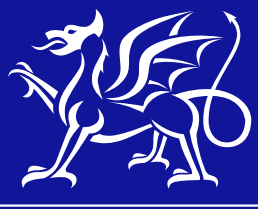

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Technical Analysis on the Implications Arising from BREEAM 2011 on the Planning for Sustainable Buildings National Planning Policy

Final Report

This research was prepared for the Planning Division of the Welsh Government by Mott MacDonald in January 2012.

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Background and Objectives

Planning Policy Wales (Edition 4) stipulates a requirement for all new build non-domestic development to achieve a BREEAM 2008 'Very Good' rating, with a minimum of six credits achieved under BREEAM issue *Ene 01 – Reduction of CO_2 emissions*.

BRE Global Ltd published an updated version of BREEAM in 2011, which accounts for changes made to England and Wales Building Regulations Part L 2010. All new development after 1st July 2011 seeking a BREEAM assessment must be registered against the new BREEAM 2011 New Construction Scheme.

Welsh Government has commissioned this research to assess the implications arising from BREEAM 2011 on Welsh Government's planning for sustainable buildings national planning policy, contained within Section 4 of Planning Policy Wales.

Disclaimer

This document should not be relied upon as a design guide for building development, or in carrying BREEAM assessments. The assessment carried out is purely a theoretical analysis in order to verify the effect on Welsh Planning Policy.

The cost calculations and assumptions made in this building analysis have been prepared for the purpose of identifying the strategic level implications of BREEAM 2011 on Planning Policy Wales, and should not be used for any other purpose.

The research undertaken for the purposes of this report refers to new build non-domestic buildings only.

Acronyms & Abbreviations

AC	Air Conditioned
ALO	Architectural Liaison Officer
AI	Accessibility Index
AP	Accredited Professional (BREEAM qualification)
BER	Building Emission Rating
BMS	Building Management System
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
BS	British Standard
BS EN	British Standard European Norm
BUG	Building User Guide
CABE	Commission for Architecture and the Built Environment
CHP	Combined Heat and Power
CIBSE	Chartered Institute of Building Services Engineers
CO_2	Carbon Dioxide
CPDA	Crime Prevention Design Advisor
DELC CO_2e	Direct Effect Life Cycle CO_2 equivalent emissions
DF	Daylight Factor
ECA	Enhanced Capital Allowance
EER	Energy Efficiency Ratio
Ene	BREEAM Energy Environmental Section
EPC	Energy Performance Certificate
EPR_{NC}	Energy Performance Ratio for New Constructions
FRA	Flood Risk Assessment
GWP	Global Warming Potential
Hea	BREEAM Health and Wellbeing Environmental Section
HVAC	Heating, Ventilation and Air Conditioning
IAQ	Indoor Air Quality
Kg	Kilogram
kW	Kilowatt (unit of power)
ILE	Institute of Lighting Engineers
IT	Information Technology
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
LE	BREEAM Land use and Ecology Environmental Section
LZC	Low or zero carbon technology
m^2	Metres squared (area)
Man	BREEAM Management Environmental Section
Mat	BREEAM Materials Environmental Section
Min	Minimum
MM	Mott MacDonald
NO_x	Nitrogen oxide (Emission associated with combustible fuels)
O_x	Oxygen
POE	Post Occupancy Evaluation
Pol	BREEAM Pollution Environmental Section
RIBA	Royal Institute of British Architects

SD	Scheme Document
SuDS	Sustainable Drainage Systems
SWMP	Site Waste Management Plan
TER	Target Emission Rating
Tra	BREEAM Transport Environmental Section
VOCs	Volatile Organic Compounds
Wat	BREEAM Water Environmental Section
Wst	BREEAM Waste Environmental Section

0. Executive Summary

0.1 Introduction

In May 2009 the Welsh Assembly Government published Ministerial Interim Planning Policy Statement (01/2009) Planning for Sustainable Buildings. This set out an expectation for most new developments seeking planning permission to achieve a minimum sustainable building standard. This was consolidated into section 4.11 of Planning Policy Wales. Non-domestic developments with a floorspace ≥ 1,000 m^2 or a site area ≥ one hectare must achieve:

- BREEAM 2008 'Very good'; and
- Mandatory 6 credits for 'Excellent' under issue *Ene 01: Reduction of CO_2 emissions*.

Following the introduction of the new BREEAM 2011 scheme in July 2011 (replacing the former 2008 scheme), this research report provides a summary of the effect on Planning Policy Wales in terms of the resulting design and operational performance requirements of non-domestic buildings in Wales. Recommendations have been made to either:

- Maintain the existing policy outcome outcomes (from the former BREEAM 2008 baseline); or
- Uplift policy outcomes (in light of changes to Building Regulations and energy policy direction in Wales).

0.2 BREEAM 2011

Consolidation and restructuring of several issue categories has been undertaken for the BREEAM 2011 'New Construction' scheme; with the most significant changes occurring in the Management, Health and Wellbeing, and Energy categories.

The overall category weightings have remained the same as for the 2008 schemes, however, the number of credits available, and consequently the percentage score per credit has changed. Due to the many variations and design options available across different building types, it is not possible to determine the exact increase or decrease in percentage per credit available under each scheme. This is discussed in detail in the building analysis section of this report.

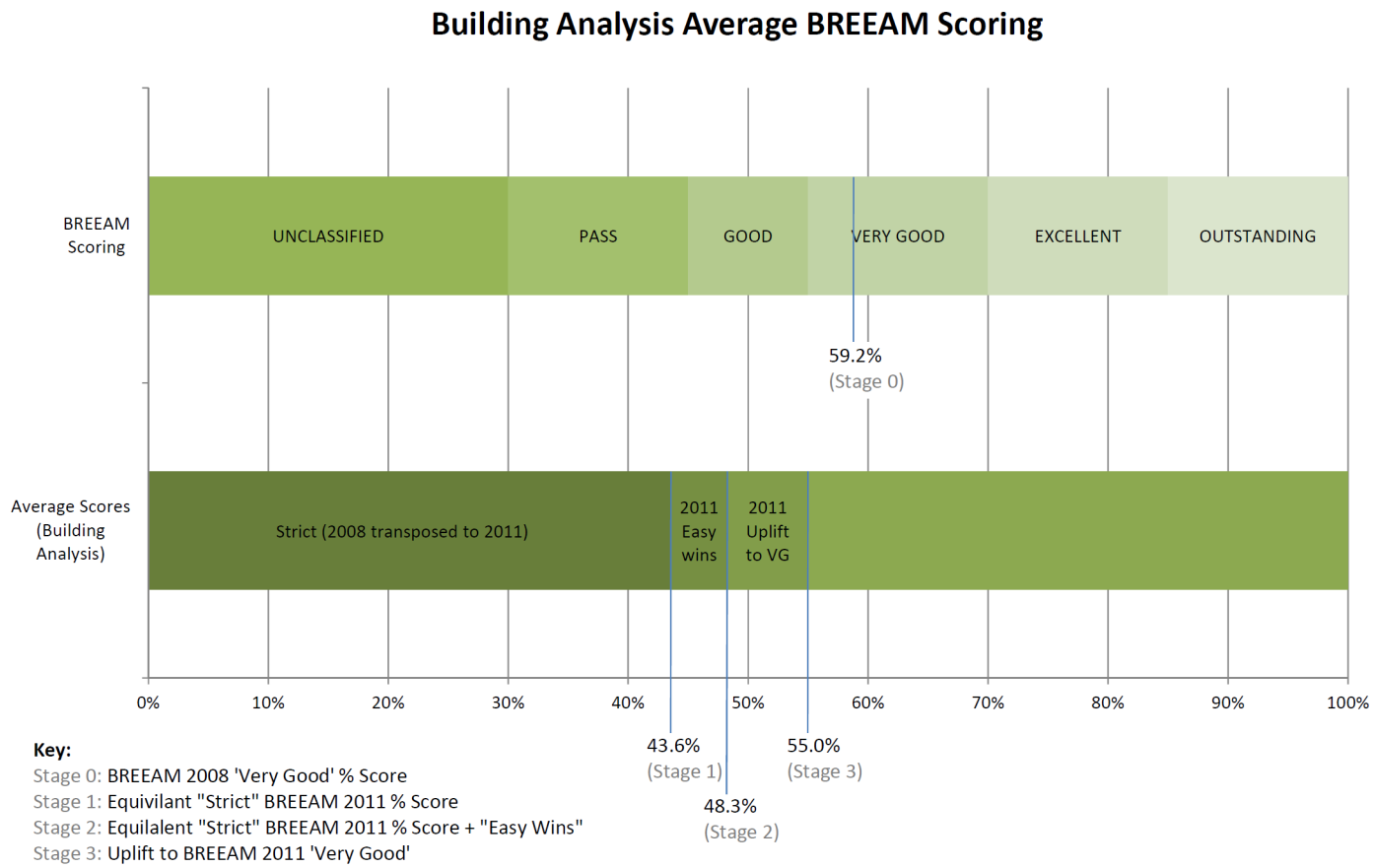
0.3 Building Analysis

0.3.1 Building Design and BREEAM Evidence Requirements

Management, Health and Wellbeing, and Energy exhibit the most significant losses in credit. For Management and Health and Wellbeing, this is predominantly due to the large degree of consolidation which has occurred for these categories, and introduction of several new credits not previously covered by BREEAM 2008. In the case of the Energy category, significant changes have been made to *Ene 01*, with a high score in 2011 requiring energy efficiency in terms of demand, consumption and carbon emissions.

An increase in individual credit weighting (due to loss of a number of credits) for the Materials section has had a largely positive impact across all building types. Increased stringency of construction waste thresholds has reduced the relative performance for all building types in the Waste category. Transport and Land Use and Ecology issues are highly site dependant, therefore there is a significant variation between the performance of different buildings and building types for these categories.

Figure 1.1: Average of percentage scores following assessment stages 1, 2 and 3



Source: Mott MacDonald

0.3.2 Construction Cost

There is a degree of cost uplift for all building types when considering the extra-over cost of achieving a BREEAM 2011 'Very Good' rating compared to BREEAM 2008. Cost has been demonstrated to be highly influenced by building location and size. The cost increase on average across building types is however, deemed to be relatively insignificant, at approximately 1% of the total project cost. In addition, no building types appear to be more heavily penalised than others (for example public vs. commercial).

0.4 Policy Recommendations

This report provides three recommendations to Welsh Government in regards to Section 4.11 of Planning Policy Wales:

- **Option 1: Maintain Policy Wording:** Under this scenario, all non-domestic buildings that meet the above criteria would be expected to achieve a BREEAM rating of 'Very Good' and 6 credits under Ene 01 category using the new 2011 scheme.
- **Option 2: Maintain Policy Outcome:** This option maintains the policy outcome of the current national planning policy (i.e. BREEAM 'Very Good' standard using the BREEAM 2008 schemes, and 6 credits under Ene 01 issue). Under BREEAM 2011, this would approximately translate as a 'Good' rating and 1 credit under Ene 01 issue.
- **Option 3: Uplift Policy Outcome:** This option increases the performance requirement of non-domestic buildings in Wales to obtain a BREEAM 'Very Good' standard using the 2011 scheme. 3 credits are recommended under Ene 01 issue.

It is recommended that **Option 3** is selected for adoption for Planning Policy Wales:

> *Applications received on or after [date to be confirmed] for new build non-residential development which will either have a floorspace of 1,000 m2 or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) **'Very Good'** standard and achieve **3 credits** under issue Ene1 - Reduction of CO_2 Emissions.*

It should be noted that while there may be a degree of cost uplift as a result of either Option 1 or 3 listed above, these costs refer to capital cost of design and construction only. The value of operational, or lifecycle costs, have not been included. It is likely in a majority of cases that there will actually be a cost reduction as a result of increased energy performance. In addition, holistic sustainability in terms of socio-economic or environmental benefits will be improved through uplifting the policy requirements.

1. Introduction

1.1 Purpose of Report

This report provides a summary of the implications arising from BREEAM 2011 on the Planning for Sustainable Buildings National Planning Policy contained in Section 4.11 of Planning Policy Wales.

An overview of Planning Policy Wales is provided, in addition to a summary of the new BREEAM 2011 standard. The report then provides an in depth overview of the technical changes resulting from the revision to the previous BREEAM 2008 standards.

A number of building scenarios are then provided to demonstrate the differences between the 2008 and 2011 schemes, in addition to assessing the resulting scoring changes and how this affects the technical and financial viability of meeting the new 2011 standard.

Finally recommendations are made to the Welsh Government on Planning Policy Wales on the current policy requirements and how these should be adapted to reflect the new BREEAM standard.

1.2 Planning Policy Wales

In May 2009 the Welsh Assembly Government published Ministerial Interim Planning Policy Statement (01/2009) Planning for Sustainable Buildings. This set out an expectation for most new developments seeking planning permission to achieve a minimum sustainable building standard. This was consolidated into section 4.11 of Planning Policy Wales.

In summary, from 1st September 2009 onwards ***non-domestic developments with a floorspace ≥ 1,000 m^2 or a site area ≥ one hectare*** must achieve:

- ***BREEAM 'Very good'; and***
- ***Mandatory 6 credits for 'Excellent' under issue Ene 01: Reduction of CO_2 emissions.***

This research is intended to inform Welsh Government planning policy which will subsequently be used to guide Local Planning Authorities (and the wider development industry) on the implementation of the national planning policy for sustainable buildings following commencement of BREEAM 2011 schemes from 1st July onwards.

1.3 Research Objectives

In October 2010 changes were made to England and Wales Building Regulations Part L2A which introduced more stringent requirements for carbon emissions for both residential and non-residential dwellings. These changes improved the carbon performance by an aggregate of 25% for non-domestic buildings compared to Part L2A 2006 requirements. In preparation for the changes to Building Regulations the owners of BREEAM (BRE Global Ltd) reviewed the scheme to ensure they were consistent with the new regulations and released the 2011 revision of the BREEAM scheme.

The aim is to assist the Welsh Government in maintaining the policy outcomes of the current national planning policy and to issue advice and clarification on the implementation of the national planning policy under the new BREEAM 2011 scheme. Maintaining policy outcome expected by the current national planning policy would mean the BREEAM 2008 'Very Good' level and 6 credits achieved under issue *Ene 01: Reduction of CO_2 Emissions*.

The following Principle Documents have been used when compiling this report:

- Planning Policy Wales: Edition 4 (February 2011)[1];
- BREEAM New Construction: Non-Domestic Buildings, Technical Manual SD5073-2.0:2011[2];
- BREEAM Scheme Document SD 5050: BREEAM Courts 2008 (Issue 4.0); SD 5051: BREEAM Education 2008 (Issue 4.0); SD 5052: BREEAM Industrial 2008 (Issue 4.0); SD 5053: BREEAM Healthcare 2008 (Issue 4.0); SD 5054: BREEAM Prisons 2008 (Issue 4.0); SD 5055: BREEAM Offices 2008 (Issue 4.0); SD 5056: BREEAM Retail 2008 (Issue 4.0); SD 5065: BREEAM Multi-residential 2008 (Issue 2.0); and SD 5068: BREEAM Data Centres 2010 (Issue 1.0).

[1] Document can be sourced from the following location: http://wales.gov.uk/topics/planning/policy/ppw/?lang=en

[2] Document can be sourced from the following location: http://www.breeam.org/page.jsp?id=374

2. Overview of BREEAM 2011

2.1 Introduction

On July 1st 2011, BRE introduced an updated BREEAM[3] Scheme Document for New Construction (SD 5073), which describes the new environmental performance standard against which new, non-domestic buildings in the UK can be assessed, rated and certified.

