number of people involved in a building project, responsibilities can become blurred. To address this, the Design Guidelines should coordinate and centrally supervise the process. The role could be overtaken by the newly formed Environment & Energy Section.

12. Visually pleasing and engaging.

We live in an era of visual communication.
Rating tools: Are they the Answer?

A multitude of rating systems have been developed worldwide to provide simple and transparent methods of assessing the environmental and social impacts of the built environment. Tools to measure the energy as well as general impact of buildings have gained popularity as a tool to demonstrate engagement and improved sustainability to the public. The impact of rating tools however tends to be exaggerated for most of them address only certain project stages or are a static picture of the overall performance at the end of construction. Therefore they are not necessarily maximising sustainable outcomes for a development and do not necessarily promote easy comparability of projects for benchmarking.

An extensive analysis of existing local, national and international tools undertaken by Arup Sustainability in 2004 for the Brisbane City Council confirms the above statement. High, medium and low priority evaluation criteria have been set and workshops have been conducted with the City Council to filter available rating tools in a second stage and recommend the most appropriate one that will serve the needs of the client and improve their performance in terms of sustainability and according to the prioritised criteria.

The study is relevant to the University of Cambridge because it has looked specifically at the usefulness of rating tools to large institutions. Rating tools are often designed to suit a specific country’s legislation and therefore could be perceived as superimposed or easy to skirt if there is a back door.

Some of the tools are applicable and have been adapted for different countries such as BREEAM but tend to inform the project in an already advanced design stage and therefore do not provide tools to engage all stakeholders from the very start. BREEAM would tend to document achievements as opposed to motivating progress, as it once may have when it was initiated in 1990 as a pioneering scheme.

The Arup Sustainability Report concludes that the use of sustainable rating tools alone is not the solution to delivering sustainable buildings.

Is A Bespoke Framework the Answer?

The development of a Bespoke sustainability framework such as the one recommended by Arup Sustainability seems to be the proper solution that would best suit the needs of the UoC. Since a bespoke framework can only be developed with the input and engagement of many stakeholders it is more likely to promote buy in across the university from students and staff and motivate innovation.

This has been already recognised and targeted as a potential successful strategy by the UoC for the forthcoming review of the environmental Policy of the UoC. It will involve specialist across the University and will be developed in workshops with focus groups to secure the majority would identify with the future policy.

A higher level of engagement and identification with the tool can be achieved which will secure a better overall performance. It also could be incorporated into the various structures of the institution and encompass all departments and administration.

Such a framework could also be created to encompass the rest of 60% capital projects (refurbishments and extensions) and is therefore more likely to yield meaningful progress toward the university’s sustainability goals.

Rating tools might have their role inside this broader framework (see Arup Sustainability Report). Such a framework would have a fixed set of minimum categories and criteria to guide and assess performance. It will also allow priorities to be modified with time.

In practice, a bespoke framework already exists at the University of Cambridge, which will make the development of the next iteration much easier. The Arup Building Refurbishment Framework engages not only with the building fabric but also with future users from the very start and has so far been seen by stakeholders as a positive and motivating new approach.
4. How should it be achieved?

Due to the complexity of the matter and the long-term impact the Design Guidelines are likely to have on the built environment a phased development is proposed. It should include all the steps from initial calculations and target setting through development of the framework and its supplementary tools and its final stage: an optional web-based platform. All suggested phases are further discussed in detail in terms of content, timing and overlapping of processes, milestones and people involved and are also represented in a timeline. The phased development of the framework is envisioned in line with the forthcoming review of the UoC Environmental Policy.

Diagram of Proposed Phased Development and Corresponding Timeline below
Phase 1 - Backcasting & Data Gathering

Phase 1 is dedicated to setting new and ambitious though realistic targets for sustainable performance which would clearly commit the University of Cambridge to being a pioneer in sustainability. Backcasting approach is recommended and forming working groups of representative users, internal and external experts for data gathering, calculations and commissioning of further investigations and analysis reports where necessary. Schedule review frequency and time plan for producing the necessary reports, conducted research and stipulate responsibilities

Time estimate: 6-12 months

As the diagram to the right from the Carbon Management Plan 2010-2020 (CMP) shows, in order to meet HEFCE’s requirements the University must reduce carbon emissions by 60% until 2020; however, at the same time the University has a continued growth of 8% annually which only adds up to its footprint instead of decreasing it.

