

The Green Guide Explained

BRE Centre for Sustainable Products

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1 The Green Guide Explained

This document provides an overview of the Green Guide to Specification. The document has been designed to allow you to explore different aspects of the Green Guide at the level of detail you are interested in.

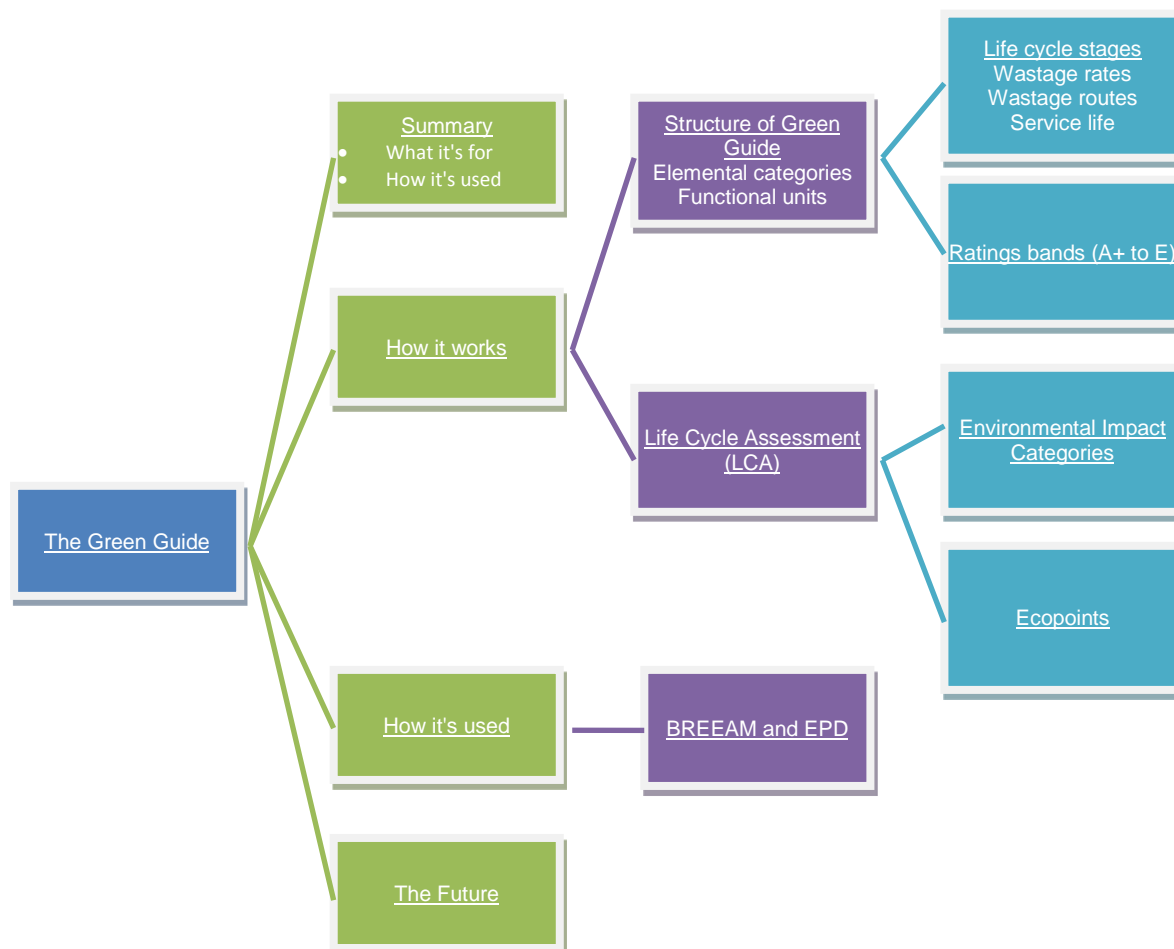
The document will be particularly useful to those who use the Green Guide as part of BREEAM (BRE Environmental Assessment Method) or as a part of their selection of specifications in design. It will also be useful for construction product manufacturers whose materials are included in the specifications of the Green Guide.

The Green Guide considers typical UK construction specifications and compares their environmental impact on a scale of A⁺ (lowest environmental impact) to E (greatest environmental impact). Comparisons are made using specifications that achieve the same levels of performance and the environmental impact is for a complete lifecycle (from manufacture to end of life disposal).

The specifications are separated into element types such as external walls and windows. The building types covered by the Green Guide are those within BREEAM and the Code for Sustainable Homes.

This document covers the background to the Green Guide - the ratings themselves are on the Green Guide to Specification website and in the printed version.

The document's structure is illustrated below, click on a box to go to that section.



There is also a [Glossary](#) and a list of [Further Reading](#).