2.2 Scope of BREEAM 2011

The BREEAM 2011 version is applicable to the same range of buildings covered by BREEAM 2008, but incorporates all 2008 guidance manuals into one 'New Construction' scheme document, where individual criteria can be assessed or discounted depending on the particular building function. Table 2.1 summarises the buildings that can be assessed under BREEAM 2011:

Table 2.1: New Construction Building Types

Sector	Building Type	Description
Commercial	Offices	▪ General office buildings ▪ Offices with research and development areas (i.e. cat 1 labs only)
	Industrial	▪ Industrial unit – warehouse storage/distribution ▪ Industrial unit – process/manufacturing/vehicle servicing
	Retail	▪ Shop/shopping centre ▪ Retail park/warehouse ▪ 'Over the counter' service provider e.g. financial, estate and employment agencies and betting offices ▪ Showroom ▪ Restaurant, cafe & drinking establishment ▪ Hot food takeaway
Public (non housing)	Education	▪ Pre-School ▪ Schools and Sixth Form Colleges ▪ Further Education/Vocational Colleges ▪ Higher Education Institutions
	Healthcare	▪ Teaching/specialist hospitals ▪ General acute hospitals ▪ Community and mental health hospitals ▪ GP surgeries ▪ Health centres and clinics
	Prisons	▪ High security prison ▪ Standard secured prison ▪ Young offender institution and juvenile prisons ▪ Local prison ▪ Holding centre
	Law Courts	▪ Crown & criminal courts ▪ County courts ▪ Magistrates' courts

[3] For more information on BREEAM and the BRE, refer to the following website: http://www.breeam.org/index.jsp

Sector	Building Type	Description
		▪ Civil justice centres ▪ Family courts ▪ Youth courts ▪ Combined courts
Multi-residential Accommodation	Residential Institutions	▪ Residential care home ▪ Sheltered accommodation ▪ Residential college/school (halls of residence) ▪ Local authority secure residential accommodation ▪ Military barrack
Other	Residential Institutions	▪ Hotel, hostel, boarding and guest house ▪ Secure training centre ▪ Residential training centre
	Non-residential Institutions	▪ residential institutions ▪ Art gallery, museum ▪ Library ▪ Day centre, hall/civic/community centre ▪ Place of worship
	Assembly and Leisure	▪ Cinema ▪ Theatre/music/concert hall ▪ Exhibition/conference hall ▪ Indoor or outdoor sports/fitness and recreation (with/without pool)
	Other	▪ Transport hub (coach/bus station and above ground rail station) ▪ Research and development (cat 2 or 3 labs - Non Higher Education) ▪ Crèche

Source: BREEAM New Construction Technical Manual SD5073 - 2.0:2011

The BREEAM 2011 'New Construction' scheme is not specifically designed for use on refurbishment and fit-out projects, as a standalone scheme covering these projects is to be published by BRE Global in 2012. Prior to publication of the new refurbishment scheme, major refurbishments can be assessed under BREEAM 2011, while fit-out projects and minor refurbishments should be assessed and certified using the BREEAM 2008 version. Planning Policy Wales and the BREEAM requirements therein only refer to non-domestic new buildings.

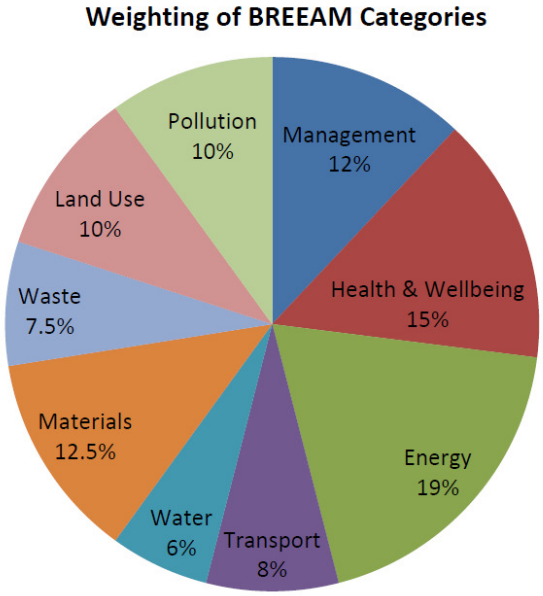
2.2.1 Technical Changes to BREEAM Categories

Consolidation and restructuring of several issue categories has been undertaken for the BREEAM 2011 'New Construction' scheme; with the most significant changes occurring in the Management, Health and Wellbeing, and Energy categories.

The overall category weightings have remained the same as for the 2008 schemes, however, the number of credits available, and subsequently the percentage score per credit has changed. Due to the many variations and design options available across different building types, it is not possible to determine the exact increase or decrease in percentage per credit available under each scheme. This is discussed in detail in the building analysis section of this report.

Appendix A provides a detailed comparative assessment of the changes from BREEAM 2008 to BREEAM 2011. In addition summary tables are provided in Appendix B for each BREEAM category. Finally, Appendix F provides a detailed overview of the changes to each BREEAM Issue under 2011.

Figure 2.1: Weighting of BREEAM Categories



2.2.2 Minimum Standards by Rating Level

The following table presents the minimum standards by rating level under the new BREEAM 2011 scheme. Most of these minimum standards remain as per the 2008 schemes, albeit under different issues, except for Mat 03, which is a new requirement for projects across all types and rating levels to confirm that all timber used on the project is sourced in accordance with the UK Governments Timber Procurement Policy.

Table 2.2: BREEAM 2011 Minimum Standards by Rating Level

BREEAM Issue	BREEAM Rating Level				
	PASS	GOOD	VERY GOOD	EXCELLENT	OUTSTANDING
Man 01: Sustainable Procurement	One credit	One credit	One credit	One credit	Two credits
Man 02: Responsible Construction Practices				One credit	Two credits
Man 04: Stakeholder Participation				One credit (building user information)	One credit (building user information)
Hea 01: Visual Comfort	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only
Hea 04: water Quality	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only
Ene 01: Reduction of CO_2				6 credits	10 credits

BREEAM Issue	BREEAM Rating Level				
	PASS	GOOD	VERY GOOD	EXCELLENT	OUTSTANDING
Emissions					
Ene 02: Energy Monitoring			One credit (first sub-metering credit)	One credit (first sub-metering credit)	One credit (first sub-metering credit)
Ene 04: Low or Zero Carbon Technologies				One credit	One credit
Wat 01: Water Consumption		One credit	One credit	One credit	Two credits
Wat 02: Water Monitoring		Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only
Mat 03: Responsible Sourcing	Criterion 3 only	Criterion 3 only	Criterion 3 only	Criterion 3 only	Criterion 3 only
Wst 01: Construction Waste Management					One credit

Source: BREEAM 2011 Scheme Document

2.3 Sustainability and BREEAM 2011

Whilst BREEAM is an environmental assessment method for buildings and principally considers the environmental aspect of sustainability in terms of building design and operation, the scheme also encompasses a wide range of socio-economic impacts and benefits.

The 2011 scheme has expanded on these wider benefits across the majority of building types when compared to the 2008 schemes. Many issues that were previously only relevant to certain scheme types have now been extended to all buildings. Additionally, separate new criteria have been added to the scheme, particularly in the area of community and stakeholder involvement. The following credits, previously only applicable to certain building types are now relevant to all buildings:

- *Man 04: Stakeholder Participation – Consultation* – criteria now included for commercial schemes (offices, industrial and retail), to encourage wider stakeholder participation; and
- *Hea 04: Water Quality – Building occupants: Provision of fresh drinking water* – criteria now included for all schemes (previously only education), to provide fresh drinking water to all building occupants (where there are permanently staffed areas); supplying a welfare facility for staff and visitors.

The following issues are new to BREEAM 2011:

- *Man 01: Sustainable Procurement – Project brief and design* criteria encourage consideration of the building occupants at early project stage so that they can contribute to the design process. Similarly *Construction and handover, and aftercare* criteria now promote additional support for building users and Facilities Management;
- *Man 04: Stakeholder Participation – Post Occupancy Evaluation and info dissemination* – criteria promote the sharing of "lessons learnt" in building design; and
- *Hea 02*: *Indoor Air Quality* – Provision of an *Indoor Air Quality (IAQ) Plan* helps promote a healthy building environment for occupants. Volatile Organic Compound (VOC) requirements have also been extended, with a new credit for post-construction measurement of VOC's, which targets the avoidance of detrimental health effects such as sick building syndrome.

- The principles behind sustainable design of buildings; including materials, and low energy/carbon building services are still promoted to a high degree, but these wider sustainability issues facilitate the active engagement of the broader community and stakeholders. Project teams and clients are consequently rewarded for considering these issues across all stages of the buildings development. BREEAM 2011, therefore, is considered to take a more holistic approach to sustainability when compared to the former 2008 schemes.

When focusing on energy and carbon performance, the new assessment method again takes a more holistic approach as a result of the new *Ene 01: Reduction of CO_2 Emissions* calculation methodology. The new process, discussed in detail in section 3.3.4, considers energy demand, energy consumption and carbon emissions of the building, as opposed to just the carbon emissions. By applying a weighting to each of these factors, designers are encouraged to focus on the energy hierarchy (energy demand reduction and building fabric and services efficiency), rather than purely on final carbon emissions. This reduces the temptation for some building developments to "bolt-on" low or zero carbon (LZC) technologies in an effort to reduce carbon, where such an approach might not be the most appropriate or cost effective design solution. This shift of methodology also mirrors the approach and guidance provided by the Welsh Government in Technical Advice Note (TAN) 12: Design (2009)[4] in addition to other policy and publications.

Finally, building energy and carbon performance in BREEAM 2011 has been shifted to cover operational energy and carbon performance to a greater degree, expanding further on the principles of embodied carbon and lifecycle assessments. This process broadly fits with higher level policy setting and direction in terms of bridging the gap between theoretical design performance and actual "in-use" performance. Welsh Government energy and carbon targets are thus more likely to be achieved through the use of the revised BREEAM scheme, in coordination with other key standards and legislation such as *Building Regulations Part L2, Conservation of energy and power in buildings*. Key BREEAM issues relevant to the above include:

- *Man 05: Life Cycle Costing and Service Life Planning* – This issue is now applicable to all commercial and multi-residential schemes. It encourages consideration of the implication of design decisions over the buildings whole life;
- *Ene 04: Low or Zero Carbon Technologies* – Criteria have been expanded to award additional credit for undertaking a lifecycle assessment of the chosen LZC technology; and
- *Ene 08: Energy Efficient Equipment* – New criteria which consider major consuming "unregulated" equipment, i.e. those not regulated under Building Regulations. This encourages efficient design for items such as computer equipment, or swimming pools, which previously were not included to the same extent, and were only applicable to certain building types.

[4] Document can be sourced from the following website: http://wales.gov.uk/topics/planning/policy/tans/tan12/?lang=en

3. Building Analysis: Methodology

This section provides a summary of the assessment process used to determine the extent of changes between BREEAM 2008 and 2011 and the associated impact on design and percentage scores. A dataset of 29 BREEAM 2008 'Very Good' rated buildings were assessed using a three stage process; strict comparison of results between 2008 and 2011, "easy wins" under 2011, and uplift to 'Very Good' level under 2011.

3.1 Introduction

As already discussed, BREEAM 2011 is now based on a single manual for 'New Construction', which incorporates all of the above building types and in many places, consolidates several BREEAM 2008 credits into single issues. Additionally, a number of new credits have been introduced and some 2008 credits have been removed. The availability of particular credits has therefore altered for some building types, potentially impacting the BREEAM rating.

As part of a comprehensive review of the changes made to BREEAM and the likely affect that this will have on new development in Wales and Welsh planning policy, comparative analysis has been undertaken for 29 buildings, across a wide spectrum of functions, location, size and other key factors.

The BRE have developed spreadsheet scoring tools in support of BREEAM assessments, to facilitate straightforward determination of scores and ratings for buildings. These BREEAM 2008 and BREEAM 2011 spreadsheet tools have been used as the basis for the building analysis undertaken.

3.1.1 Glossary of Terms

The following provides a brief description of terms that have been developed within this Building Analysis to assist the reader. Other acronyms and abbreviations can be found at the front of this report.

Table 3.1: Glossary of Terms

Term	Description
"Easy wins"	This term refers to credits new to 2011 which are considered to be straightforward from a design perspective and/or are inexpensive to implement.
"Equivalent credit"	This refers to 2008 credit issues which closely or exactly match the requirements for a particular 2011 credit issue. For example, one of several equivalent credits for 2011 *Man 01 – Sustainable Procurement (criteria 14 – 17)* is 2008 *Ene 06 – Building fabric performance and avoidance of air infiltration.* See Appendix A.
"Strict score"	This refers to the score achieved when equivalent 2008 credits are exactly mapped onto a BREEAM 2011 assessment i.e. each credit achieved under 2008 is assumed to satisfy the 2008 issue requirements and nothing further; when translated onto equivalent 2011 issues, the credit can only be achieved where no additional requirements have been introduced in BREEAM 2011. Additionally, under the strict score, credits new to 2011 with no equivalent 2008 credit could not be achieved.
"Uplift"	This refers to the process by which the overall percentage score for a building is improved to a 'Very

Term	Description
	Good' rating under BREEAM 2011. Uplift is undertaken by initially ranking additional credits on a cost and design complexity basis. The score is then improved as necessary by awarding the most cost and design effective credits.
"Fixed cost"	These are costs which are standard for a particular building size, regardless of type. These include reports (e.g. LZC feasibility study, travel plan, site waste management plan) and specification of leak detection systems. While there may be some degree of variation in these costs, an assumption has been made to standardise these costs across all buildings for the purposes of consistency.
"Variable cost"	Variable costs are those which are dependant on the building size, type and performance, typically measured on a per m^2 basis. These include costs associated with fabric efficiency, energy performance, daylighting, and site specific criteria such as surface water attenuation measures.

Source: Mott MacDonald

3.2 Methodology

3.2.1 Building Selection

The Building Research Establishment (BRE), as the governing and auditing body for BREEAM retains data on all buildings which have been submitted for BREEAM certification. A database of such information for buildings submitted for certification under BREEAM 2008 between 2009 and 2011 was acquired from BRE so that the building analysis could be undertaken using reliable and relevant data.

It should be noted that the BREEAM 2011 'New Construction' manual only supersedes BREEAM 2008 for new build development. Refurbishment and fit-out development continues to be assessed under BREEAM 2008 until this version is superseded (a new refurbishment BREEAM manual is anticipated for 2012)[5].

27 buildings were selected from the BRE database based on the following criteria:

- An overall BREEAM 2008 rating of 'Very Good' – only buildings which achieved 'Very Good' with a score of close to the minimum acceptable score of 55% were chosen where possible;
- In line with Welsh Government planning policy requirements, only buildings which achieved 6 or more credits for BREEAM 2008 issue Ene 01 – Reduction of CO_2 emissions were selected for the analysis; and
- A broad spectrum of buildings types were selected, ensuring that buildings of varying size (small, medium, large) located in both urban and rural areas were used. Planning Policy Wales currently requires buildings to achieve BREEAM 'Very Good' where either greater than 1,000m^2 in size, or where the site is greater than 1 hectare. Therefore, in some cases buildings have been selected that are less than 1,000m^2 in size to allow for variation[6].

Due to lack of information available from BRE regarding law court buildings (which are a relatively rare form of construction) it was necessary to generate two hypothetical court buildings for the purposes of the analysis. BREEAM 2008 scores for these two developments were generated assuming that the buildings comprised a small, rural civil justice centre and a large, urban Crown

[5] Planning Policy Wales only considers new build projects.

[6] Note that the building area has a negligible effect on the overall BREEAM score.

Court. Credits for these buildings were awarded based on common credits achieved for the other 27 'mock buildings' and standard good practice across the nine BREEAM categories, resulting in borderline 'Very Good' BREEAM 2008 ratings for each building.

A key consideration when selecting buildings was the relevance of the analysis to types of buildings which might be constructed in Wales. The 29 mock buildings were located across the UK, with five buildings situated in Wales, two from the West Midlands and the remainder from other mainland UK regions including Scotland, South West, East/West Midlands, Yorkshire, South East and the North. The location of buildings geographically in BREEAM is largely irrelevant to the overall scoring process, therefore, the selection criteria was more focused on choosing buildings that were likely to be built in Wales, such as primary schools and offices, rather than substantial shopping centres or major transport nodes (which would be rare other than exceptional circumstances in Cardiff for example). The buildings were also selected to ensure urban and rural were represented fairly. Appendix C provides a summary of the buildings selected.

3.2.2 Stage 0: Verification of 2008 Building Data

Prior to undertaking the analysis, the BRE database was verified by checking the issue credits awarded for each building against the BREEAM 2008 pre-assessment spreadsheet tool[7].

In order to accurately generate the BREEAM 2008 spreadsheet tool for each mock building, it was first necessary to determine the presence of particular building features. This was achieved by identifying whether particular BREEAM 2008 credits had been awarded. For instance, the presence of lifts or escalators in a building could be determined by noting whether credits had been achieved for BREEAM 2008 *Ene 08 – Energy efficient transportation systems* or whether this field had been left blank. Similarly, the presence of cold storage in the building could be determined by assessing BREEAM 2008 *Ene 07 – Cold Storage* and *Pol 03 Refrigerant GWP – Cold Storage.* This information was then retained for completion of the BREEAM 2011 spreadsheet tools in Stages 1 to 3 of the Building Analysis assessment process.

While the BRE database specified whether or not a building had achieved any innovation credits, the credit issues for which these credits had been awarded were not specified. For the purposes of completing the BREEAM 2008 assessment spreadsheet tool, innovation credits were awarded in the following order:

- Where only one innovation credit had been awarded for a particular building, and where the first credit had been achieved for BREEAM 2008 *Wat 02 – Water Meter* the innovation credit was also assigned to this issue; and
- Where 2 credits had been awarded under BREEAM 2008 issue *Man 02 – Considerate Contractors*, the second innovation credit (where awarded for the building) was assigned to this BREEAM issue.