From the latest annual report of the Energy and Carbon Reduction Project (ECRP) (Dated 13/2/2013) it becomes apparent that undertakings in relation to the CMP’s targets concern only the existing buildings and their optimization and have not considered new builds until now.

In order to meet the carbon reduction target by 2020 however, efforts should not remain limited to Scope 3 emission and to retrofitting existing buildings but should in practice aim for a zero impact or a negative footprint of the new builds to ‘build up an allowance for existing buildings to adapt’.

Backcasting Targets

Adopting a back-casting approach could facilitate achieving targets and could be applied both with carbon emissions as well as with other relevant criteria. Having a strict maximum absolute value of allowed CO₂ emissions for construction and operational stages i.e. is a good starting point to adopt any measures available to achieve it instead of limiting the design with regulations (such as the 10% Merton Rule on Renewables.) A generous policy that allows a future achievement of the goal is a harder one to commit to and assess achievability.

Assess Full Cycle

Assessing the emissions and energy consumption of the building fabric separately from the energy consumption arising from academic and scientific research is inappropriate, particularly given the fact that many excellent rated new buildings have performed poorly once occupied.

An absolute level of combined emissions as a back-casted figure and increased involvement of stakeholders should allow for flexible adjustments during design, construction and operational stages. Research intensity cannot be an excuse to improve poor performance but rather a motivation to progress and a motivation to engage external funding bodies to help realize the UoC’s high aspirations.

A limit in emissions and energy used is likely to provoke decrease of demand or at least force stakeholders to explode more renewable energies and low carbon technologies and equipment.

Such an approach could also overhaul BREEAMs post-construction evaluation since it relates to the full life-cycle of a building.

Demands from the building change with occupancy change. Frequently adjusted absolute targets would secure a steady footprint and user compliance.
Setting strict priorities and concrete targets to know where one is heading helps maintain focus and improves performance.

1. **Form Focus Groups**
   Borrow best practice categories from Arup Sustainability Framework and BREEAM; abstract them to suit the general sustainability policy of the UoC and to encompass all project types. This process could comprise a part of the forthcoming review of the University Environmental Policy due to time overlap.

2. **Set New Absolute Targets**
   Revise the current targets for the footprint of the UoC (Carbon Emissions, Ecological Impact, Transport, Waste, Water, etc.) or set new targets where inexistent until now. If necessary, commission external experts to do backcasting calculations for absolute targets for the various categories and sub-categories.

3. **Further Analysis/Research**
   Campus-wide strategies should be commissioned in order to produce a more comprehensive picture and to foster wider understanding of sustainability issues. This process will also generate a pool of possibilities that can be drawn on for future projects (as low carbon technologies, biomass collection for composting, etc.).

**Who?**
- Environment & Energy Section
- Estate Development
- Academic (Research Groups)
- External Advisors
Phase 2 - Framework Development

Using the Arup Sustainability Framework criteria as the starting point and the BREEAM categories as a reference, the University should produce a set of short and targeted framework documents for each category (ca. 1 page per sub-category). They should layout the time frame, responsibilities and universities vision on the topic and cover design, construction and operational stages. Individual papers could be then reassembled according to project scope and stage. Focus groups of future users should be a centrepiece of the process and will help ensure targets are tailored to each project.

The currently developed Bespoke Sustainability Framework for the refurbishment of the Arup Building offers an excellent starting point. Moreover it relies on the BREEAM scheme, therefore it is drawing on the best practices from both frameworks. Abstracting the sustainability aspirations of the UoC from those frameworks will help to put them in a tool that can be readily applied to nearly any future project.

The ten main categories defined by the Sustainability Advisor during focus groups meetings with the future users of the Arup Building are:
- Energy and Carbon
- Biodiversity and Ecology
- Collaboration and Inclusion
- Education and Outreach
- Health and Wellbeing
- Transport and Mobility
- Materials
- Pollution
- Waste
- Water

[Outdoor Public Space is a sub-category suggested for consideration are not enough quality and weather protected outdoor spaces for staff and students to linger]

Heritage Issues
Compostable Waste

None of these (sub-)categories impose strict values but facilitate discussion and invite engagement and careful consideration from a wide array of parties. They also should not limit the possible ways to reach a target (such as 10% renewables or passive design rules being just one of many possible solutions that could be adopted).