1.1 Outline of the Green Guide

The first edition of The Green Guide in 1996 aimed to provide a simple 'green guide' to the environmental impacts of building materials that would be easy to use and soundly based on numerical data.

The Green Guide is now part of BREEAM, an accredited environmental rating scheme for buildings. The Green Guide contains more than 1,500 specifications used in various types of building. Through the various editions, information on the relative environmental performance of some materials and components has altered, reflecting both changes in manufacturing practices, the way materials are used in buildings, and our evolving environmental knowledge.

To produce the Green Guide, we use Life Cycle Assessment (LCA)¹ to examine a broad range of environmental impacts for different construction approaches to meeting the same performance criteria. We consider six main building types:

- Commercial buildings, such as offices
- Educational
- Healthcare
- Retail
- Domestic
- Industrial

Materials and components are combined to model specifications that are grouped on an elemental basis so that designers and specifiers can compare and select from comparable approaches. The elements covered are:

- External walls
- Internal walls and partitions
- Roofs
- Ground floors
- Upper floors
- Windows
- Insulation
- Landscaping
- Floor finishes

Across these building element categories, the Green Guide provides an extensive but not exhaustive catalogue of building specifications covering most common building materials.

By evaluating the relative environmental performance using ratings bands of A+ to E (for the overall ecopoints – see [Glossary](#) - score or for individual environmental impact categories), it is possible for the specifier to select specifications on the basis of personal or organisational preferences or priorities.

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¹ Via BRE's Environmental Profiles Methodology 2008; available from the Green Guide online.

2 How it works

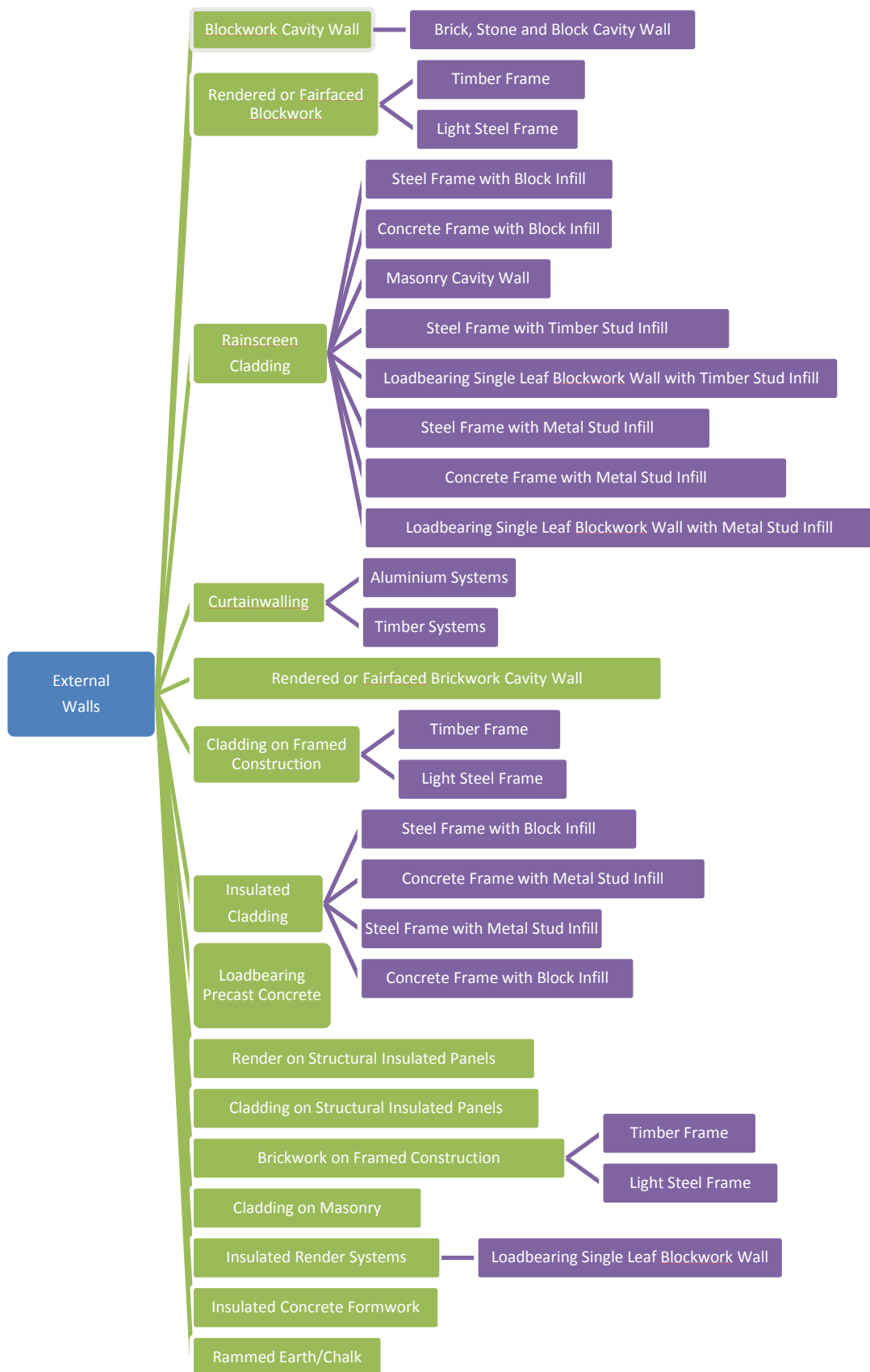
This section explores the way that the Green Guide works and provides different levels of detail on the underlying Life Cycle Assessment (LCA) methodology, the assessment of the life cycle and how the ratings bands were produced.