When running each building through the BREEAM 2008 spreadsheet tool, discrepancies were observed in a number of cases where a building was awarded a 'Very Good' rating yet failed to

[7] The 2008 BREEAM pre-assessment tool can be downloaded from the 'resources' section of the BREEAM website. See the following link: http://www.breeam.org/page.jsp?id=301

achieve a credit listed as mandatory for a 'Very Good' rating (e.g. BREEAM 2008 *Man 12 – Microbial contamination*). In such cases, the mandatory credit was awarded and the overall percentage and category scores updated accordingly (the results contained within Appendix D show these updated scores for Stage 0).

In other instances, lack of suitable buildings at the 'Very Good' level under 2008 necessitated a reduction in a building's score from 'Excellent' to 'Very Good'. In these cases, innovation credits were first removed from the BREEAM 2008 score, followed by credits from BREEAM issues where the building had performed particularly well. Where building scores were reduced to 'Very Good', a higher percentage score of 60% or more was retained to introduce a degree of variation into the analysis, and to maintain the relevance of the BRE database. While the main focus was to select buildings at the lower end of the 'Very Good' scoring threshold, it was important to assess the relative drop in performance for higher scoring buildings at the 'Very Good' rating level.

3.2.3 Stage 1: BREEAM 2011 Assessment

Following verification of all BRE data and necessary adjustment of scores and issue credits in Stage 0, the formal assessment process was undertaken using the new BREEAM 2011 scheme. The first stage involved directly transferring the 2008 credits achieved for each building into the BREEAM 2011 spreadsheet tool to determine the corresponding 2011 score and rating. This can be thought of as the buildings **"strict"** 2011 score, i.e. credits must have met all criteria under BREEAM 2011 issues, irrespective of whether the criteria were present under BREEAM 2008. Credits here may be lost either through consolidation of former separately treated issues, or through expansion of credit criteria and applicability (see Section 2 for further information on each credit). New credits under the 2011 scheme were also assumed to be not achieved for this first stage. The principal tool for transferring credits from 2008 to 2011 is shown in Appendix A.

3.2.4 Stage 2: BREEAM 2011 Assessment + "Easy wins"

The second stage of analysis expands on the score achieved in Stage 1 for each building, taking a less conservative approach. Credits that are new to the 2011 scheme and deemed to be either straightforward in design, or relatively inexpensive have been awarded to produce an increased score. The number of credits that can be added under this stage depends on both building type, and the existing credits achieved. These credits are herein referred to as the **"easy wins"**, and are identified in section 3.3.3.

3.2.5 Stage 3: BREEAM 2011 Assessment + "Easy wins" + Uplift to 'Very Good'

The final stage of the assessment process takes the results from Stage 2 and "**uplifts**" the scores to the minimum percentage score required for a 'Very Good' rating (55%) under the 2011 scheme. This has been carried out in order of both cost effectiveness and design feasibility, therefore, the credits added (and the associated percentage weightings) vary depending on the following:

- Building type – credits can only be added where relevant to the building type and function;
- Building size – the size of the building affects the viability of aiming for certain credits when considering cost. For larger buildings, it may be more cost effective to aim for a credit that requires a report to be produced (fixed cost), rather than aiming for a variable cost credit that could have large cost implications in terms of £/m^2 additional cost (e.g. increased u-values or

green guide ratings for materials). A small building could find the opposite to be true, with variable costs being more straightforward;

- Existing credits achieved – It was necessary to consider the existing building design at the 2008 level, to determine which credits were likely to be achievable for the project. If for example no credits were previously awarded under *Mat 01: Life Cycle Impacts* it was deemed to be cost effective to add 2 credits here, whereas if 2 or more credits had already been achieved, it would be increasingly cost prohibitive to achieve higher scores. Alternatively, if buildings had already scored under *Hea 03: Thermal Comfort* under the second criteria for occupant controls, it was deemed straightforward and cost effective that the first credit for thermal comfort modelling should also be added.

While Stage 3 follows a cost and design feasibility based approach to uplifting scores, these assumptions are based on good or typical practice. In practice building teams can follow or pursue a range of design approaches. In particular, costs will vary substantially depending on the complexity of the project, in addition to the procurement route and funding. While the methodology also suggests “easy wins”, these may not always be straightforward to achieve, particularly in the case of disjointed procurement routes, or where designers are brought on late to a project. Many credits in these scenarios may be lost and subsequently a more expensive route followed. The assessment process aims to follow a consistent approach to allow a fair comparison to be made, but should not be relied upon for design decisions or as an approach to value engineering for real life projects (the assessment is a high level strategic assessment for the purposes of Planning Policy Wales).

3.3 Assumptions and Limitations

As with any theoretical research exercise, there are a number of assumptions that have been made when carrying out this assessment. In addition it is important to highlight the limitations of the assessment and any conclusions that can be drawn from the results. The following sections provide a summary.

3.3.1 Data Set: Size

The BRE dataset of BREEAM assessed buildings contained a total of 217 accredited buildings, across the full range of BREEAM 2008 scheme ratings. This list was then filtered to consider ‘Very Good’ buildings only (reducing to 82 buildings). In addition, refurbishment buildings were filtered out and those at the lower end of the ‘Very Good’ threshold were prioritised (55%). A total of 27 buildings were chosen from the final pool of buildings, in order to ensure that all building scheme types were represented, and as varied as possible in terms of design (e.g. energy performance), size, and location (e.g. transport links).

The buildings selected represent the maximum ‘useful’ data that could be extracted from the original dataset. It is important, therefore, to state that the sample size is relatively limited (27 no.) and particularly when drawing conclusions later in this report as to the effects of changes to BREEAM (between 2008 and 2011) at a building scheme level.

3.3.2 Data Set: Level of Detail

The BRE dataset provided the following information for each building:

- Scheme type;
- Building type and brief description;
- Area;
- BREEAM rating (total percentage score and category scores);
- CO_2 Index;
- Water consumption (m^3/person/yr);
- Waste (tonnes or $m^2/100m^2$);
- Public transport Accessibility Index; and
- Credits achieved under each BREEAM issue.

This level of information provides sufficient detail to accurately model credits which haven't changed (from 2008 to 2011), in addition to particular credits based on site or design/construction thresholds, for example, the transport accessibility index required to assess *Tra 01: Public Transport Accessibility,* or the amount of waste produced during construction. For other credits, however, the database did not provide enough detail to determine exactly how particular credits had been achieved. For these issues, a conservative approach was taken, where it was assumed that minimum compliance had been met for the issue, e.g. when considering the threshold CO_2 reduction levels under *Ene 04: Low or Zero Carbon Technologies*.

3.3.3 Method of Analysis

A four-tiered approach of analysis was adopted for the Building Analysis (as already outlined in section 3.2). When completing the BREEAM 2011 spreadsheet tool for each of the buildings, a number of assumptions were required when awarding or withholding issue credits. The key assumptions are summarised in Table 7.11 contained within Appendix E (for assessment Stage 1). 'Easy win' credits are also listed in Table 7.12 (for assessment Stage 2) contained within Appendix E.

3.3.4 Ene 01: Reduction of CO_2 Emissions

For buildings assessed during this Building Analysis, it has not been possible to directly translate the BREEAM 2008 CO_2 index to a score under the new BREEAM 2011 *Ene 01: Reduction of CO_2 emissions*. This is due to the inherent differences in Building Regulations compliance calculations under Part L2A, *Conservation of fuel and power in new buildings other than dwellings* (between 2006 and 2010), in addition to changes made to BREEAM methodology for awarding *Ene 01* credits.

These changes are discussed in detail in the accompanying Mott MacDonald report, *295389/MNS/BTL/01 – National Planning Policy Wales: BREEAM 2011 Technical Analysis – Ene 01: Reduction of CO_2 Emissions.* The following paragraphs provide a summary and the assumptions made in this Building Analysis to award credits.

The CO_2 Index (or Asset Rating) for a building is produced as part of compliance calculations for Building Regulations Part L2A, *Conservation of fuel and power in new buildings other than*

dwellings, and is displayed formally on the building's Energy Performance Certificate (EPC). Under BREEAM 2008, this CO_2 Index was used to award credits based on a performance scale. As such, BREEAM 2008 only considered the calculated CO_2 emissions of a building, and did not consider its relative performance in terms of energy demand, or energy consumption (energy efficiency).

Under BREEAM 2011, this methodology has been overhauled, with credits now awarded based on a new measurement called the buildings Energy Performance Ratio (EPR). The EPR is based on an assessment of the energy demand, energy consumption and CO_2 emissions of the building. These three components are calculated via compliance modelling undertaken for the building before being translated to BREEAM credits via a weighted performance indicator, as shown below.

Figure 3.1: BREEAM 2011 Ene 01 performance indicators

Performance Indicator	Weighting
Energy demand	0.28
Energy consumption	0.34
CO_2 emissions	0.38

Source: BREEAM 2011 Scheme Document

As information on energy demand and energy consumption was not known for each building assessed, and in order to assign an indicative EPR corresponding to a score under 2011 *Ene 01*, a number of assumptions and considerations have been made.

The CO_2 Index and credit score under BREEAM 2008 *Ene 01* were first considered for each building; where relevant and where a CO_2 index of 40 (or similar) was achieved, the results of thermal modelling undertaken as part of this research[8] were taken into account. As the CO_2 Index only considers the CO_2 emissions component of the EPR under BREEAM 2011 a number of other factors had to be taken into account in order to determine the energy demand and energy consumption components. This process looked at other energy related BREEAM 2008 issue credits achieved:

- Hea 01: Daylighting – Achievement of credits here require a high average daylight factor. This is likely to result in a reduction in the buildings energy demand and consumption due to lighting;
- Hea 06: Lighting Zones and Controls – Achievement of these credits indicates a reduction in building energy consumption, either via an increase in controllability via manual switching, or reductions associated with automatic controls (e.g. daylight linked switching or dimming);
- Hea 10: Thermal Comfort – Achievement of thermal comfort credits would likely result in a reduction in a buildings energy consumption, by maintaining and controlling temperatures depending on building type and occupant number;
- Hea 11: Thermal Zoning – This is assumed to reduce the building energy consumption, as a result of greater controllability;

[8] See accompanying report, *295389/MNS/BTL/01 – National Planning Policy Wales: BREEAM 2011 Technical Analysis – Ene 01: Reduction of CO2 Emissions*

- Ene 05: Low or Zero Carbon Technologies – Achievement of these credits indicates a reduction in the building CO_2 emissions. The percentage reduction in CO_2 as a result of incorporation of LZC's can be estimated using the BREEAM 2008 credit thresholds for this issue; and
- Ene 06: Building Fabric Performance and Avoidance of Air Infiltration – Achievement of credits under this issue is likely to result in reduction in building energy demand.

The process of determining the relative improvement as a result of the above measures is largely arbitrary; a high level of detail on building energy performance would be required in order to accurately model the EPR outcome. In order to maintain a level of consistency and based on results from building modelling exercises the following approach has been taken. Where credits listed above relating to energy demand reduction were achieved (e.g. Ene 06), a 10% reduction in the buildings 'actual' energy demand (i.e. design case, as a percentage improvement against the calculated 'notional' building under Part L2A compliance) was entered into the demand component of the EPR. Similarly where energy consumption related credits listed above were achieved (e.g. Hea 06, Hea 10), a 10% reduction in the buildings 'actual' energy consumption was entered into the consumption component of the EPR. These two components of the EPR were also checked against the overall CO_2 index to check the validity of these assumptions.

An indicative example is provided below for calculating the EPR. For this particular example, a 10% improvement has been made to the energy demand and energy consumption components, while there is a 20% reduction in CO_2 emissions. In this example the weighted EPR was 0.448, corresponding to 4 credits (2.81%).

Figure 3.2: Example EPR Calculation (showing Ene 01 Calculator and Key Performance Indicators)[9]

Building floor area	1200	*m2*
Notional building energy demand	100.00	*MJ/m2/annum*
Actual building energy demand	90.00	*MJ/m2/annum*
Notional building energy consumption	100.00	*kWh/m2/annum*
Actual building energy consumption	90.00	*kWh/m2/annum*
Target Emission Rate (TER)	100.00	*kgCO2/m2/annum*
Building Emission Rate (BER)	80.00	*kgCO2/m2/annum*
Building improvement over TER	20.00%	
Demand Energy Performance Ratio (EPR)	0.124	
Consumption Energy Performance Ratio (EPR)	0.142	
CO_2 Energy Performance Ratio (EPR)	0.181	
Overall Building Energy Performance Ratio (EPR_{NC})	0.448	
Total BREEAM credits achieved	4	
Total contribution to overall building score	2.81%	
Total BREEAM innovation credits achieved	0	
Minimum standard(s) level	Very Good level	

Source: Extract from BREEAM 2011 Assessment Scoring and Reporting Tool Template

[9] Notional values are arbitrary and are used for the purpose of comparison only. EPR calculation is based on percentage improvement factor rather than absolute values.

The final EPR component (CO_2 emissions) was determined by first checking the reduction in CO_2 from BREEAM *2008 issue Ene 05: Low or Zero Carbon Technologies*[10]. For example, if a building achieved 15% reduction in emissions in 2008 (3 credits in BREEAM 2008 Ene 05), a 15% reduction in the CO_2 component of the EPR was entered. If the building also achieved a high CO_2 index, it was assumed that the building was more reliant on "bolt on" renewables and wasn't inherently 'low demand' or 'low consumption' through good building design. If on the other hand, a high score had been achieved under BREEAM 2008 *Ene 05*, and the building had a low CO_2 Index, this implied that the building had followed the Energy Hierarchy to a greater degree, resulting in a higher score being achieved under BREEAM 2011

While the approach taken to *Ene 01* as part of this Building Analysis allows for consistency, it must be noted that the predicted scores and associated credits are estimations only. The methodology used takes a relatively conservative approach to assessment and award of credits. The actual energy demand and energy consumption figures cannot be known without carrying out detailed modelling for all buildings, and in reality the scores will vary across all building types.

[10] Note that BREEAM 2008 Ene 05 and BREEAM 2011 Ene 04 are equivalent credit issues and both relate to Low or zero carbon technologies.

4. Costing Analysis: Methodology

The aim of this section is to provide estimations of cost uplift for the various building types under the 2011 scheme in terms of an 'extra-over' cost when compared to the existing Planning Policy Wales requirement under BREEAM 2008.

4.1 Assumptions and Limitations

4.1.1 Cost Expectations

As part of the procurement process in construction, tenders for work can vary from each other such that there is a substantial cost differential (lowest tender may be half or a third of the highest). Costs are dependent on a range of variables including supply chain, seniority of staff employed, and location.

This analysis endeavours to estimate realistic costs which retain a level consistency in a relation to each other. It should be noted that due to a number of exclusions, these costs are unlikely to represent total marketplace costs for many procurers of BREEAM services and sustainable technology. Exclusions include preliminaries, fees, contingencies, and allowances for Builders Work in Connection (BWIC) etc which can increase the overall cost by as much as 25%. This percentage increase is however likely to be similar for both BREEAM 2008 and BREEAM 2011.

4.1.2 Calculated Building Costs

Costs have been referenced to high level, rule of thumb capital construction costs for typical buildings. The indicative percentage increases in cost refer to the uplift in capital construction cost against a baseline building designed to meet a BREEAM 2011 'Very Good' standard. In order words, the percentage increase represents the "extra-over" design or construction costs resulting from the increased performance requirements under BREEAM 2011.

These costs should be viewed as guidelines only for the scenarios considered. Actual project costs and the increase associated with the new BREEAM scheme will vary substantially depending on a number of key factors e.g. building type, scale, location, occupancy, orientation, form and function. In many cases there may be no overall cost increase when compared to BREEAM 2008, and for others there may actually be a cost saving in terms of lifecycle or whole life costs. For example, increasing energy performance, while potentially raising capital cost expenditure, will likely result in net saving over the operational lifespan of the building.

Cost implications of BREEAM issues under the 2011 scheme have been calculated in terms of fixed and variable costs:

- Fixed costs – these costs include items such as reports to BREEAM criteria (*Man 04: Stakeholder Participation – Building User Information*), or items of plant or equipment that are typically fixed in size and thus cost, e.g. leak detection systems (*Wat 03: Water Leak Detection and Prevention*).

- Variable costs – dependent on location, size and type of building. For example, to achieve a certain percentage carbon emissions reduction through *Ene 04: Low or Zero Carbon Technologies;* the degree to which renewable technologies are used, and hence the cost of their implementation, is dependant on the size of the building, Alternatively, improving the life cycle impact of building fabric has variable costs associated with the specification of higher performing building elements under the Green Guide (*Mat 01: Life Cycle Impacts*).

When comparing costs under 2011 to the 2008 schemes, the "extra-over" cost has been used as the basis of uplift (from 2008 'Very Good' to 2011 'Very Good').

4.2 Cost Analysis Methodology

The costing analysis was focused on the "extra-over" cost of meeting a BREEAM 2011 'Very Good' rating compared to a 2008 'Very Good' rated building. The cost analysis, therefore, refers to Stage 3 of the Building Analysis process (see section 3). The uplift was carried out in the following hierarchical stages:

4.2.1 Cost Stage 1

All relevant "free" credits which have not already been achieved are added to the building.