The content of the framework sections and sub-topics should include (see also excerpt from the Arup Evidence Handbook to the right):

1. Aim of the target (Why is it important to UoC)
2. Minimum Requirements & Desired Output
3. Responsibility (Who is in charge?)
4. Relevant Project Stage

Treating all categories separately will ensure they are simple to grasp, easy to review and update and would more clearly define responsibilities. Moreover a different set of criteria can be assembled according to project scale and type and can be modified in focus workshops.

In this context, a best practice to follow is Harvard’s University’s strategy of differentiating between 4 project levels. This makes it easy to identify relevant points for any project and the involvement required (be it a new build, refurbishment or extension). Cambridge should adopt this policy and include all estate projects, rather than dismissing assessments due to the inapplicability of a few of the criteria.

A fine grained frame with plausible rules of application would secure credibility and comprehensiveness due to transparency of the scheme to all participants and the public.
A break down to easy to define and control units allows recombination, delivers transparency and makes it easy to keep components up-to-date.

### E-1 FABRIC PERFORMANCE

#### Aim
To reduce demand for space conditioning energy consumption in the Arup Building through improvements to the building fabric and air tightness.

#### Assessment Criteria
The following is required to demonstrate compliance:
1. Comply with minimum U-values in Building Regulations Part L 2013 as far as practically possible in agreement with Building Control
2. Achieve an overall air tightness for the building of ≤ 5 m³/m²·h @ 50Pa.

#### Schedule of Evidence Required

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Design Stage</th>
<th>Post-Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Part L modelling report approved by Building Control including confirmation of all major elemental U-values. Proposed insulation thicknesses specification, including baseline U-values and overall area weighted reduction in steady state heat loss.</td>
<td>Sustainability Framework Assessor’s site inspection report verifying workmanship of insulation and specification of insulation against design stage drawings.</td>
</tr>
<tr>
<td>2</td>
<td>Baseline air tightness confirmed via pressure test. Presence of air tightness target and specification of measures to achieve required reduction levels.</td>
<td>Air-tightness certified via pressure test.</td>
</tr>
</tbody>
</table>

#### Relevant Definitions

- **Part L2B 2010**: ‘Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings’

#### Ownership and stakeholders

- Contractor led design team to take ownership and compile evidence.

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**1. ** **Abstract Criteria Set**

- **Define Aims** and develop clear position of the UoC for every category and sub-category.
- **Define responsibilities** according to project stage.

**2. Clearly Categorise**

- Clearly designate all sub-topics according to their relevance to scope and project type as well as according to ownership of the credit. The more categories a sub-topic fits into, the finer the granularity and preciseness in the algorithm of how criteria gets reassembled in the application of the framework and engagement required.

---

**Who?**

- **Environment & Energy Section**
- **Estate Development**
- **Academic (Research Groups)**
- **External Advisors**

---

**Who?**

- **Environment & Energy Section**
- **Focus Groups**
Phase 3 - Supplementary Tools

Phase 3 is designed for the assembly and supplementary tools, procedures and documents that should facilitate the implementation of the Sustainability Framework but do not necessarily comprise a crucial part needed before implementation can begin. These additional tools are likely to strengthen the power of the Framework as a tool, increase its visibility across all university structures and among all people, permanent staff, visitors, public bodies, and secure its long-term successful application. The proposed tools are just a set of possibilities that could be expanded with all tools part of a bigger framework.

The suggested supplementary tools are following the example of best practice across industry and other universities, but are also in line with recommendations made by UoC project managers and external advisors. Some of them are also recommendations made after observations of the current operational practice across the UoC Estates. The aim of these supplementary tools is to be incorporated as a preventive tool at project initiation instead of being a cure once operational problems have already occurred and also help to design buildings in a tailored and sensitive approach for case-to-case best solution and performance.

1. Continued engagement of stakeholders.

Workshop Guidance Framework shall facilitate focus groups sessions and help maximise results. This tool shall also focus on the future responsibilities the users/responsible champions would have.