The Green Guide separates the parts of buildings into elemental categories to enable the direct comparison of the environmental performance associated with different methods of achieving a set level of performance called the functional unit. The Green Guide online has been set up to present similar specifications together, but specifications from different sections of the same elemental category can be compared with each other because they perform the same function; this is explored further in this section using the external wall elemental category as an example.

The various possible specifications typically used to achieve the set functional unit are identified before any evaluation of their environmental impact is carried out. Once the specifications are known, they are assessed over a 60-year study period using these life cycle stages: manufacture; installation; use (including maintenance and repair); final disposal at demolition.

The performance of the specifications within an elemental category is compared to establish the lowest environmental impact and the highest environmental impact. These values set the range of the A⁺ to E rating scale: the rating bands are produced by dividing the range into six equal sections. This process is done for the ecopoints range and for the range for each environmental impact category.

The figure below presents the different sections of the external wall elemental category to show how each sub-category relates to the main category.



2.1 Structure of the Green Guide

The Green Guide considers six main building types:

- Commercial buildings, such as offices
- Educational
- Healthcare
- Retail
- Domestic
- Industrial

The elements most influential on the environmental impact of the building are assessed individually with the elements assessed differing between building types. The following elements are covered, consideration is being given to including foundations in the future:

- External walls
- Internal walls and partitions
- Roofs
- Ground floors
- Upper floors
- Windows
- Insulation
- Landscaping
- Floor finishes

The elemental categories assessed varies according to building type

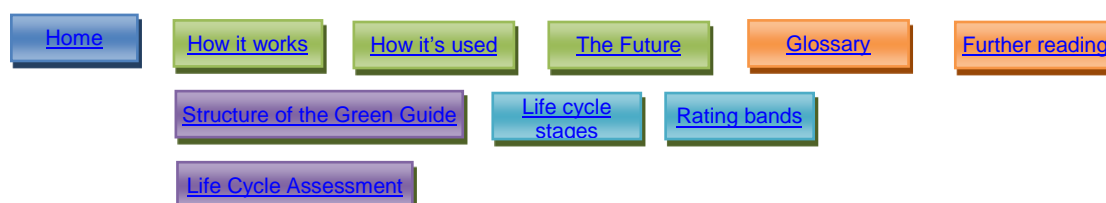
Building Type	Elemental category					
	External walls	Windows	Roof	Upper floor slab	Internal walls	Floor finishes / coverings
Office	•	•	•	•	-	•
Retail	•	•	•	•	-	•
Industrial	•	-	•	-	-	
Education	•	•	•	•	•	•
Healthcare	•	•	•	•	•	•
Prisons	•	-	•	•	-	•
Courts	•	•	•	•	•	•
Multi-residential	•	•	•	•	•	•
Other buildings	•	•	•	•	•	•

Within each elemental category, the specifications relevant to the building type are presented. All specifications need to achieve the same technical performance, which is described by the functional unit. The functional unit describes what is being assessed and what levels of performance are required. For example, the functional unit for external walls is:

1m² of external wall construction, to satisfy current Building Regulations, and a U-value of 0.3 W/m²K. Where relevant, the specification will also include an internal wall finish.

Variation for retail/industrial:

1m² of external wall construction, to satisfy current Building Regulations, and a U-value of 0.3 W/m²K.



2.1.1 Life cycle stages

All specifications are assessed over a 60-year study period using these life cycle stages:

- manufacture;
- installation;
- use (including maintenance and repair);
- final disposal at demolition (regardless of whenever beyond the 60-year study period demolition occurs).

As part of this, it is necessary to know how much wastage typically occurs at installation and where that wastage goes. It is also necessary to know where material removed during use goes. BRE has obtained information on typical wastage rates and disposal routes at installation, replacement and demolition.