These are credits that are unlikely to have a significant impact in capital cost and/or are common practice in building design. Only credits relevant to the particular building type were added, in ascending order of complexity. For some buildings, this stage alone was enough to secure a BREEAM 'Very Good' rating under 2011 and the cost implication was thus zero. Most buildings, however, required further credits to be awarded using the cost stages 2 and 3.

4.2.2 Cost Stage 2

Ene 01: Reduction of CO_2 Emissions score is raised by two credits.

All buildings (which had not achieved 2011 'Very Good' through cost stage 1) were then awarded an additional two credits under the 2011 *Ene 01* issue. Work undertaken during thermal modelling as part of the 'BREEAM 2011 Technical Analysis: *Ene 01* analysis' (report reference 295389/MNS/BTL/01/0) indicated that increasing the carbon emissions performance of a building by a degree is relatively straightforward.

The improvement factor of +2 *Ene 01* credits represents building design upgrades that can be made at relatively low cost when considered at an early project stage, particularly passive design measures (orientation of the building for example), or measures to help reduce building energy demand such as daylighting. Other potential measures relate to building services or fabric efficiency; improved U-values (thermal transmittance) and airtightness, lower specific fan powers (for ventilation) or increased boiler efficiencies.

It is important to state that in the first instance, these improvements are often required to comply with regulatory requirements under Building Regulations Part L2A; *Conservation of fuel and power in new buildings other than dwellings,* rather than necessarily to meet BREEAM. New buildings

under Part L 2010 regulations require a 25% aggregate improvement in energy performance when compared to Part L under 2006 regulations. These regulations are complimentary to the BREEAM 2011 and 2008 assessments respectively. Consequently, the associated costs cannot be directly attributed to BREEAM as opposed to Part L. An indicative cost uplift has been applied where these credits have been added, and is discussed further later in this section.

4.2.3 Cost Stage 3

The remaining score deficiency is then eliminated through addition of fixed and variable cost credits in ascending order to achieve BREEAM 2011 'Very Good' rating (55%).

Once all "free" credits and energy efficiency improvements had been made to each building assessed, the remaining 'uplift' percentage requirement was built up via credits in ascending cost order.

Variable costs depend on building size, type and location, therefore a building-specific approach was taken when awarding issues. In cases were buildings had already achieved the majority of the low-cost credits, more expensive credits needed to be aimed for.

In general credits were added across the management, health and wellbeing and energy categories, as the higher weighting of these issues mean that there is more scope to influence scores here. Other categories, including transport or land use and ecology are very site dependent and can either incur large costs, or restrict award of credits due to site constraints.

4.2.4 Supplementary Costs

In order to account for any discrepancies and variations in design and construction approach, a fixed cost and variable cost were added for all building types during stages 1 and 2 of the cost assessment. A fixed cost of £3,000 for small buildings (assumed for the cost assessment to be less than 2000m^2), and £6,000 for large buildings, was included to cover cost of new reports and evidence requirements under BREEAM 2011. A variable cost of £2/m^2 was also added to cover minor improvements in energy efficiency and other areas. These costs are largely arbitrary, but have been chosen again to allow for a consistent approach for all the buildings assessed.

The fixed and variable costs were then summed for each building and shown relative to typical total construction cost benchmarks[11]. This is for reference purposes and to allow an approximate order of cost estimate to be made in terms of the "extra over" cost.

All cost estimates should be considered as indicative only, and have been prepared for the purpose of identifying the strategic level implications of BREEAM 2011 on Planning Policy Wales only.

[11] Capital construction value of building types is based on information sourced from Franklin & Andrews Construction Economists: *Construction Property Benchmarks.*

5. Building Analysis: Results

The following section provides a summary of the results from the Building Analysis undertaken as part of this research report. The findings presented consider the overall absolute percentage scores for each building, in addition to the relative changes that have resulted from the updated criteria required within the 2011 scheme document. Conclusions have been drawn both for building scheme types, and the separate categories within the BREEAM assessment method.

Throughout the building analysis, the 'easy win' score (Stage 2) under BREEAM 2011 has been taken as the primary comparative score against which to compare building performance under BREEAM 2008. The 'easy win' 2011 score is considered to be the most realistic; a good practice building aiming for certification under BREEAM 2011 would be likely to address the more readily achievable, cost effective credits from an early project stage and thus the 'strict' 2011 score (Stage 1) is considered to be an overly conservative estimate.

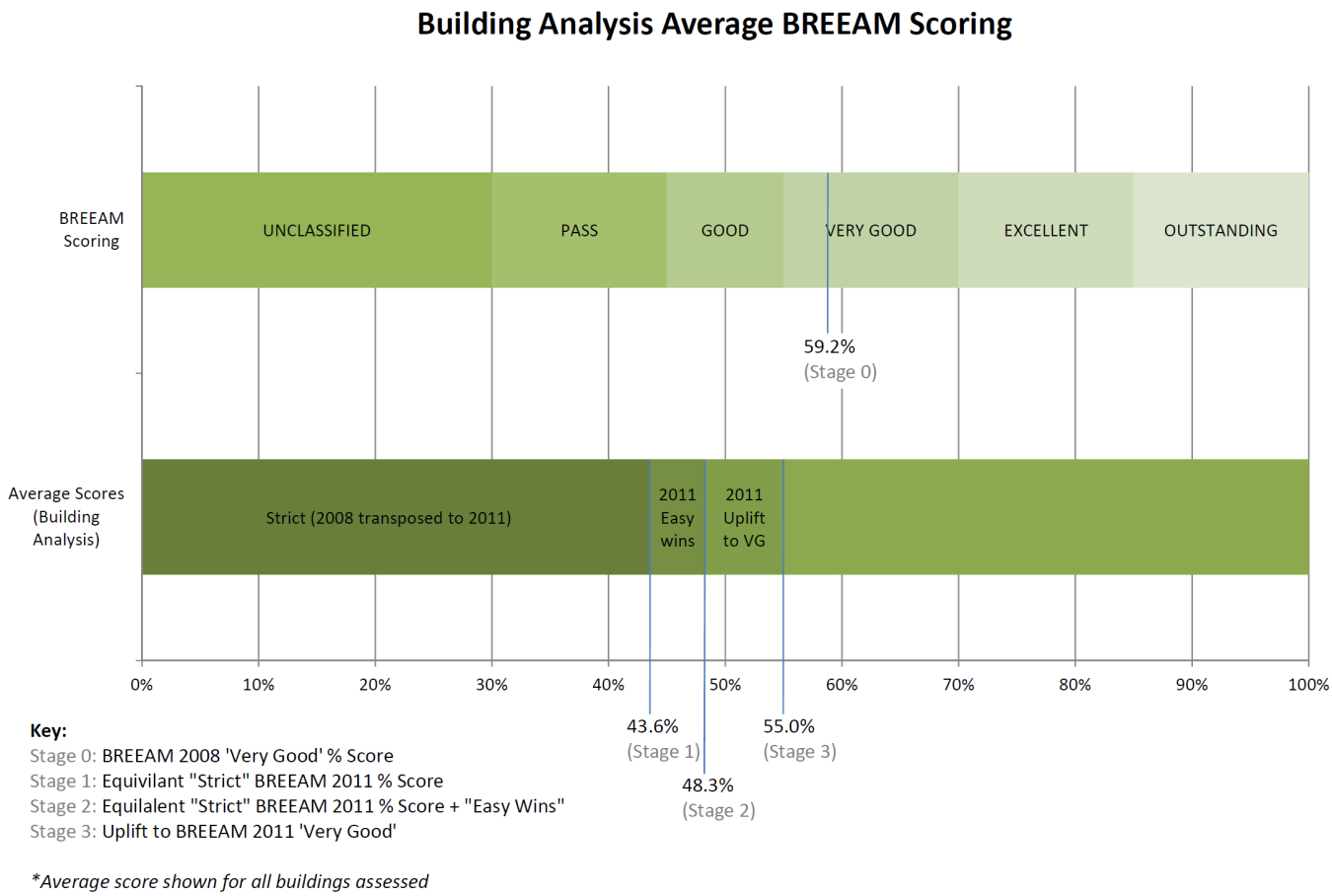
5.1 Summary of Percentage Scores

Figure 5.1 presents the overall percentage scores achieved at each assessment stage (as detailed in section 4) averaged across all building types. As the results represent a mean average, no conclusions should be drawn for particular building types from these overall averages. The scores shown represent a guide for each assessment stage as to the approximate percentage achieved on average under the 2011 scheme when compared to the 2008 buildings.

The average score under 2008 for all buildings assessed was 59.20%, this is somewhat higher than the minimum standard required (55%) to achieve a 'Very Good' rating, however, it was deemed preferable to assess and compare some higher rated buildings under 2008 to see the relative performance drop in 2011 against the lower scoring buildings.

As shown in Figure 5.1, the average score when transposing credits strictly to 2011 (Stage 1) was 43.60%, a 'Pass' rating. Once the "easy wins" under the 2011 scheme had been added across all buildings (Stage 2), the average score increased to 48.30%, a 'Good' rating. The score for each building was then increased to meet the minimum 'Very Good' requirement, where necessary of 55.00% (Stage 3).

Figure 5.1: Average of percentage scores following assessment stages 1, 2 and 3



Source: Mott MacDonald

Details for each of the buildings assessed, in addition to the BREEAM 2011 scores under Stages 1 to 3 are provided in Table 5.1.

Table 5.1: Building analysis outputs

Building Reference	Details	Size of building	BREEAM 2011 scores		
			Strict	Easy win	Uplift to Very Good
Commercial - Industrial					
Building 1	Warehouse	Medium	38.94%	42.79%	55.38%
Building 11	Industrial units	Small	41.33%	45.32%	55.41%
Building 13	Food units	Small	44.44%	49.40%	55.22%
Building 27	Warehouse unit with offices	Large	49.40%	54.09%	55.16%
Commercial - Offices					
Building 2	Office building	Medium	37.99%	42.86%	55.15%
Building 3	Gatehouse	Small	39.03%	43.48%	55.07%

Building Reference	Details	Size of building	BREEAM 2011 scores Strict	Easy win	Uplift to Very Good
Building 9	Police office	Medium	38.02%	43.63%	55.16%
Commercial - Retail					
Building 18	Supermarket.	Medium	45.67%	51.29%	55.69%
Building 19	Supermarket	Medium	41.21%	43.76%	55.43%
Public - Education					
Building 10	Secondary school	Medium	42.99%	47.15%	55.04%
Building 12	University building	Medium	55.42%	58.01%	N/A
Building 22	Primary school	Medium	45.32%	51.69%	56.15%
Building 23	University building	Large	56.82%	63.14%	N/A
Building 25	Secondary school	Medium	44.42%	45.97%	55.39%
Building 26	Primary school	Medium	44.60%	49.07%	55.66%
Public - Healthcare					
Building 4	Primary care centre.	Medium	45.48%	48.20%	55.45%
Building 21	Health centre	Large	43.26%	49.17%	55.53%
Building 24	Medical centre	Small	49.23%	51.49%	55.03%
Public - Law Courts					
Building 28	Hypothetical civil justice centre	Medium	43.91%	47.76%	55.29%
Building 29	Hypothetical crown court	Large	43.46%	47.31%	55.33%
Public - Prisons					
Building 14	Prison block and reception	Medium	43.72%	52.08%	57.59%
Building 20	Workshops & training rooms	Large	44.13%	52.26%	58.67%
Multi-residential accommodation					
Building 15	Residential care facility	Large	36.70%	43.69%	55.47%
Building 16	Residential care facility	Large	39.31%	42.99%	55.28%
Building 17	Self contained sheltered housing	Medium	40.70%	46.02%	55.42%
Other					
Building 5	University technical facilities	Medium	44.64%	48.10%	56.02%
Building 6	Community centre	Small	41.12%	47.28%	55.69%
Building 7	Hotel	Small	41.85%	46.90%	55.86%
Building 8	Leisure centre	Medium	40.53%	45.60%	55.65%

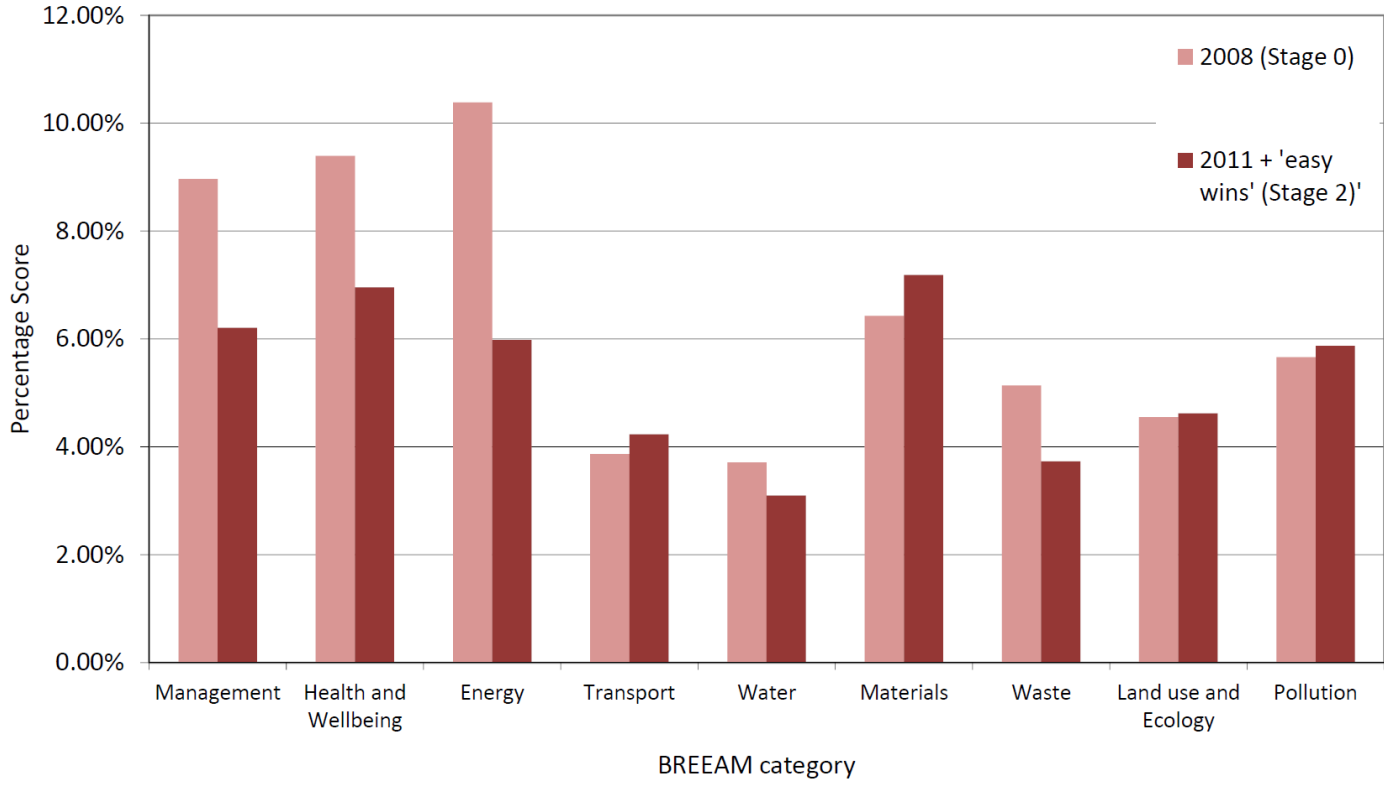
Source: BRE

A comparison of the absolute score for each issue category for BREEAM 2008 and BREEAM 2011 (easy win score) is provided in figure 5.2 on the following page. From the figure it is evident that the Management, Health and Wellbeing, and Energy categories have suffered the most significant reduction in score, whereas the change elsewhere has not been as severe.

Whilst the figure above provides a good indication of the category scores which have been adversely or beneficially impacted by changes made to BREEAM between 2008 and 2011, a significant degree of credit consolidation, movement of credits between categories, and introduction

of new credits has occurred; consequently the 2008 and 2011 category scores by name are not directly comparable. Additionally, the variation in the buildings 2008 scores selected for assessment, from around 55.30% up to 69.59% means that it is difficult to draw robust conclusions from overall average values taken. Subsequently the relative changes across categories and building types were assessed.

Figure 5.2: Comparative absolute scores for BREEAM 2008 (Stage 0) and BREEAM 2011 + 'easy wins' (stage 2)



Source: Mott MacDonald

5.2 Summary of Relative Changes

In order to undertake a more accurate performance comparison for each BREEAM category, the 2008 credits which are directly equivalent or comparable to 2011 credit issues have been used, rather than the absolute 2008 category scores.