2. Challenge Agreements for Funding body

As envisioned by the CRP 2010-2012 mechanisms should be developed that ensure ‘the management of carbon emissions formally becomes part of the University planning process’. A set of sign-off commitments could be developed to allow passing of costs associated with carbon emissions to commissioning funding body to secure an independent best practice of UoC.

3. Green Lease Agreement

A document that would ensure that set targets would be complied with and UoC values would be respected, even if the occupants or purpose of the building changes with time. A Green Building Guide as well as a responsible committee or person to contact could be appointed.

4. Standard Evaluation / Documentation Forms

Both architects and occupants have expressed a desire for an ongoing commitment after project delivery. Evaluation and documentation standard forms can be developed to have a quick uncomplicated and frequent feedback for quick reaction from maintenance and environment and energy teams. These forms can inform a more engaging and transparent post-occupancy evaluation reports with valid users opinions and recommendations centrally available.

5. Green & Financial Incentives

A cost-by-cause principle could be introduced in tenancy/lease agreements as a financial incentive towards behavioural change. On the other hand performance beyond set criteria shall be rewarded and encouraged. Smart PR tools to communicate performance internally and to the public can be beneficial.
### On Green Lease Agreements

**Green Lease Agreement** is a tool envisioned particularly for **Shell & Core** developments where fit-out or finishing is left to be commissioned by future tenants themselves.

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### Harvard Green Building Standards 2009 (Source: Harvard University)

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Whole Building</th>
<th>Fit-Outs</th>
<th>System Upgrades</th>
<th>Non-Energy</th>
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<td>Project Scope</td>
<td>New Buildings and Building-Wide Full-Cut Renovations</td>
<td>Partial Building Interior Fit-Outs</td>
<td>Limited Scope Projects w/ Energy and GHG Impact</td>
<td>Limited Scope Projects w/ No or Limited Energy and GHG Impact</td>
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<td>Multiple Building Systems</td>
<td>One or Few Building Systems</td>
<td>One or Few Building Systems</td>
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<tr>
<td>Energy Modeling and GHG Calculations</td>
<td>Level I</td>
<td>Level II</td>
<td>Level II</td>
<td>NA</td>
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</tbody>
</table>

---

### 2.3. CO₂ performance

Q5) *Do you want to put in place an absolute target for in-use CO₂ emissions performance?*

If you want the operational carbon performance of the finished, operational building to be a key focus of the project, you should answer yes. The setting of this kind of target will cascade a series of other activities which should be aimed at improving the carbon efficiency of your building.

### 2.4. Energy performance

Q6) *Do you want to put in place an absolute target on in-use energy performance?*

---

### 1. Scope Definition Tool

Consult Harvard Green Building Standards Document and the Oxford Scoping Questions on how to develop a tool to identify issues relevant to a project at an early stage and facilitate assembling criteria set.

### 2. Secondary Framework

Clearly designate all sub-topics according to their relevance to scope and project type as well as according to ownership of the credit. The more categories a sub-topic fits into, the finer the granularity and preciseness in the algorithm of how criteria gets reassembled in the application of the framework and engagement required.

---

### Who?

Environment & Energy Section  
Estate Development

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### Who?

Environment & Energy Section  
Focus Groups  
External Specialists
PHASE 4 - INTERACTIVE PLATFORM (OPTIONAL)

The proposed Phase 4 is an optional step, building upon the previous three phases and suggesting an interactive element to the life-cycle approach adopted already. Since all prerequisites now exist and the information has been prepared in a detailed way, developing a platform with an easy interface and engaging interactive content and modern approach should be an easy step. It benefits from the breaking down to smallest and controllable units of information and small achievable targets and responsibilities in the previous steps and clothes them in a modern web-based, highly accessible and user-friendly platform.

The new web-based tool will facilitate sustainable behavior in the design, construction, and in use stages. It will address all three aspects of sustainability and extend even over digital sustainability issues.

It will state the clear vision of the University of Cambridge to excel in sustainability and in its field. Clear instructions on how to use the tool as well as its application and different output media shall be included. The role of Estate Management should be clearly defined. The tool will include all the previously developed documents on categories and sub-categories and will define responsibilities, aims, evidence required for the various stages. An interactive and web-based platform would deliver an easy to reproduce and flexible tool.