All the wastage rates used in the Green Guide are taken from those in the pricing document Laxton's². Laxton's construction pricing tool includes figures on site wastage for building materials.

Where appropriate, BRE made adjustments to the original data based upon either:

- a) evidence in the form of an established report that was representative of UK-wide practice.
- b) best available BRE knowledge; including data acquired from commercial-in-confidence projects that used BRE's SMARTWaste tool.

Information on disposal routes was obtained from a variety of sources including WRAP³ and BRE expert knowledge.

Details of the rates and routes used in the Green Guide can be found on the 'external links' section of the consultation exercise page of BRE's website (<http://www.bre.co.uk/greenguide/page.jsp?id=558> see files '7b Waste Disposal Routes for Industry Consultation' and '7c Site Wastage Rates for Industry Consultation').

The impacts from the use stage arise from any replacement needed during the 60-year study period and any maintenance required.

The number of replacements, the Replacement Factor, is calculated as:

$$\text{Replacement Factor} = (\text{study period/reference service life}) - 1$$

The reference service life determines the number of replacements during the 60-year study period.

ISO 15686 service life planning defines seven factors which influence component durability which need to be considered when determining service life. These seven factors are considered below with a comment on how they are incorporated in the Green Guide reference set (i.e. the conditions under which the specified material will be used):

1. Material and component quality. **Will be specified as complying with relevant BS/ISO standards**
2. Design. **To good practice standards**
3. Workmanship. **To good practice standards and BS 8000**
4. Indoor environment. **Dry and warm**
5. Outdoor environment. **Inland with normal urban pollution**
6. Maintenance. **Maintenance in accordance with manufacturer's recommendations**
7. Use. **Specifications adjusted to building sector, eg carpets in a school will be to a different specification than that for domestic carpets**

The Green Guide used the following data sources for the assessment of reference service lives:

- HAPM (1992). Component life manual (Spon)

² Laxtons Building Price Book 2006, V B Johnson (version available when Green Guide prepared).

³ Waste & Resources Action Programme

- BPG (1999). Building fabric component life manual (Spon)
- BLP (2000). Building services component life manual (Blackwell Publishing)
- CIBSE (2000). Guide to ownership, operation and maintenance of building services (CIBSE)
- BMI (2001) Life expectancy of building components (BCIS)
- PSA (1991). Costs-in-use tables (HMSO).

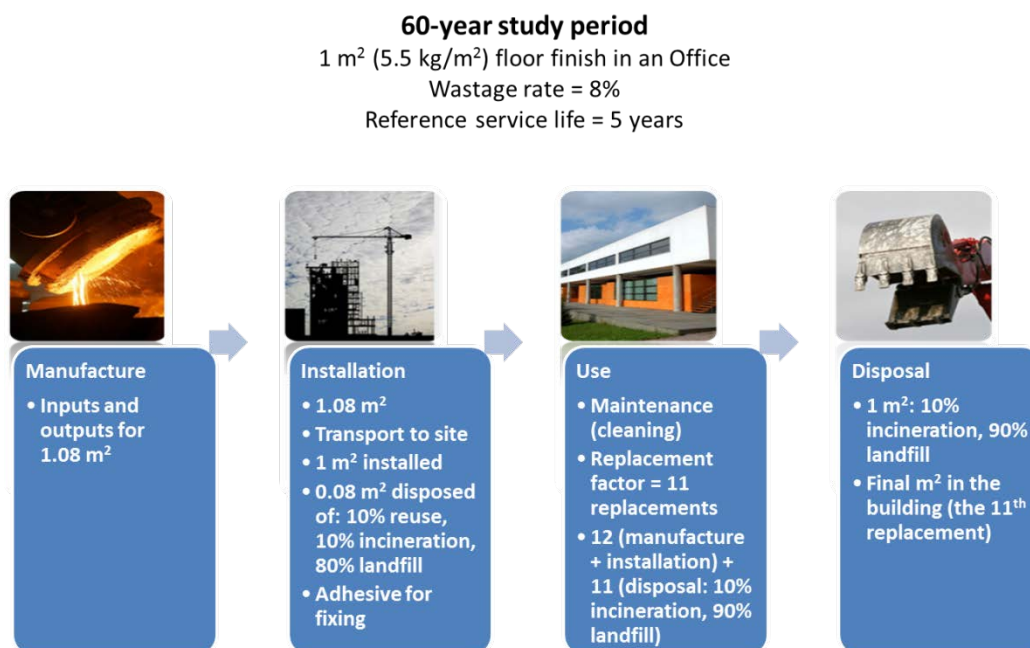
Where there were differences between the data sources, BRE derived average typical lives based on its own experience.