For example, under the 2011 scheme *Man 01: Sustainable Procurement,* criteria 14-17, awards a credit for undertaking a thermographic survey, with any defects then identified and rectified (*Construction and handover (thermographic survey)*). The equivalent issue under the 2008 schemes was *Ene 06: Building fabric performance and avoidance of air infiltration,* which awarded a credit for the same criteria. Even though this issue was formally under a separate category (Energy as opposed to Management), the weighted increase or decrease in score for this criteria has been compared for the new scheme category (Management). Full details of the equivalent 2008 BREEAM issues for every 2011 issue are provided in Appendix A. For the purposes of this research

a relative change, where the 2011 score is presented as a percentage of the equivalent 2008 score, is more informative than an absolute change.

Figure 5.3 summarises the comparison for each building type. Looking at the waste category as an example, an office building may achieve a BREEAM 2011 score 30% lower than the equivalent 2008 score i.e. if the building achieved a 2008 percentage score of 6.0%, it could achieve 4.2% for the same category in 2011.

It should be noted that the innovation category has not been included in this analysis; credit achievement within this category is almost entirely dependant on features of individual buildings. The removal of an innovation credit for *Wat 02 – Water Meter* (the requirements for which have been incorporated into the main credit requirements for this issue) has adversely impacted buildings across the board. This credit was awarded where plant or building areas consuming more than 10% of the total water consumption were sub-metered. Buildings such as educational institutes, healthcare buildings and leisure facilities, which are more likely to contain such plant or areas, have potentially been more significantly adversely affected by the removal of this credit compared to e.g. office buildings which are unlikely to include significant water consuming plant and thus less likely to have achieved the 2008 innovation credit.

Within each building type, there is some variation in score for each issue category. The range in performance for each building type is summarised in Figure 5.4.

Figure 5.3: Average relative percentage change in issue category performance for each building type

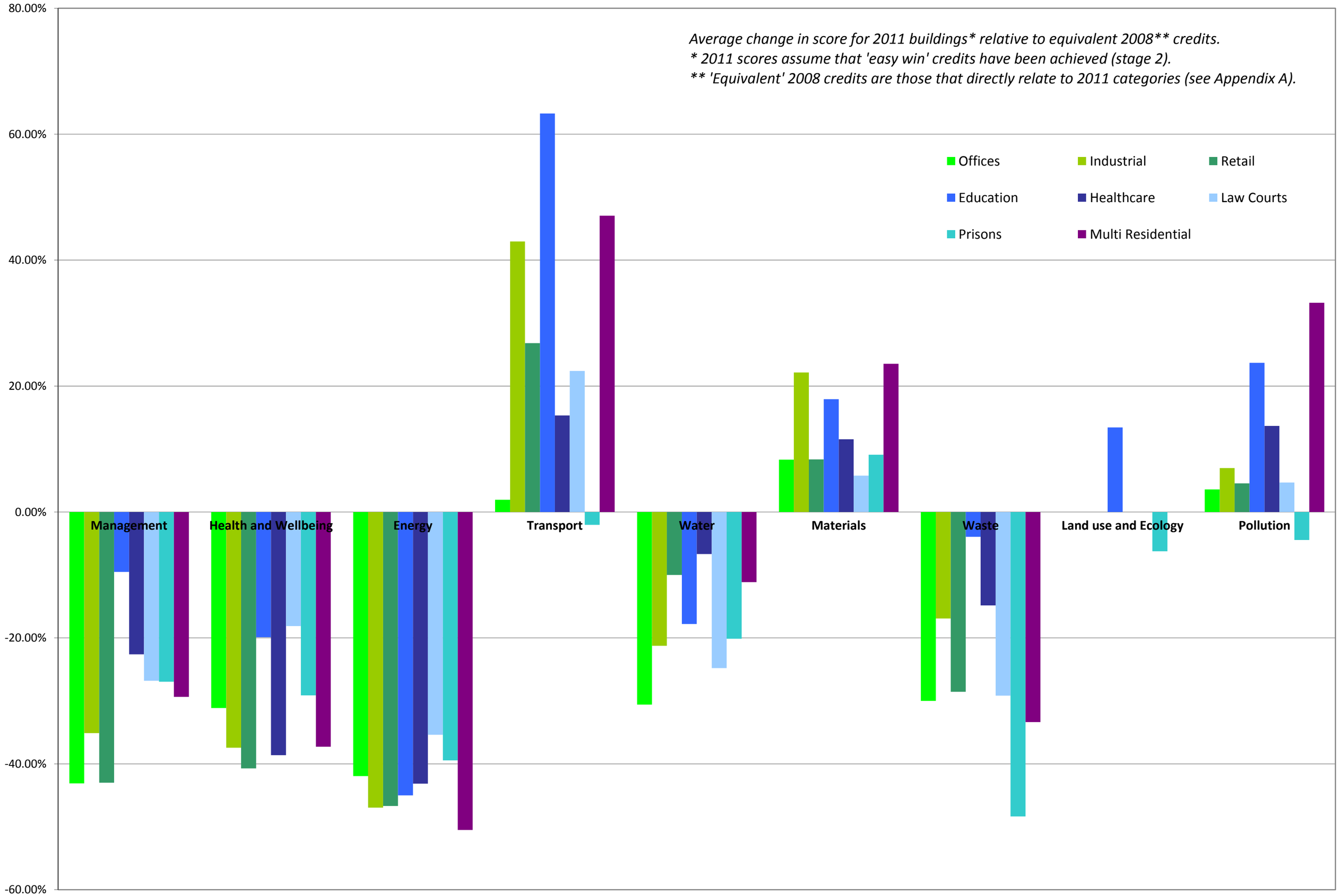
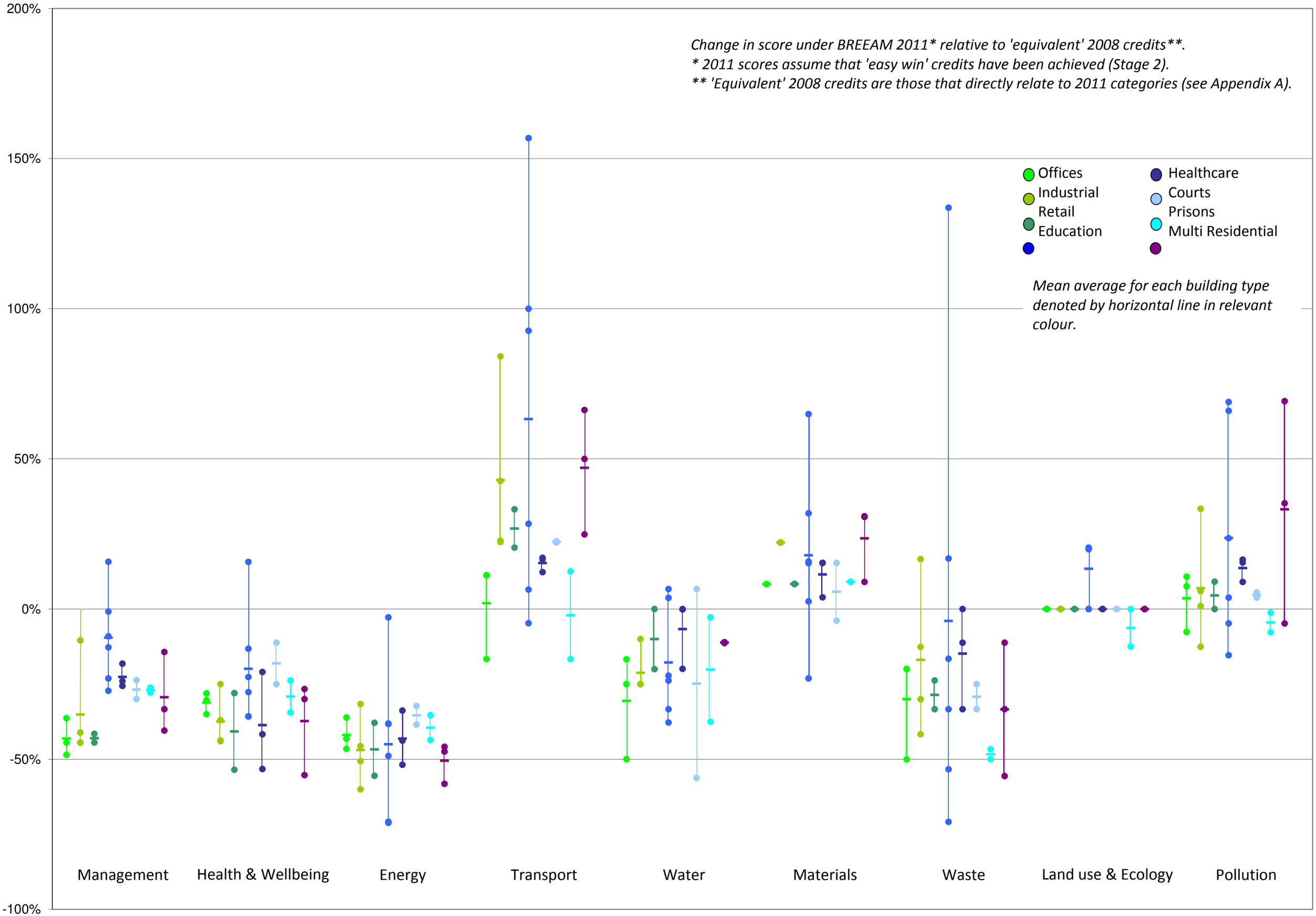


Figure 5.4: Relative percentage change in issue category performance for individual buildings



5.3 BREEAM Category and Building Type Analysis

Across all BREEAM issue categories, education buildings exhibit the greatest range in score. This is due to the large variation between different types of education building and therefore the varying applicability of individual BREEAM credits. For example, a university (higher education) building might contain cold storage, laboratories and fume cupboards and so have potential to achieve credit for these features, while the reverse is true for a primary school, which is unlikely to contain any of the above features.

5.3.1 Management (Man)

From BREEAM 2008 to BREEAM 2011, all building types suffer a significant reduction in percentage score within the Management category. Commercial buildings (offices, industrial and retail) score particularly badly due to the introduction of several new credits which were not previously applicable to these building types. Education buildings are the least affected by the changes as several credits previously specific to Education buildings e.g. relating to consultation, shared facilities and site investigation have now been introduced to all building types.

5.3.2 Health and Wellbeing (Hea)

In a similar situation to the Management category, a high score in the 2011 Health and Wellbeing section becomes harder to achieve across all building types, due to credit consolidation, credit loss and additional requirements such as the introduction of an 'Indoor Air Quality Management Plan' as a pre-requisite to a number of credits, although this credit is assumed to be achieved for the 2011 'easy win' analysis.

5.3.3 Energy (Ene)

All building types suffer a reduction in score in the Energy category. This is primarily due to significant changes in methodology for credit *Ene 01 - Reduction in CO_2 emissions*. This credit has become more stringent and now assesses the performance of the building in terms of several factors, compared to BREEAM 2008 which only considered the Energy Performance Certificate (EPC) rating. Further details on this change in methodology are provided in Section 3.3.4. It should be noted under this section that a conservative approach to awarding credits under the new Ene 01 assessment category for this analysis. Buildings may in fact perform better in reality, but the new methodology is dependent on too many factors (relating to building form, fabric, and HVAC systems) to make more optimistic assumptions on energy performance.

5.3.4 Transport (Tra)

In order to draw robust conclusions on the changes in the Transport category, a large sample size comprising many buildings would be necessary due to the site specific nature of public transport and amenity accessibility. However, the initial analysis highlights that the majority of building types achieve a higher rating in this category in BREEAM 2011 compared to BREEAM 2008. A number of credits previously covered under the Transport category have been moved to other categories and consequently the remaining transport credits are individually worth a higher percentage of the overall score.

Prisons perform poorly within this category, suffering a score reduction of around 40%. Issues associated with accessibility to public transport and amenities are less relevant to prison sites and so fewer credits are available for this building type.

Office buildings exhibit lesser overall improvement in this category compared to other building types. This is partly due to changes made for this building type under 2008 *Tra 06 – Maximum car parking capacity* (equivalent to 2011 *Tra 04*). Under BREEAM 2011, this issue is linked to the transport accessibility index. For sites with a high accessibility index, the allowable parking space allocation has become more stringent and thus some office buildings which were awarded credit in 2008 cannot achieve credit in 2011.

There is a considerable range in performance for the six education buildings assessed. A marked increase in the performance of schools is observed for BREEAM 2011; with a score improvement of up to 150% in one case, compared to equivalent 2008 credits. This is predominantly due to the significantly increased weighting of individual transport credits, which for schools are worth 1.14% in 2011 compared to 0.89% to 1.00% in 2008.

5.3.5 Water (Wat)

It has not been possible to draw any accurate conclusions from analysis of the water category; limited data on water consumption and sanitary fittings was provided within the BRE database. However, the analysis suggests that all building types lose out to some degree.

5.3.6 Materials (Mat)

All building types perform better in this category in 2011 when compared to 2008. This is due to the reduction in overall credits available in the new scheme. Therefore, each credit achieved is worth proportionally more in percentage terms (as the overall weighted score for each category remains as per 2008). Multi-residential in particular has gained the most in scoring terms.

5.3.7 Waste (Wst)

All buildings have lost out under the new scheme in the waste category. This is due to the increase in complexity for achieving the *Wst 01 - Construction Waste Management* issue. Industrial buildings are the least affected here from the sample building analysed. Some building types have been affected more than others from the sample buildings investigated. The reason for this is due to the waste data available. Where measured in volume, rather than tonnage, buildings have performed worse. This is shown in the multi-residential and prison categories (which, purely by coincidence, in most cases had waste figures provided in volumetric terms).

5.3.8 Land Use and Ecology (LE)

Similarly to the transport category, land use and ecology is highly dependent on the site being investigated, and therefore the scores can vary here. Prisons are the only buildings that have lost out in this category. This is due to the fact that *LE 04 - Enhancing Site Ecology*, has changed for this one building type. Whereas previously 1 or 2 credits could be achieved based on meeting different criteria, this criteria has now been consolidated and either 0 or 2 credits are now

achievable. As one of the buildings assessed achieved one credit in 2008, the results show a loss in 2011 for this one particular case. In all likelihood this credit would be either aimed for in entirety in the new scheme or substituted by design teams elsewhere. Therefore, there is unlikely to be a net loss overall.

The performance of four of the six educational buildings improved by around 20% in 2011 compared to 2008. Under BREEAM 2008, these four buildings, which are all schools (primary or secondary), were able to achieve credit for *LE07 – Consultation with students and staff* and *LE08 – Local wildlife partnership*. The resulting weighting of individual 2008 LE credits for these building was consequently slightly lower than for higher educational buildings, at 0.83% per credit compared to 1.00%. Under BREEAM 2011, the 2008 credits *LE07* and *LE08* have been removed or transferred to other assessment categories and consequently 2011 LE credits are now worth 1.00% for all educational buildings. School buildings therefore achieve higher percentage scores for achievement of equivalent 2011 and 2008 credits thus experiencing a slightly positive change in overall category score.

5.3.9 Pollution (Pol)

The pollution category in Figure 5.4 shows a varied distribution, with some buildings actually increasing their scores, and others losing out in this category. The reason for this is entirely dependent on whether the building includes refrigerants (either in heating, cooling or cold storage); where included the building loses out, whereas if refrigerants are excluded the percentage score achieved can actually increase overall. The buildings that include refrigerants mirror likely patterns in building stock (prisons, industrial, offices, and law courts). Education and residential on the other hand are often naturally ventilated.

5.3.10 Summary

Management, Health and Wellbeing, and Energy categories exhibit the most significant losses in percentage terms when comparing the equivalent credits under BREEAM 2008. For Management and Health and Wellbeing, this is predominantly due to the large degree of consolidation which has occurred for these categories, and introduction of several new credits not previously covered by BREEAM 2008. In the case of the Energy category, significant changes have been made to *Ene 01*, with a high score in 2011 requiring energy efficiency in terms of demand, consumption and carbon emissions.

An increase in individual credit weighting (due to loss of a number of credits) for the Materials section has had a largely positive impact across all building types. Increased stringency of construction waste thresholds has reduced the relative performance for all building types in the Waste category. Transport and Land Use and Ecology issues are highly site dependant, therefore there is a significant variation between the performance of different buildings and building types for these categories.