1. Engage & Include

The tool would engage all stakeholders involved in the project and across the institution. It will have a colour coded interface and icons to be visually clear and user-friendly so that responsibilities and progress are easy to track.

2. Target oriented & Inclusive

The tool is focused around the backcasted targets in the various sub-categories and mediates between targets and stakeholders all project stages. Adjustments to the target directly affect the diagram and are visible live for project participants to take actions.

3. Credibility

Being transparent to any project participant and open to the public with the user based categories restrictions would increase the credibility of a bespoke approach since anyone can check live how sustainable the building actually is - something not given by a static certificate showing a rating dating back to time of construction. A quick reference output on a dashboard or as a phone application generated to educate the public on their footprint is likely to trigger behavioural change.

4. Coordination and supervision

All sustainability issues could be brought under one umbrella supervised by the Environment and Energy Section and monitored closely at all stages of a project. That would also allow frequent evaluation and reaction to change of requirements and policies, University’s and Government’s.
Scoring the interim assessment

In order to provide an indication of the overall performance of the design interim assessment, a scoring wheel, shown in Figure 2 has been developed; the key for this wheel is given in Figure 3. As shown, each individual segment of the scoring wheel covers a sub-topic and indicates the number of criteria to be achieved within the targets. The segments have been partially shaded to illustrate the current level of performance against the base requirements. Any risks that were flagged at the meeting have been highlighted, towards the centre of the wheel.

Arup Sustainability Framework Stage E (Source: Buro Happold)

Key for Scoring of Formal Evidence (Source: Buro Happold)

1. **Software Commissioning**
   
   An interactive tool is commissioned to deliver a web-based easy accessible and user-friendly platform that centralises information and can be adopted in design, construction or occupancy stage.

   **Who?**
   
   Environment & Energy Section
   Software Developer
   User Groups
   Academic/Student Groups

2. **Creative Commons Licence**

   Dissemination and PR of the tool across international and national higher education institutions and other interested parties. This step would promote the UoC leadership and also make the tool transparent for external evaluation.

   **Who?**
   
   Environment & Energy Section
**Diagram of how the platform relates to other existing tools, policies and monitoring.**

**Benefits**
- Exists in a non-interactive form already
- Weighting of categories is flexible
- Recognisable and familiar across institution
- Solid basis to start from at workshops and focus groups
- Web-based = Accessible from anywhere
- Different filtering & user permissions
- Life-Cycle oriented and not static assessment
- Transparent and Comprehensive
- Independent tool for Sustainability
- Easy to Update

**Challenges**
- Digital Sustainability and Property Rights
- Permanence and Stability of the Tool

**Potentials**
- Partnership with institutions
- Branding image (social media, mobile apps)
- Popular with staff and students
- Adaptable for Dashboards/Display Systems
- Direct Link and Evaluation from Sub-metering data
- Potential to integrate Long-term research and innovation
- Bring Digital Sustainability into Discussion


**TARGET ORIENTED**

**PERMANENT MONITORING OF PERFORMANCE**

**ADJUSTMENT** OF TARGET ALLWAYS POSSIBLE

**ENGAGING INFORMATION & INTERFACE DESIGN** (Source: oberhaeuser.info)

**DIFFERENT LEVEL OF DETAIL >> APPLICABLE ACROSS INSTITUTION**

**VISUALLY CLEAR >> USER-FRIENDLY INTERFACE, COLOUR CODED**

**REGULAR & DIRECT** FEED OF INFORMATION

**INFORMATION & INTERFACE DESIGN** (Source: oberhaeuser.info)

**CLEAR RESPONSIBILITY**

**HYPERLINK TO RELEVANT POLICIES & DOCUMENTS**

**TRANSPARENCY & INVOLVEMENT OF ALL STAKEHOLDERS**
ANNEX: REFERENCES & LITERATURE

17th June 2013

BUILDINGS COMMITTEE PAPERS
\internal\division\EM\Uni&EM Committees\Buildings Committee

UNIVERSITY OF CAMBRIDGE GUIDANCE DOCUMENTS
http://www.admin.cam.ac.uk/offices/EM/sustainability/environment/guidance/index.html