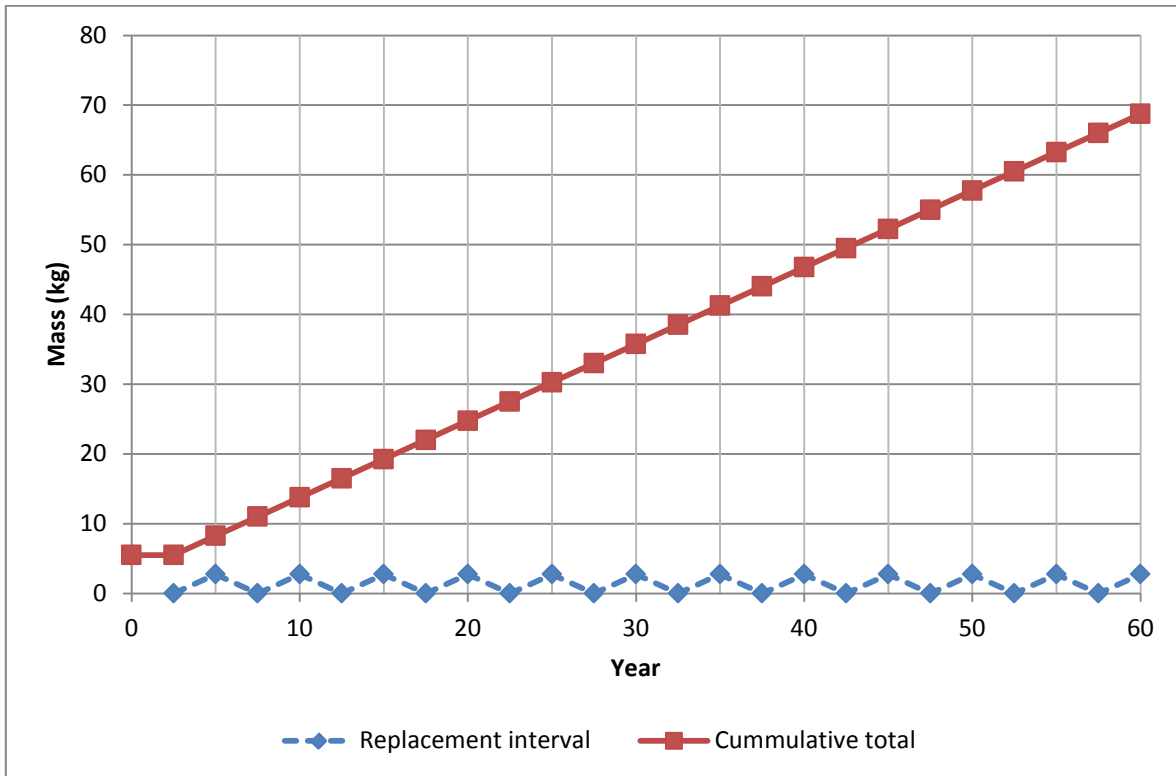
BRE also considered service life data provided by trade associations. The evidence supplied by an association had to cover as many of the following issues as possible:

- Material or product under consideration and its specifications
- Reference service life proposed by association
- Evidence of service lives from installations supported by photographs and evidence of installation dates
- Where evidence has been provided from outside the UK, confirmation that similar products with similar specifications have been installed in the UK
- Third party certification covering reference service lives
- Evidence from long-term site exposure and/or accelerated testing
- Confirmation that the product or material complies with relevant codes of practice and standards.

Where a material within a specification is known to last well beyond the 60-year study period, no replacement was done. Replacement was assumed to begin at 0.5 of the Reference Service Life and be complete at 1.5 times the Reference Service Life; this time period is referred to as the replacement interval.

The following example uses a floor finish to illustrate the influence of wastage rate, disposal route and reference service life on the LCA. The first figure shows the influencing factors at each life cycle stage. The second shows how the amount of floor finish accumulates and when each replacement starts and finishes.