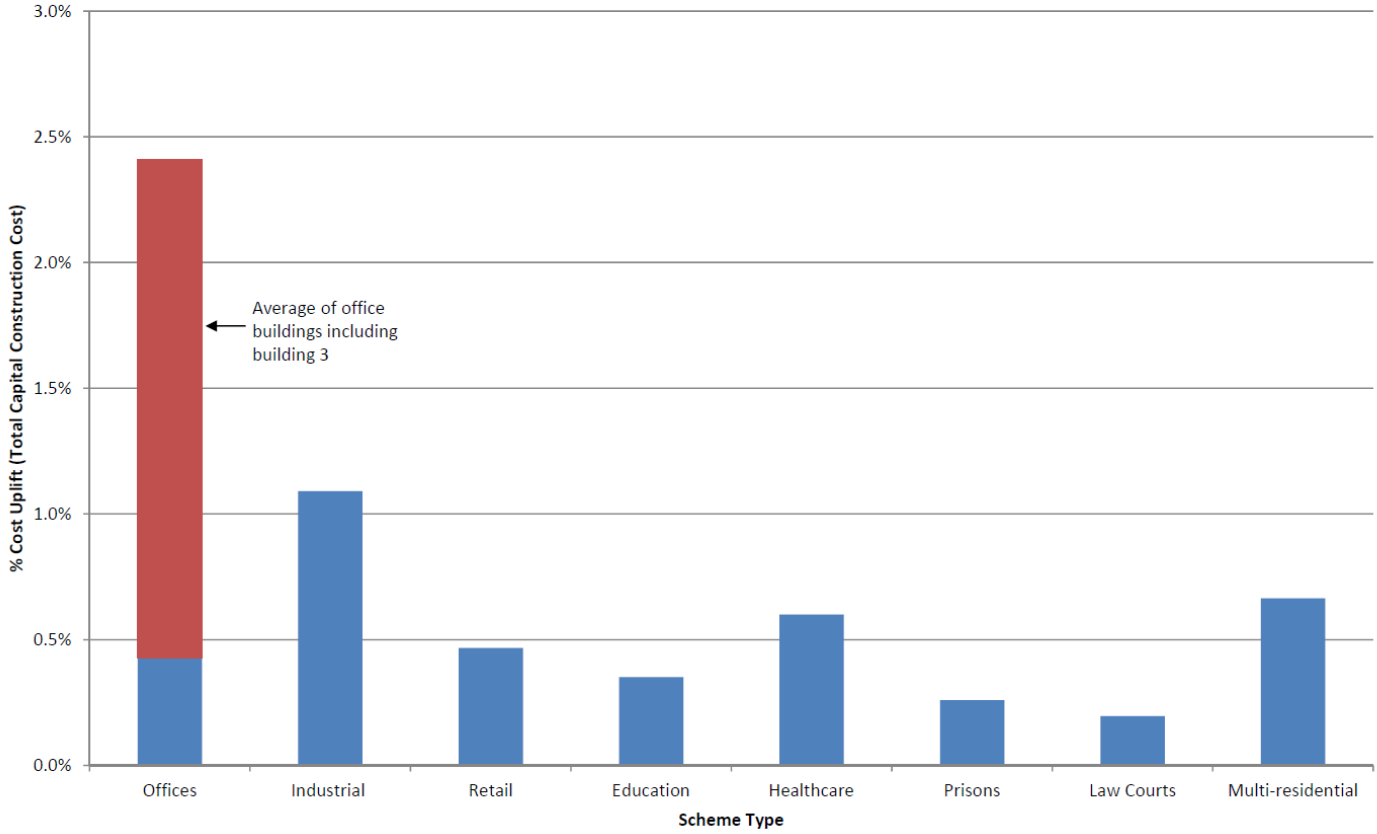
5.4 Cost Analysis

5.4.1 Average of Performance

A small increase in overall cost, in design or construction, has been identified for all buildings, as a result of the changes to BREEAM 2011 to maintain. On average, the cost increase as a percentage of total construction cost is approximately 1%. This value is somewhat increased due to one office building assessed (building 3), the proportional cost increase for which was significantly higher at 5%, due to the building's small gross internal area. Removing building 3 from the cost results reduces the overall average to approximately 0.7%, as shown in Figure 5.5 below.

Figure 5.5 shows the average results for each building type, with similar average cost increases of between 0.5% and 1% identified for all building types. It is difficult to draw separate conclusions for each building type; many costs are building specific and dependant on the credits awarded prior to uplifting the percentage score to 'Very Good' under BREEAM 2011 (Stage 3 of Building Analysis).

Figure 5.5: Average % Cost Uplift by BREEAM Building Type from 'Easy Wins' to BREEAM 2011 'Very Good' rating (Building Analysis Assessment Stage 2 to 3)



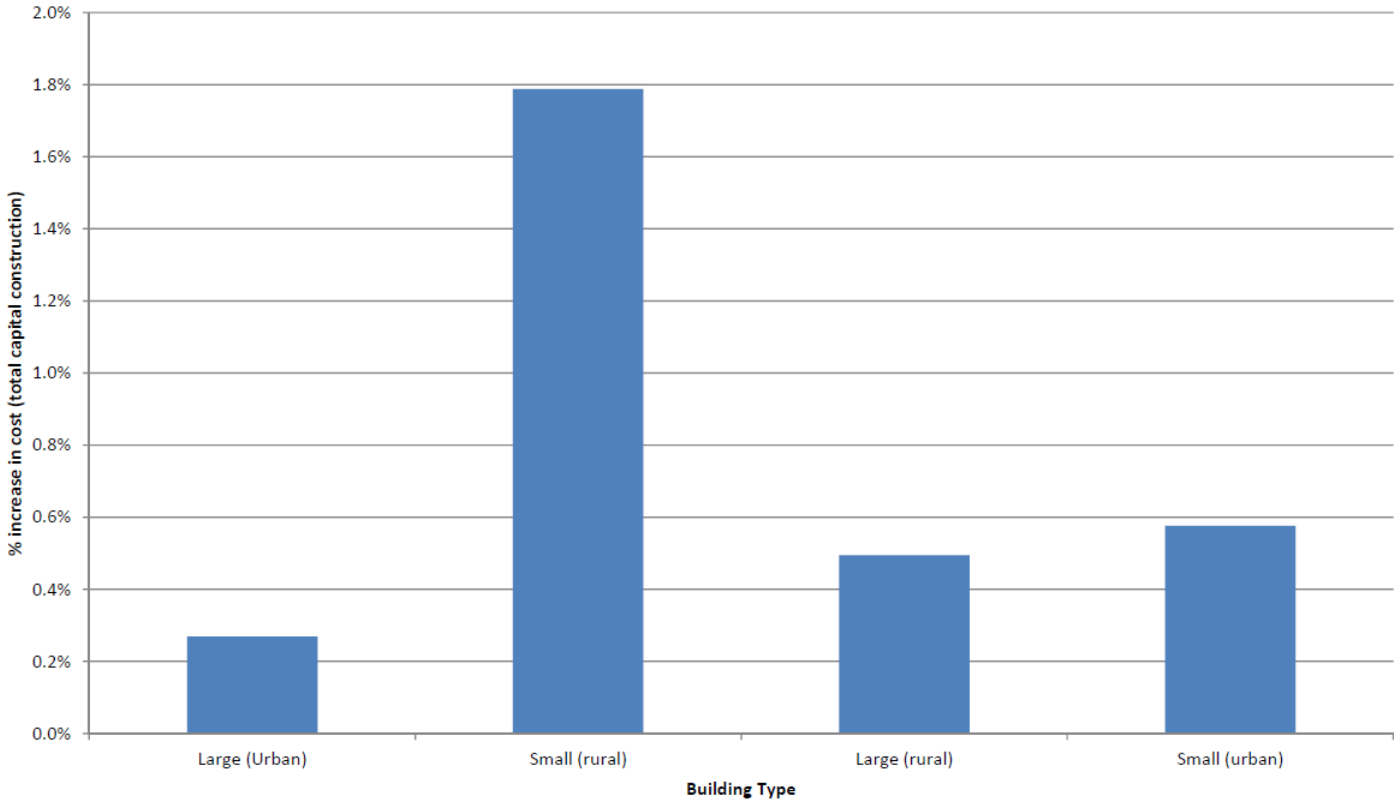
Source: Mott MacDonald

5.4.2 Building Location and Size

Location and building size are the biggest determinants for the increase in cost, with rural locations losing out more heavily than urban, due to less BREEAM credit being available overall. Figure 5.6 shows the average cost results for size and location. For the purposes of this cost assessment, large buildings are deemed to be those greater than 2,000m^2, while location is based indicatively on the buildings performance in the transport category (accessibility index).

While taking into account the relatively small sample set of buildings and the assumptions made in this costing exercise, it can still be concluded that small rural buildings fare worse overall than large or urban buildings.

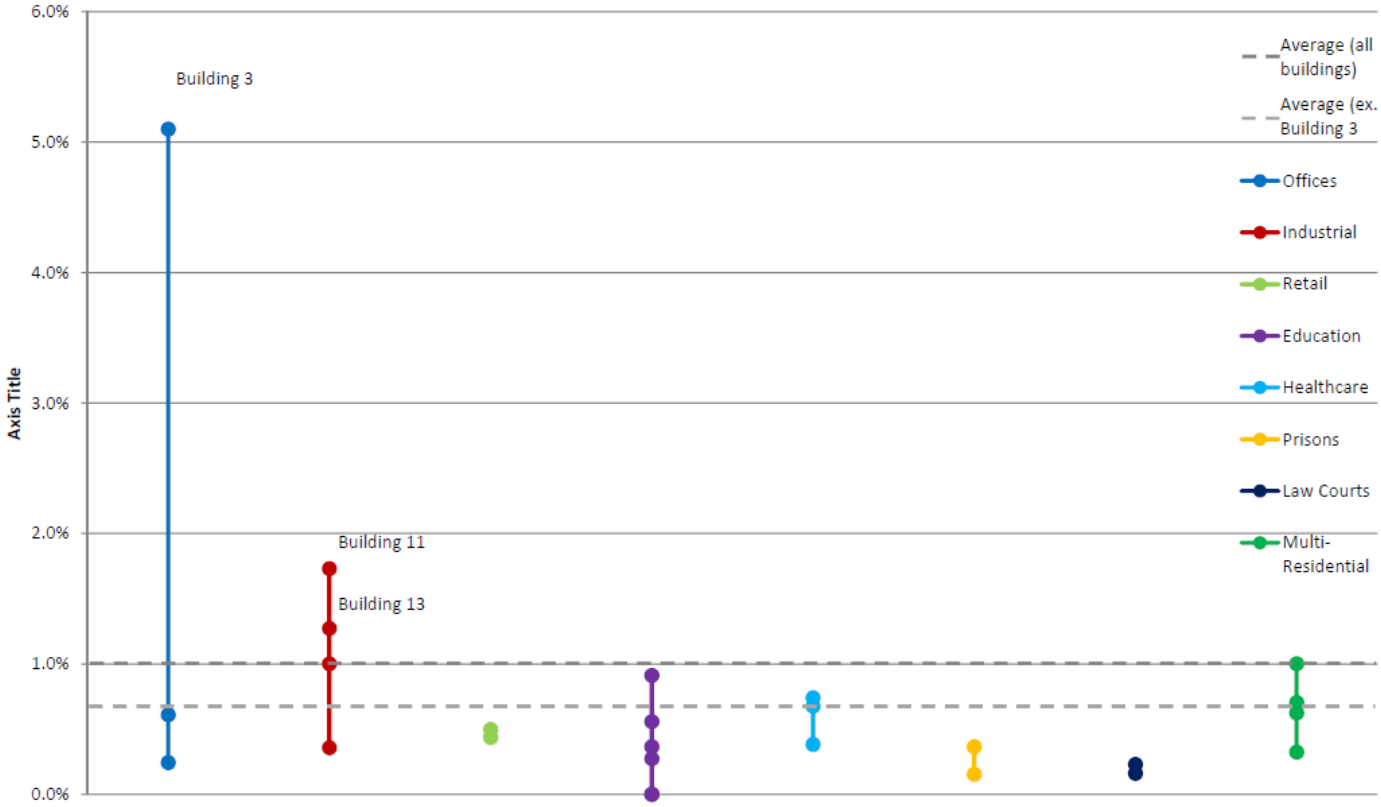
Figure 5.6: Average % Cost Uplift by Building Size and Location from 'Easy Wins' to BREEAM 2011 'Very Good' rating (Building Analysis Assessment Stage 2 to 3)



Source: Mott MacDonald

Figure 5.7 validates the location observation; buildings 3 (office), 11 (industrial) and 13 (industrial), which show the highest cost increase, are all rural buildings with gross internal areas less than 2,000m^2, Larger buildings have generally faired better overall; fixed costs associated with credits comprise a smaller proportion of the overall project cost for buildings with a larger floor area.

Figure 5.7: Estimated % Cost Uplift by BREEAM Building Type from 'Easy Wins' to BREEAM 2011 'Very Good' rating (Building Analysis Assessment Stage 2 to 3)



Source: Mott MacDonald

5.4.3 Summary

There is a degree of cost uplift for all building types when considering the extra-over cost of achieving a BREEAM 2011 'Very Good' rating compared to BREEAM 2008. Cost has been demonstrated to be highly influenced by building location and size. The cost increase on average across building types is however, deemed to be relatively insignificant, at approximately 1% of the total project cost. In addition, no building types appear to be more heavily penalised than others (for example public vs. commercial).

6. Policy Recommendations

After review of the technical changes to the BREEAM assessment process, and following a theoretical building assessment across a wide spectrum of building types, the following recommendations are presented to Welsh Government for adoption into the Sustainable Building Standards.

Mott MacDonald recommend revising the existing Planning for Sustainable Buildings requirement contained within section 4.11 of Planning Policy Wales. The existing requirement is as follows:

> *Applications received on or after 1st September 2009 for non-residential development which will either have a floorspace of 1,000 m^2 or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) 'Very Good' standard and achieve the mandatory credits for 'Excellent' under issue Ene1 – Reduction of CO_2 Emissions.*

The following sections present three options to the Welsh Government for revision to Planning Policy Wales.

6.1 Option 1: Maintain Policy Wording

This option retains the same wording as the existing policy:

> *Applications received on or after [date to be confirmed] for non-residential development which will either have a floorspace of 1,000 m^2 or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) 'Very Good' standard and achieve the mandatory credits for 'Excellent' under issue Ene1 - Reduction of CO_2 Emissions.*

Under this scenario, all non-domestic buildings that meet the above criteria would be expected to achieve a BREEAM rating of 'Very Good' and 6 credits under Ene 01 category using the new 2011 scheme.

Having undertaken an assessment of the cost and technical feasibility of increasing the BREEAM rating to the 'Very Good' level under 2011, the uplift in cost and technical difficulty is not considered to be high. However, achieving mandatory credits under issue Ene 01 (for 'Excellent' level - 6 credits) could increase complexity and cost substantially for some buildings.

Under the 2011 BREEAM scheme, an 'Excellent' standard (6 credits) under Ene 01 issue would also require a CO_2 parameter[12] for the EPR_{NC} (Energy Performance Ratio) calculation of 0.22. This is equivalent to a 25% improvement on the buildings TER (Target Emission Rating) as calculated during Building Regulations Part L2A compliance calculations.

While designers can reduce energy demand and consumption through a variety of design options and contrasting strategies; in some cases there may be no cost or design implications when compared to the 2008 base case, other buildings will be affected substantially, particularly where CO_2 emissions can only be reduced to a certain level through passive design and building fabric or services efficiency. In this case a high level of low or zero carbon (LZC) technologies would be required in order to achieve the higher EPR_{NC} required under Ene 01.

From investigating a selection of buildings using thermal modelling to determine the impact of this increased performance in carbon emissions, and assessing a base case, gas (space heating and hot water) and grid derived electricity, the indicative cost increase associated with meeting the target under the 2011 scheme could be in the region of 1% to 4% (capital cost increase over 2008 capital cost as a result of LZC technologies[13]). There is also a general cost uplift of approximately 1% to achieve the higher BREEAM standard, as a result of new credit criteria and improvement in building design and construction requirements. Therefore, the total increase in capital cost for this case lies between 2% and 5%.

6.2 Option 2: Maintain Policy Outcome

This option maintains the policy outcome of the current national planning policy (i.e. BREEAM 'Very Good' standard using the BREEAM 2008 schemes, and 6 credits under Ene 01 issue).

> *Applications received on or after [date to be confirmed] for new build non-residential development which will either have a floorspace of 1,000 m^2 or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) **'Good'** standard and achieve **1 credit** under issue Ene1 - Reduction of CO_2 Emissions.*

This recommendation relies on the basis of uplifting existing BREEAM 2008 buildings to the 2011 scheme. In many cases, there will be no overall increase in design complexity or cost in order to achieve a 'Very Good' rating in 2011.

6.3 Option 3: Uplift Policy Outcome

This option increases the performance requirement of non-domestic buildings in Wales to obtain a BREEAM 'Very Good' standard using the 2011 scheme.

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[12] Unlike Ene 01 under 2008, which considered the buildings CO_2 index only (EPC asset rating), the 2011 scheme awards credits based on the buildings calculated energy demand, energy consumption, and CO_2 emissions (as calculated under Building Regulations Part L2A).

[13] These costs have been based on incorporating photovoltaics or wind turbine(s) in the development to reduce carbon emissions (by approximately 25%). Other LZC's have not been considered for this particular assessment due to complexity regarding existing site conditions, existing utilities, proposed HVAC services, and proposed function of building.