COMBE, M., A how to guide for using the Building Research Establishment Environmental Assessment Methodology (BREEAM) Retrieved from http://www.slideshare.net/MatthewCombe/breeam-presentation

18th June 2013

ARUP SUSTAINABILITY FRAMEWORK

UNIVERSITY OF MASSACHUSETTS DESIGN GUIDELINES

UNIVERSITY OF ST. ANDREWS

UNIVERSITY OF MELBOURNE MASTER PLAN 2008

HISTORY OF THE UNIVERSITY OF CAMBRIDGE

HISTORY OF THE UNIVERSITY OF CAMBRIDGE

STRUCTURE PLAN CAMBRIDGE
http://www.cambridgeshire.gov.uk/NR/rdonlyres/E5D7DF57-9987-481F-9BFE-78B0D0D27BAE/0/StructurePlan.PDF

CITY OF ZURICH SUSTAINABILITY
http://www.stadt-zuerich.ch/content/hib/de/index/hochbau/nachhaltiges_bauen/lsp4_tf3/grundlagen.html#bauen_fuer_die_2000-watt-gesellschaft
http://www.stadt-zuerich.ch/content/hib/de/index/hochbau/nachhaltiges_bauen/vorgaben.html

COMPETENCE CENTRE FOR ENVIRONMENTAL DEVELOPMENT
http://www.cces.ethz.ch/downloads/index

SWISS FEDERAL OFFICE OF LAND DEVELOPMENT PAPERS ON SUSTAINABLE DEVELOPMENT
http://www.are.admin.ch/themen/nachhaltig/02519/03697/index.html?lang=de

SWISS FEDERAL INSTITUTE OF TECHNOLOGY GUIDELINES
http://www.vs.ethz.ch/standortentwicklung/science_city
http://www.vs.ethz.ch/standortentwicklung/index
http://www.ressourcen.ethz.ch/real_estate/hoenggerberg/hib

GOOD CAMPUS RESOURCES AND TOOLS
http://www.goodcampus.org/resources/index.php?siteID=0

HISTORIC MAPS OF THE UNIVERSITY OF CAMBRIDGE
http://www.old-maps.co.uk/maps.html

CSR CASE STUDY ON ARUP CORPORATE SUSTAINABILITY

19th June 2013

HARVARD GREEN BUILDINGS INITIATIVE, 2009
http://green.harvard.edu/theresource/building-standards

UNIVERSITY OF MELBOURNE SUSTAINABLE CAMPUS GUIDELINES

20th June 2013

SUSTAINABLE CAMPUS NETWORK
http://www.international-sustainable-campus-network.org/

INTERNATIONAL SUSTAINABLE CAMPUS NETWORK
http://www.novatlantis.ch/sustainable-campus.html

GREEN REPORT COMPARISON OF UNIVERSITIES GOOD PRACTICE US
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<td>27th June</td>
<td>Greening Spires, Universities and the Green Agenda, Universities UK, 2008</td>
<td><a href="http://www.universitiesuk.ac.uk/highereducation/Pages/GreeningSpires.aspx">http://www.universitiesuk.ac.uk/highereducation/Pages/GreeningSpires.aspx</a></td>
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<td>AUDE Estate Management Toolkit for a Sustainable Estate Development</td>
<td><a href="http://www.aude.ac.uk/info-centre/goodpractice/universitiesplanningguidance">http://www.aude.ac.uk/info-centre/goodpractice/universitiesplanningguidance</a></td>
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<td>Green Building Partnership</td>
<td><a href="http://www.greenbuildingpartnership.co.uk">http://www.greenbuildingpartnership.co.uk</a></td>
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<td>Guidelines from the European Commission</td>
<td><a href="http://www.ukgbc.org/content/measurement-and-reporting">http://www.ukgbc.org/content/measurement-and-reporting</a></td>
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28th July 2013


Building and Land Use Tool Comparison http://www.petus.eu.com/
My gratitude goes out to the Environment and Energy Section, Estates Management, and the other IARU Fellows and Summer Interns for their highly appreciated support during the research phase and for creating such a pleasant working atmosphere. I deeply hope this report as well as the supplementary documentation will help inform an even more sustainable future for the University of Cambridge.

Ivelina Grozeva
IARU Fellow, ETH Zurich, Summer 2013