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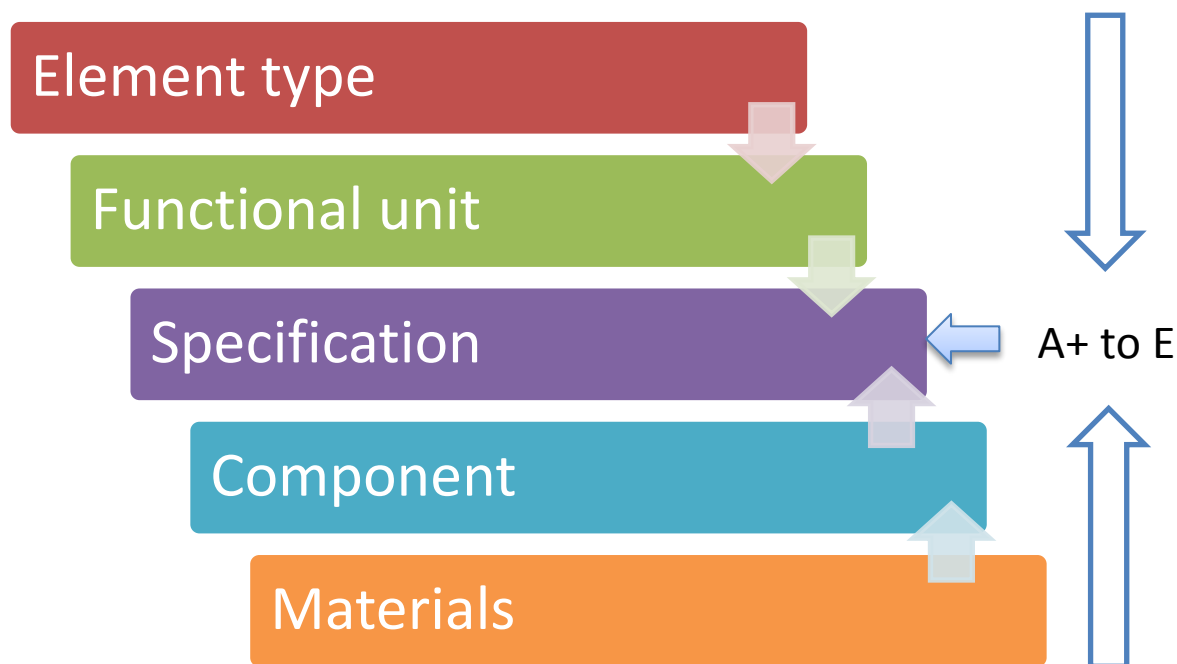
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2.1.2 Ratings bands (A+ to E)

The schematic below outlines how the information flows to produce the Green Guide ratings for each elemental category: the element type dictates the functional unit to which the specifications are designed. The specifications are then modelled using the relevant materials' LCA data (where materials are linked together, e.g. plasterboard and paint, then they are combined in a single component that can be used in all relevant specifications).



The ratings bands for each elemental category were calculated using the following approach:

$$Range = Ecopoint_{maximum} - Ecopoint_{minimum}$$

$$Band\ width = \frac{Range}{6}$$

$$A^+ Band = Ecopoint_{minimum} \text{ to } \left(Ecopoint_{minimum} + \frac{Range}{6} \right)$$

$$A Band = A^+_{maximum} \text{ to } \left(A^+_{maximum} + \frac{Range}{6} \right)$$

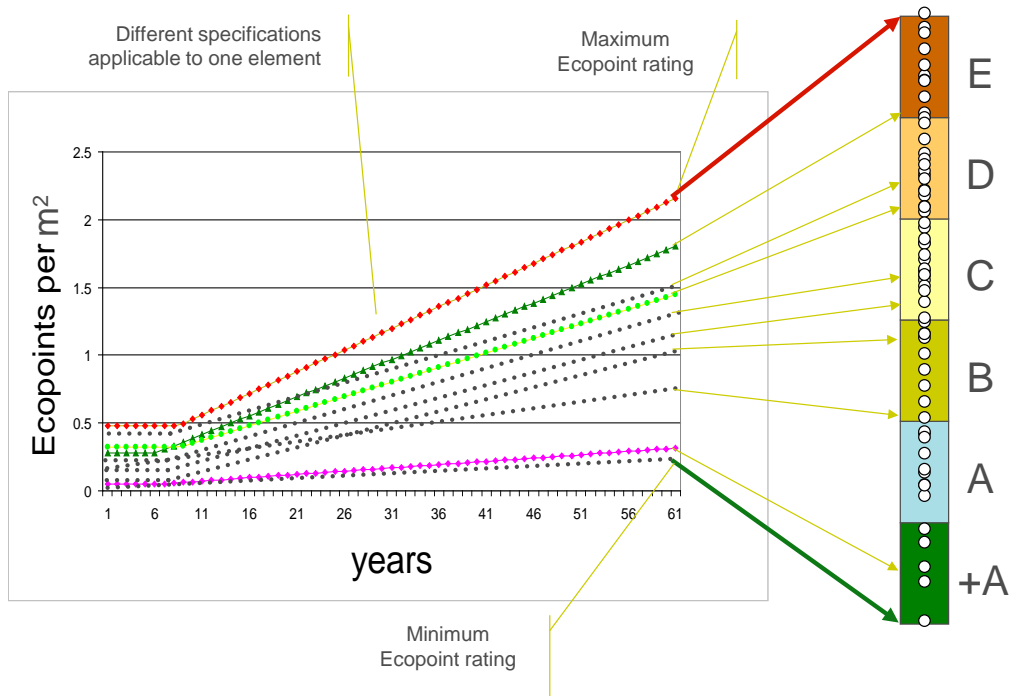
$$B Band = A_{maximum} \text{ to } \left(A_{maximum} + \frac{Range}{6} \right)$$