Having undertaken an assessment of the cost and technical feasibility of increasing the BREEAM rating to the 'Very Good' level under 2011, the uplift in cost and technical difficulty is not considered to be substantial. The overall indicative cost increase in terms of capital construction cost is approximately 1% for the buildings analysed during this assessment. The Welsh Government should consider adopting this higher rating, particularly in light of the timeline to zero carbon buildings. Costing has also demonstrated that no building types would appear to be more heavily penalised than others (for example public vs. commercial).

> *Applications received on or after [date to be confirmed] for new build non-residential development which will either have a floorspace of 1,000 m^2 or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) **'Very Good'** standard and achieve **3 credits** under issue Ene1 - Reduction of CO_2 Emissions.*

This policy phrasing reinforces the importance of the energy hierarchy, whilst allowing flexibility in building design. It should be noted that 'Public' buildings in particular (Education, Healthcare, Prisons, and Law Courts under the BREEAM 2011 Scheme) have performed better when transferring scores from the 2008 scheme to the new 2011 scheme. I.e. Public Buildings can achieve the higher rating at relatively less expense, or design effort than for commercial scheme (Offices, industrial and retail). This option is considered to be the preferred approach for Planning Policy Wales.

6.4 Policy Recommendation

It is recommended that **Option 3** is selected for adoption for Planning Policy Wales:

> *Applications received on or after [date to be confirmed] for new build non-residential development which will either have a floorspace of 1,000 m2 or more, or will be carried out on a site having an area of one hectare or more, to meet the Building Research Establishment Environmental Assessment Method (BREEAM) **'Very Good'** standard and achieve **3 credits** under issue Ene1 - Reduction of CO_2 Emissions.*

It should be noted that while there may be a degree of cost uplift as a result of either Option 1 or 3 listed above, these costs refer to capital cost of design and construction only. The value of operational, or lifecycle costs, have not been included. It is likely in a majority of cases that there will actually be a cost reduction as a result of increased energy performance. In addition, holistic sustainability in terms of socio-economic or environmental benefits will be improved through uplifting the policy requirements.

7. Recommendations for Further Work

7.1 BREEAM 2011 and Planning Policy Wales

The following provides a list of recommendations for potential further work related to BREEAM and Welsh Government planning policy:

- Lifecycle cost assessment and implications of BREEAM 2011 for new non-domestic buildings in Wales;
- Detailed cost assessment based on actual costs of building developments and projects in Wales;
- BREEAM 2011 Assessment toolkit and guidance for designers in Wales (Compliance Toolkit);and
- Assessment of the impact and changes associated with BREEAM for refurbishment projects (due to commence 2012) and options for Planning Policy Wales for non-domestic buildings.

7.2 Building Thermal Modelling Assessment[14]

This study has demonstrated the number of credits required under BREEAM 2011 Ene 01 issue in order to match, as closely as possible, 6 credits under BREEAM 2008 Ene 01 issue. The outcomes have shown that there are significant differences in energy demand and consumption depending on building type, and for this reason further work could be carried out in order to determine the relative performance advantages associated with different design aspects, for example building fabric improvements, vs. HVAC efficiency improvements. This will enable a greater understanding of when and why energy is consumed in buildings and help to provide designers with advice on where to focus for each building type. The results of this assessment could also form part of a design guide to non-domestic buildings in Wales.

[14] These recommendations match the options recommended in accompanying report produced on behalf of Welsh Government : *295389/MNS/BTL/01 – National Planning Policy Wales: BREEAM 2011 Technical Analysis – Ene 01: Reduction of CO_2 Emissions*

Appendices

Appendix A. Comparison of BREEAM 2008 and 2011 Criteria

Appendix B. Summary of BREEAM 2011 Category Changes

B.1. Management (Man)

The BREEAM Management category has undergone considerable restructuring and consolidation in the 2011 'New Construction' version.

Table 7.1: Summary of 2011 Management BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Man 01 Sustainable Procurement	Integrated design development and clear definition of project team roles; Consideration of end user requirements and handover training proposals; BREEAM Accredited Professional (AP) services; and Commissioning and aftercare support.	8	1	BREEAM 2011 awards credit for ensuring that the actual thermal performance of the building is as specified by the design. This credit includes BREEAM AP services, formerly considered within the 2008 Innovation category. Three credits are available for comprehensive use of BREEAM AP throughout project. Under BREEAM 2011, an exemplary credit is available for long term aftercare support.
Man 02 Responsible Construction Practices	Contractor use of compliant considerate construction scheme with credit awarded based on performance of contractor against scheme requirements.	2	1	No significant changes have been made to this credit however the credit has been reworded to provide flexibility with regards to the considerate construction scheme (i.e. no longer specifically refers to Considerate Contractors Scheme).
Man 03 Construction Site Impacts	Contractor monitors, records and reports energy, water and transport consumption during construction; Contractor use of compliant Environmental Management System; and Sustainable procurement of timber.	5	-	While no significant changes have been made to the content of this issue, the compliance requirements have been restructured so that for 2011, one credit is available for each monitoring category and hence one additional credit is available for this issue compared to 2008 Man 03.
Man 04 Stakeholder Participation	Consultation with relevant bodies and stakeholders; Accessibility of building including design & access statement; Shared building facilities; Building User Guide; and Post Occupancy Evaluation.	4	-	This is a new credit under 2011 which consolidates the requirements for up to eight 2008 Management issues. Consequently, fewer credits are available for some building types for topics covered under this issue.
Man 05 Life Cycle Costing and Service Planning	Completion of life cycle costing analysis to inform design; and Critical appraisal of maintenance requirements to inform design process	3	-	Three credits are available under BREEAM 2011 for this issue with credit awarded based on the degree to which the LCC and maintenance strategy inform the design and construction process.

B.2. Health and Wellbeing (Hea)

The BREEAM Health and Wellbeing category has undergone restructuring and consolidation in the 2011 'New Construction' version, however, much of the criteria assessed is largely the same as under the 2008 schemes.

Table 7.2: Summary of 2011 Health and Wellbeing BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Hea 01 Visual Comfort	Specification of high frequency lighting; Adequate daylighting; Occupant glare control and view out from relevant building areas; Suitable internal and external lighting levels with occupant controls and zoning; and Visual art strategy (healthcare buildings only)	4 to 6	1	This credit consolidates the requirements of up to seven BREEAM 2011 issues. A credit is no longer awarded for use of high frequency lighting; BREEAM 2011 makes this a pre-requisite for the achievement of any credits under this issue. No other significant changes have been made although the standards to which lighting levels must comply have been updated and expanded.
Hea 02 Indoor Air Quality	Minimising sources of air pollution such as VOC's and external polluting sources; Potential for natural ventilation and user control of fresh air supply; and Specification of compliant laboratory fume cupboard and containment areas	3 to 6	-	This credit combines up to five BREEAM 2008 issues. Under BREEAM 2011, an indoor air quality plan must be produced in order to achieve some of the further credits. BREEAM 2011 introduces a new credit to undertake post-completion VOC measurements to compare actual VOC levels against those specified in the design.
Hea 03 Thermal Comfort	Thermal modelling is undertaken; and Local and zoned occupant temperature control is provided.	2	-	In order to achieve the second credit, thermal modelling must have been undertaken. This is new to BREEAM 2011, as thermal modelling and zoning where assessed under separate credits in BREEAM 2008. Guidance must be produced for control strategy detailing multiple control systems interact.
Hea 04 Water Quality	All water systems must be designed to minimise the risk of contamination (i.e. Legionella); and Chilled mains-fed point-of use water coolers for particular building types.	1	-	There have been no significant changes to the evidence requirements for this issue however this BREEAM 2011 combines requirements from two separate BREEAM 2008 issues.
Hea 05	An acoustician is appointed at RIBA Stage B (pre-requisite); and Building is designed and built to relevant standards. Pre-completion testing undertaken by acoustician with remedial works completed where necessary.	2 to 4	-	The requirements have not significantly changed since 2008 however there is a new pre-requisite to appoint an acoustician early in the project. Additional credit is now available for a number of building types which contain acoustically sensitive areas.
Hea 06 Safety and Security	Safe access for pedestrians and cyclists, separate delivery/manoeuvring areas; and Consultation with an ALO or CPDA prior to RIBA Stage C building is constructed in line with 'Secured by Design'	2	-	This 2011 credit transposes safe pedestrian and cyclist access from the BREEAM 2008 Transport section, and includes an additional standard with which access routes must comply. The credit requirements regarding security have not significantly changed.

B.3. Energy (Ene)

The BREEAM Energy category has undergone significant restructuring in the 2011 'New Construction' scheme. Some criteria remains as per the 2008 scheme, however, this has been expanded in some instances and Ene 01: Reduction of CO_2 Emissions in particular has been changed substantially.

Table 7.3: Summary of 2011 Energy BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Ene 01 Reduction of CO_2 Emissions	Credits are awarded based on the energy demand, energy consumption and CO_2 emissions of the building	15	5	There have been major changes in the methodology underlying this credit, which is now based on the BRE EPR. This accounts for energy demand, consumption and emissions rather than for the BREEAM 2008 EPC which only considered CO_2 emissions. An additional three exemplary credits are available under BREEAM 2011 for buildings which approach or meet 'true zero carbon'.
Ene 02 Energy Monitoring	All major items of plant are covered by energy sub-meters; and Relevant function areas of building are sub-metered and labelled with end consuming use.	1 to 2	-	The requirements for this credit have not changed significantly although the issue combines two BREEAM 2008 credits.
Ene 03 External lighting	Energy efficient external lights with daylight sensors	1	-	The requirements for this credit have not changed significantly
Ene 04 Low or zero carbon technologies	LZC feasibility study with recommendations implemented, increasing credit depending on percentage CO_2 saving achieved; and Free cooling strategy	5	1	This issue consolidates the requirements from two BREEAM 2008 issues. In BREEAM 2011, the number of credits awarded is dependant on the scope of the LZC study as well as the percentage reduction in CO_2 emissions achieved. Credit is also available for undertaking LCA analysis of selected LZC technology.
Ene 05 Energy efficient cold storage	Refrigeration system and controls designed in accordance with relevant standards; and Use of Carbon Trust refrigeration road map	2	1	The requirements for this issue have not significantly changed however fewer credits are available for compliance. An exemplary credit is available under BREEAM 2011.
Ene 06 Energy efficient transportation systems	Transport analysis to identify requirement for transportation systems; and Specification of energy efficient features in transportation systems	2	-	The evidence requirements for this issue have not significantly changed.
Ene 07 Energy efficient laboratory systems	Design of laboratory fume cupboards and contaminant areas compliant with indoor air quality requirements, flow rates and recirculation. Additional credit available for educational buildings where laboratories comprise > 10% floor area	1 to 5	-	Although the descriptions for this issue have been amended, the requirements are largely unchanged. The relevance of this issue to different building types has been expanded to account for all buildings, rather than only Education as assessed in BREEAM 2008.
Ene 08 Energy efficient	Where applicable, items consuming the majority of unregulated energy	2	-	This is a new credit under BREEAM 2011 which consolidates requirements from five issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
equipment	consumption must demonstrate energy efficient design			under BREEAM 2008.
Ene 09 Drying space	Adequate internal or external space for holding drying lines	1	-	This issue is only applicable to multi-residential developments. Slight amendments have been made to the requirements in BREEM 2011 where individual bedrooms are present, with a threshold provided for developments with >30 individual bedrooms.

B.4. Transport (Tra)

The BREEAM Transport category has undergone restructuring and consolidation in the 2011 'New Construction' version, however, most issues assessed are largely the same as under the 2008 versions.

Table 7.4: Summary of 2011 Transport BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Tra 01: Public Transport Accessibility	Credits are awarded based on the assessed buildings accessibility to the public transport network.	5 3 (Offices, Industrial, Multi-res) 2 (Prisons)	-	No significant changes have been made to this credit however there is an additional credit available for providing a dedicated bus service. This credit is only available if no credits are achieved through the Accessibility Index.
Tra 02: Proximity to Amenities	Credits are awarded based on the building being located within 500m of the accessible local amenities appropriate to the building type and its users.	1 N/A (Prisons)	-	The evidence requirements for this credit have not changed and are as BREEAM 2008 TRA 04.
Tra 03: Cyclist Facilities	Credits awarded for compliant number of cycle spaces, storage and facilities.	2 1 (Prisons and Multi – res)	-	While no significant changes have been made to the content of this issue, specific requirements for each building type are now based on numbers of facilities per building user and not based on percentages as 2008. In addition there is a sliding scale of compliance that now applies to recognise the increased confidence in availability that occurs where there is larger scale provision of facilities.
Tra 04: Maximum Parking Capacity	Restrictions on car parking availability to encourage the use of alternative means of transport to the building other than private car. This is dependent on outcome of Accessibility Index from Tra 01.	2 (1 – Healthcare) (Retail, Courts and Prisons – n/a)	-	While no significant changes have been made to the content of this issue, the scoring system for this credit is now linked to the Accessibility Index rating used in TRA 01. There are also subtle changes to the detailing in the compliance notes.
Tra 05: Travel Plan	Credit awarded for development of a travel plan as part of the feasibility and design stages which considers all types of travel relevant to the building type and users. This includes a site-specific transport survey and	1	-	Addition of following text in requirements; Providing suitable taxi drop-off/waiting areas. 4. Where appropriate the travel plan includes measures tailored to minimise the impacts of operational-related transport

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
	assessment and measures used to steer the design of the development to minimise car-based travel patterns.			5. Where building's final occupier is known, confirm that the travel plan will be implemented post construction and supported by the building's management.

B.5. Water (Wat)

The BREEAM Water category has undergone minor restructuring and consolidation in the 2011 'New Construction' version. In particular the methodology for Wat 01: Water Consumption, has been overhauled as detailed in the following section.

Table 7.5: Summary of 2011 Water BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Wat 01 Water consumption	Assesses per capita water consumption against a notional baseline; and Accounts for use of water harvesting and recycling	5	1	This issue combines the requirements of two BREEAM 2008 issues and the number of available credits has changed for particular building types. The calculation methodology for water consumption has been refined.
Wat 02 Water meter	Specification of a water meter (pre-requisite) and sub-metering of plant/areas consuming more than 10% of total water demand	1	-	This issue consolidates two BREEAM 2008 issues such that no additional credit is available for specification of sub-metering plant/area with a substantial water consumption (formerly an innovation credit was available for this in 2008).
Wat 03 Water leak detection and prevention	Major leak detection for mains supply and utilities; and Use of flow control devices on sanitary fittings.	2	-	The criteria for flow control devices have been expanded for BREEAM 2011. The major leak detection credit requirements are largely unchanged.
Wat 04 Water efficient equipment	Aims to reduce potable water consumption for uses such as irrigation and vehicle washing	1	-	This BREEAM issue was formerly available to only some building types in 2008; its relevance has now been expanded to cover all buildings. The equivalent 2008 issue did not include vehicle wash systems which have been incorporated for the 2011 credit.

B.6. Materials (Mat)

The BREEAM Materials category has undergone considerable restructuring and consolidation in the 2011 'New Construction' version.

Table 7.6: Summary of 2011 Materials BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Mat 01 Life Cycle Impacts	To recognise and encourage the use of construction materials with a low environmental impact over the full life	6 (5 – Office and Retail)	1	The requirements for this credit have not changed and are as BREEAM 2008 MAT 01.

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
	cycle of the building. The materials specified should be sustainable according to the Green Guide to specification.	(4 – Prisons) (2 – Industrial)		
Mat 02 Hard landscaping and boundary protection	Where at least 80% of all external hard landscaping and boundary protection (by area) achieves an A or A+ rating, as defined in the Green Guide to Specification.	1	-	The requirements for this credit have not changed and are as BREEAM 2008 MAT 02
Mat 03 Responsible sourcing of materials	Each of the applicable specified materials comprising the main building elements are assigned a responsible sourcing tier level (tier 1 to 8)	3	1	Subtle changes to the list of applicable materials and building elements. Changes to the Tier scoring for responsible sourcing. Change to the scoring scale to achieve the credits
Mat 04 Insulation	Any new insulation specified for use within external walls, ground floor, roof and building services must be assessed using the green guide rating system.	2	-	While no significant changes have been made to the content of this issue, there has been a slight adjustment to the Tier scoring for responsible sourcing as per Mat 05. Otherwise as per Mat 06 2008.
Mat 05 Designing for Robustness	Protection is given to vulnerable areas of the building such as areas exposed to high pedestrian traffic, vehicular and trolley movements.	1	-	The requirements for this credit have not changed and are as BREEAM 2008 MAT 07

B.7. Waste (Wst)

There have been no significant changes to the BREEAM waste category, which comprises the same basic requirements as BREEAM 2008. However, a degree of consolidation has been undertaken and the achievement requirements for some waste credits have become more stringent.