$$C Band = B_{maximum} \text{ to } \left(B_{maximum} + \frac{Range}{6} \right)$$

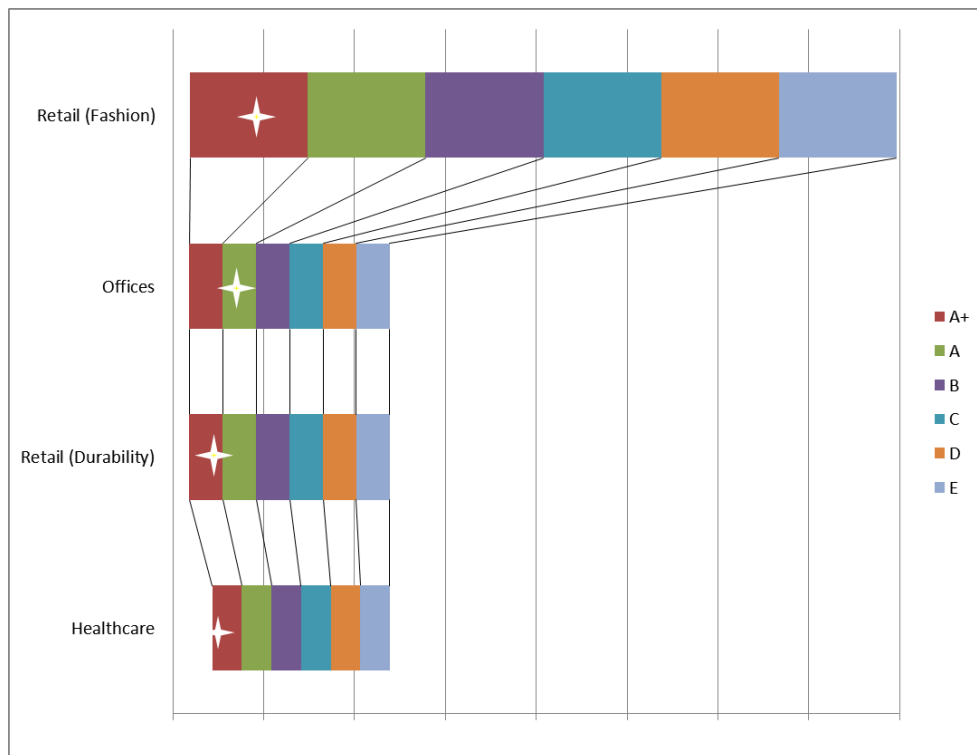
$$D Band = C_{maximum} \text{ to } \left(C_{maximum} + \frac{Range}{6} \right)$$

$$E Band \geq D_{maximum}$$

The figure below shows how the Ecopoints (see [Glossary](#)) of a set of specifications for an elemental category accrue over the 60-year study period and lead to the Green Guide rating.

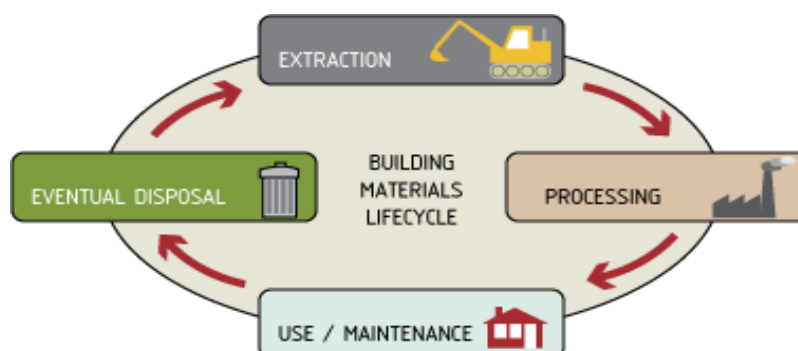


Most specifications are only compared across a single set of specifications and so have only one Green Guide rating result. However, a specification can appear in different sets of specifications and can, therefore, achieve different ratings in different applications. The following example is for Homogeneous polyvinyl chloride floor coverings (EN 649) FCSS 33, 34. It illustrates how a single specification can achieve different Ecopoints (due to different Reference Service Lives in different applications). Although exactly the same product, it may achieve different Green Guide ratings under different conditions.