Table 7.7: Summary of 2011 Waste BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Wst 01 Construction Waste Management	Up to three credits awarded for reducing the quantity of non-hazardous waste generated by the project. Requires a compliant SWMP to be implemented for the development. One credit awarded where a high percentage of non-hazardous and demolition waste is diverted from landfill. One exemplary credit is available where very high waste reduction and diversion of waste from landfill are achieved.	4	1	This credit is largely unchanged since 2008 however the waste *volume* thresholds have become more stringent. For example, in order to achieve two credits for BREEAM 2011, waste generation must be reduced to <7.5m^3 per 100m^2 of gross floor area, compared to an equivalent volume of 9.2 m^3 for 2008. The landfill diversion percentages required to achieve the fourth credit are now dependent on whether the project involves demolition or not and have become slightly more stringent.
Wst 02 Recycled Aggregates	Encourages the reuse of aggregates for high grade aggregate. Certain percentages of reused aggregate must be specified (typically 25%) in order to achieve the credit. One exemplary credit	1	1	Since 2008, this credit has been refined so that for BREEAM 2011, reuse percentages are specified for particular building elements such as structural frame, pipe bedding and floor slabs.

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
	is available where a very high percentage of reused aggregate is specified (between 50% and 100% depending on the building element).			
Wst 03 Operational Waste	Credit awarded for provision of accessible, dedicated recyclable waste storage area sized appropriately to the building use. For particular building types, there is also a requirement to provide equipment such as compactor/baler or composting facilities.	1	-	This is a new credit under 2011 which consolidates the requirements of Wst 3, Wst 4 and Wst 5 from BREEAM 2008.
Wst 04 Speculative floor and ceiling finishes	This credit is applicable to office buildings only and aims to ensure that floor and ceiling finishes are as per tenant/building user requirements.	1	-	Content of this issue, previously Wst 6 under BREEAM 2008, has been expanded to consider ceiling finishes in addition to floor finishes.

B.8. Land Use and Ecology (LE)

There are no significant changes to the Land Use and Ecology category in 2011.

Table 7.8: Summary of BREEAM 2011 Land Use and Ecology issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
LE 01 Site Selection	Awards one credit for the reuse of land. Requirement is for 75% of the building footprint to be located on 'previously developed land'. A second credit is available where it can be shown that the development site is contaminated and has undergone remedial works for the purposes of the building.	2	-	This is a new credit which combines 2008 credits LE1 and LE2. There has been no change to the content of the credit.
LE 02 Value of Site and Protection of Ecological Features	Credit where the site (construction zone) is defined as low ecological value and all existing features around the perimeter will be fully protected from construction damage.	1	-	-
LE 03 Mitigating Ecological Impact	The change in ecological value of the site before and after the development is not more than - 9 species (1 credit), or is greater than 0 (2 credits)	2	-	-
LE 04 Enhancing Site Ecology	Suitably qualified ecologist provides advice on ways to increase biodiversity. An increase in plant species of up to 6 (2 credits), more than 6 (3 credits) except for prisons where 2 credits can be achieved by implementing the recommendations of the ecologists report.	3	-	-
LE 05 Long Term Impact on Diversity	Suitably qualified ecologist appointed and provides advice/recommendations on protection of ecology. A 5 year landscape and habitat management plan is	3	-	-

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
	produced. Additional BREEAM criteria as specified by ecologist are committed to.			

B.9. Pollution (Pol)

The BREEAM Pollution category remains largely the same as the 2008 schemes for the 2011 'New Construction' scheme. There have been additional criteria added to some issues, in particular Pol 01: Impacts of Refrigerants, and Pol 03: Surface Water Run-Off.

Table 7.9: Summary of 2011 Pollution BREEAM issues

Name of issue	Summary of content	Credits available	Exemplary credits available	Key changes from 2008
Pol 01 Impacts of Refrigerants	Three credits available where no refrigerants used, two credits where the systems using refrigerants have Direct Effect Life Cycle CO_2 equivalent emissions (DELC CO_2e) of ≤100 kgCO_2e/kW cooling capacity or where refrigerants have GWP<10. One credit where refrigerants have Direct Effect Life Cycle CO_2 equivalent emissions of (DELC CO_2e) of ≤1000 kgCO_2e/kW cooling capacity or a leak detection system with auto shutdown, and alarm.	3	1	This is a new credit under 2011 which consolidates the requirements for up to three 2008 Pollution credits. Additional requirements include the addition of the Pol1 Calculator Tool to calculate Direct Effect Life Cycle CO_2 equivalent emissions (DELC CO_2e) and the use of a robust and tested automated permanent refrigerant leak detection system, normally defined as that included on the Enhanced Capital Allowance (ECA) Energy Technology Product List1 (or an equivalent list).
Pol 02 NOx Emissions	Dry NOx emissions from delivered space heating and cooling energy (at 0% excess O2) meet maximum thresholds.	3 (1 – Offices)	1	No significant changes have been made to this credit however the requirements now incorporates space heating and cooling rather than just heating as per 2008 requirements.
Pol 03: Surface Water Run-Off	Credit designed to avoid, reduce and delay the discharge of rainfall to public sewers and watercourses, therefore minimising the risk of localised flooding on and off site, watercourse pollution and other environmental damage.	5	-	This credit consolidates two 2008 credits. Additional requirements include the need for an appropriate Consultant to confirm that there is no discharge from the developed site for rainfall up to 5mm.
Pol 04 Reduction of Night Time Light Pollution	Where external lighting has been designed in compliance with the ILE guidance notes for the reduction of obtrusive light 2005 and all external lighting can be automatically switched off between 2300hrs and 0700hrs or, where 24 hour access required, levels are automatically dimmed (ILE Guidance	1	-	The requirements for this credit have not changed and are as BREEAM 2008 Pol 07.
Pol 05 Noise Attenuation	If there are, or will be no noise-sensitive areas or buildings in the locality of the assessed development, the credit can be awarded by default. Otherwise a noise impact assessment must be carried out (BS 7445: 1991) and attenuation measures.	1	-	No significant changes have been made to this credit however requirements now quotes Noise Impact Assessment compliant BS 7445:1991 for criteria 2 and specific +5dB noise level for criteria 4

Appendix C. Summary of Selected Buildings

Table 7.10: Buildings Selected for Analysis

Building no.	BREEAM Scheme Type	Building Description	Area (m^2)[15]	Location type[16]
1	Industrial	New build industrial, warehouse.	Medium	Rural
2	Offices	New build office building.	Medium	Urban
3	Offices	New build offices gatehouse.	Small	Rural
4	Healthcare	New build healthcare, primary care centre.	Medium	Urban
5	Other (Research and Development	New build Science/Technology facilities / University Buildings- Technical.	Medium	Urban
6	Other (Non residential institution)	New build community centre.	Small	Rural
7	Other (Residential institution)	New build hotel.	Small	Urban
8	Assembly and Leisure	New build sports and leisure / swimming pool	Medium	Urban
9	Offices	New build offices	Medium	Rural
10	Education	New build education, secondary school.	Medium	Rural
11	Industrial	New build industrial units	Small	Rural
12	Education	New build higher education, university building.	Medium	Rural
13	Industrial	New build food units.	Small	Rural
14	Prisons	New build prison block and reception.	Medium	Urban
15	Multi-residential	New build residential care facility.	Large	Rural
16	Multi-residential	New build multi residential, extra care facility.	Large	Rural
17	Multi-residential	New build 39 self contained extra care residential dwellings.	Medium	Urban
18	Retail	New build retail, supermarket.	Medium	Rural
19	Retail	New build supermarket.	Medium	Urban
20	Prisons	New build prisons, workshops & training rooms.	Large	Rural
21	Healthcare	New build health centre	Large	Rural
22	Education	New build education, primary school.	Medium	Rural
23	Education	New build university.	Large	Urban
24	Healthcare	New build healthcare. Medical centre.	Small	Urban
25	Education	New build secondary school.	Medium	Urban
26	Education	New build education, primary school.	Medium	Rural
27	Industrial	New build warehouse unit with offices.	Large	Urban
28	Law Courts	New build law courts, civil justice centre.	Large	Rural
29	Law Courts	New build law courts, crown court.	Large	Urban

Source: BRE Dataset – Actual project details removed for anonymity

[15] For the purposes of this assessment, small is <1,000m^2, medium is > 1,000m^2 and < 5,000m^2, and large is > 5,000m^2

[16] This is the broad location type only, within the assessment process this was further refined, e.g. suburban, major city centre etc.

Appendix D. Building Analysis Results

Appendix E. BREEAM Issue Credit Assumptions

Table 7.11: Key assumptions made when undertaking BREEAM 2011 analysis

	2011 Credit	Assumption
MANAGEMENT	Man 01 – Sustainable procurement	Criteria 1 – 3 (Project brief and design) are new to BREEAM 2011. For the 'strict' analysis, it has been assumed that these credits are not achieved, while for the 'easy win' analysis, these credits have been awarded.
		Criteria 4 – 13 (Accredited Professional) award 3 credits under 2011 whereas only 2 credits were available in 2008. Where a building achieves 2 credits in BREEAM 2008 for appointment of an AP, only 2 out of 3 credits are awarded in 2011 as the evidence requirements for 2011 are slightly more onerous and include production of progress reports by the AP for every design team meeting.
		Criteria 18 – 25 (Commissioning) includes additional requirements in 2011 for long term support and post-occupancy commissioning. Where 2 credits are awarded in 2008 for commissioning, 2 credits for criteria 18 – 22 are awarded, although criteria 23 – 24 (1 credit) and criterion 25 (exemplary credit) are not achieved due to the more onerous 2011 requirements.
	Man 03 – Construction Site Impacts	Where 4 credits are awarded in 2008, only 4 out of 5 credits are awarded in 2011. 2008 required 6 out of 8 actions to be undertaken in order to achieve 3 credits for monitoring/management of site impacts, plus 1 credit for legally responsibility sourced timber. In 2011, credits are allocated differently - in order to achieve all five 2011 credits, all of energy, water, transport, timber and EMS actions must be undertaken. It is therefore assumed that transport CO_2 emissions are not monitored for 2011.
	Man 04 – Stakeholder Participation	Where not awarded under the 'strict' 2011 analysis, the 'easy win' analysis assumes that a credit is achieved for producing a BREEAM compliant access statement or the development. Post occupancy evaluation (POE) and information dissemination is new to 2011 and consequently this credit is not awarded for any of the 'mock' buildings
HEALTH AND WELLBEING	Hea 01 – Visual Comfort	Credit available for internal and external lighting levels is achieved in 2011 where the 2008 Hea 05 is awarded as it assumed that lighting design is compliant with the updated version of relevant CIBSE guidance and British Standards.
	Hea 02 – Indoor Air Quality	The first credit is not awarded for any of the 'mock' buildings under the 'strict' 2011 analysis. To award this credit, an indoor air quality plan must be produced which is a new requirement for 2011 with no equivalent 2008 credit. For the 'easy win' analysis, this credit is assumed to be achieved.
		Measurement of VOC's post construction is a new requirement in 2011 and consequently this credit has not been awarded for any of the 'mock' buildings.
	Hea 04 – Water Quality	Provision of drinking water dispensers was previously only applicable to Education buildings in 2008 and is now applicable to all building types in 2011 that have permanently staffed areas. Consequently this credit is assumed not to be achieved for any non-educational 'mock' building under the 'strict' 2011 analysis. This credit is however awarded for the 'easy win' 2011 analysis.
	Hea 05 – Acoustic Performance	A new requirement under 2011 is that an acoustician is appointed no later than RIBA Stage B. Where a building achieves credits under 2008 Hea 13 (or 2008 Hea 21) for acoustic performance, it is assumed that the appointment has been undertaken at Stage B and so the credits can be awarded in 2011.
ENERGY	Ene 01 – Reduction of CO_2 emissions	Significant changes have been made to this credit – further details on achievement of 2011 credits based on 2008 performance are provided in Section 3.3.4.
	Ene 04 – Low or zero carbon technologies	BREEAM 2011 awards a credit where an enhanced LZC study is undertaken which includes Life Cycle Assessment of the carbon impact of the LZC technology. This is a new requirement and therefore this credit is not awarded for any of the 'mock' buildings.
	Ene 05 – Energy efficient cold storage	Where credits are awarded in 2008 for issue Ene 07 – Cold Storage, the same number of credits is awarded in 2011. This is based on the assumption that the 'mock' buildings are compliant with the amended standards/guidance detailed for the 2011 credit (e.g. Carbon Trust best practice guidance instead of specific design standards detailed in 2008)
TRANSPORT	Tra 04 – Maximum car parking capacity	The number of credits awarded for 2008 Tra 08 has been used to establish the minimum car parking spaces to building user ratio for a particular building type. This has then been used in conjunction with the buildings accessibility index (provided in the BRE database) to assign the correct number of credits in 2011.
	Tra 05 – Travel Plan	Where not achieved under the 'strict' 2011 analysis, it has been assumed that a BREEAM compliant travel plan is produced for the 'easy win' 2011 analysis.
W	Wat 01 –	2011 credits have been assigned for this BREEAM issue based on the 2008 scores for Wat 01 and Wat

	2011 Credit	Assumption
	Water consumption	05. As very little water consumption data was provided for the BRE database, the 'alternative approach' has been used, where a level of water efficiency is assigned based on sanitary fitting water consumption (Wat 01 credits) and the percentage of water recycling implemented (with 1 credit awarded for 2008 Wat 05 where, for instance, at least 50% of demand is met using recycled water)
	Wat 02 – Water monitoring	In 2008, a credit was awarded where a water meter was specified for the building, with an innovation credit achieved where plant/areas consuming more than 10% of total water demand were sub-metered. These criteria are now both required for achievement of the 2011 Wat 02 credit. Consequently, where a 'mock' building has achieved at least 1 innovation credit in 2008, this is assumed to contribute towards achievement of the Wat 02 credit. Where no innovation credits are awarded in 2008, this credit is not achieved in 2011.
	Wat 03 – Water leak detection and prevention	2011 requirements associated with sanitary supply shut off have been expanded. Where credit is achieved for issue 2008 Wat 04 it is assumed that the sanitary supply shut off is compliant with the additional 2011 requirements and therefore the credit is awarded.
MATERIALS	Mat 03 – Responsible sourcing of materials	A mandatory pre-requisite for BREEAM 2011 is that all timber is sourced legally in line with Government policy. It is assumed that all 'mock' buildings achieve this requirement, regardless of the score for 2008 Mat 05.
WASTE	Wst 01 – Construction waste management	The volume or tonnage of waste produced for each 'mock' building is provided on the BRE database. This has been used in conjunction with the overall score for 2008 Wst 01 to determine the number of achievable 2011 credits. Credit is available in 2011 where certain percentages of demolition waste are diverted from landfill. Where a 'mock' building does not achieve any credits for 2008 Mat 03 - Reuse of façade and 2008 Mat 04 - Reuse of structure, it is assumed that the required percentages of reused demolition material have not been met.
	Wst 04 – Speculative floor and ceiling finishes	In 2008, only floor finishes were considered within Wst 06 (speculative floor finishes). However, where this credit is achieved in 2008 it is assumed that ceiling finishes are also compliant with the 2011 requirements and so the credit is also awarded in 2011.
POLLUTION	Pol 01 – Impacts of refrigerants	2011 states an additional requirement to use an 'Enhanced Capital Allowance (ECA) Energy Technology Product List 1' approved leak detection system. Where 2008 credit Pol 02 (preventing refrigerant leaks) is achieved it is assumed that the refrigerant recovery system is compliant with 2011 requirements.
	Pol 03 – Surface water run-off	A new requirement under BREEAM 2011 in order to achieve 1 credit is that post-construction peak run-off rate is reduced or is no more than prior to the development. As there is no equivalent 2008 credit which covers this requirement, this credit is not awarded for any of the 'mock' buildings under the 'strict' 2011 analysis however, this credit is assumed to be achieved for the 'easy win' 2011 analysis.
	Pol 05 – Noise attenuation	The credit requirements are largely similar for BREEAM versions 2008 and 2011. However, BREEAM 2011 refers to additional decibel compliance criteria in line with BS7445. Where this credit is achieved in 2008, it is assumed that this additional stipulation is met and therefore the credit is also awarded in 2011.

Source: Mott MacDonald

Table 7.12: 'Easy win' 2011 credits

BREEAM category	BREEAM 2011 issue	Criteria	Number of credits
Management	Man 01 – Sustainable procurement	Definition of roles, responsibilities and contributions of client/building occupier/design team/contractor.	1
	Man 04 – Stakeholder participation	Access statement produced in line with CABE guidance and based on principles of inclusive design.	1
Health and Wellbeing	Hea 02 – Indoor air quality	An indoor air quality plan is produced.	1 (also pre-requisite for additional credit)
	Hea 04 – Water quality	Chilled, mains fed point of use water coolers are provided for building users	1
Transport	Tra 05 – Travel plan	A travel plan is developed for the building compliant with BREEAM requirements	1
Pollution	Pol 03 – Surface water run off	Drainage measures specified to ensure peak rate run-off is no greater post development than for pre development	1