2.2 Life Cycle Assessment (LCA)

This section gives a general introduction to the technique of Life Cycle Assessment (LCA) on which BRE's Environmental Profiles Methodology for assessing the environmental effects associated with building materials over their life cycle is based. The Life Cycle stages are illustrated below:



Environmental Profiles allow designers to demand reliable and comparable environmental information about competing building materials, and give suppliers the opportunity to present credible environmental information about their products. This means that designers can have confidence in the "level playing field" status of Environmental Profiles for every material type.

Life cycle assessments are commonly undertaken using a 3-stage approach:

- Stage 1: Goal and Scope
- Stage 2: Inventory Analysis
- Stage 3: Impact Assessment

Stage 1: Goal and Scope

What's done?

Answers the questions:

- *Why's the study being done? (Goal)*
For use within the company? For example, to improve products or processes, or to make policy decisions. Or use outside the company to make comparisons between products, processes or services?
- *Who is it for?*
For the company or for publication?
- *What's being looked at? (Scope)*
Best for looking at the different ways of meeting a need ('purpose-based') over a complete lifetime, e.g. 1 m² of external wall over a 60-year life – the 'functional unit'. LCA can also be used to look at: products; processes, and services.
What is included and what is excluded (e.g. life cycle stages, processes, etc): setting the 'boundaries'.
- *What information's needed to do it?*
The level of detail needed and the quality of data needed to meet the Goal and Scope.
- *How will it be done?*

Sets out the method to be used, including 'allocation' (how impacts will be shared between products from the same process) and which environmental impact categories will be used.

What's produced?

A Goal and Scope document.

Stage 2: Inventory Analysis

What's done?

- Mapping of the processes for each life cycle stage producing the functional unit (or units) being studied to give a Process Flow Diagram.
- Gathering of data on inputs (amounts of energy and materials used) and outputs (products and measured emissions to air, land and water) for all processes on the Process Flow Diagram.
- Conversion of data into environmental effects, e.g. electricity use becomes fossil fuel consumption and emissions to air (e.g. NO_x and SO₂), water (e.g. NO_x) and land (e.g. fuel ash), caused by electricity generation. The effects are summed over the whole life cycle to give an Inventory Table.

What's produced?

- Process Flow Diagram (also called Process Tree) showing all processes involved in the different life cycle stages.
- Inventory Table giving the summed environmental effects (resources used and emissions caused) over the whole life.

Stage 3: Impact Assessment

What's done?

There are three steps to impact assessment:

A. Classification

The results from the Inventory Table (resource use and emission generation) are placed in all the environmental impact categories where they produce an effect.

B. Characterisation and Normalisation

The amount of each substance in an impact category is converted into the amount of that category's reference substance needed to cause the same effect. For example, Climate Change uses CO₂ as its reference substance, so the amount of methane is converted to the amount of CO₂ needed to give the Climate Change effects caused by the recorded amount of methane; the other greenhouse gases would be converted into CO₂ 'equivalents' in the same way. The resulting environmental profile shows how much impact is caused in each impact category in terms of the reference substance for each category.

The levels of impact in a characterised profile cannot be compared directly with each other because they are in different units. The impacts of the functional unit under study can be compared to the annual national or global levels of impacts caused in each category. This is called 'normalisation'. The BRE Global method uses the annual impacts of 1 European citizen to normalise the environmental profile – this being equivalent to 1 Ecopoint. The categories can now be compared directly with each other since they are all on the same scale ('per person per year').

The profile now answers the question, "What's the biggest environmental impact of my functional unit?" but it doesn't answer the question "Is the biggest impact of my functional unit the most environmentally critical one?"

C. Valuation

The normalised profile is weighted to show the relative importance of each category in its effect on the environment. The results can be summed to give a single score. BRE calls them Ecopoints.

Through consultation with a cross-section of interested parties, BRE Global has produced the weighting factors set out in the table below. These weighting factors are used with the normalised environmental profile to produce a UK Ecopoints score.

Classification: Category	Characterisation and Normalisation: Per European Citizen Unit	Valuation: Weighting (%)
Climate Change	12.3 tonne CO ₂ eq. (100 yr)	21.6
Water Extraction	377 m ³ water extracted	11.7
Mineral Resource Extraction	24.4 tonnes minerals extracted	9.8
Stratospheric Ozone Depletion	0.217 kg CFC-11 eq.	9.1
Human Toxicity	19.7 tonnes 1,4-DB eq.	8.6
Ecotoxicity to Freshwater	1.32 tonnes 1,4-DB eq.	8.6
Higher Level Nuclear Waste	23,700 mm ³ high level waste	8.2
Ecotoxicity to Land	123 kg 1,4-DB eq.	8.0
Waste Disposal	3.75 tonnes solid waste	7.7
Fossil Fuel Depletion	6.51 tonnes oil equivalent (toe) **	3.3
Eutrophication	32.5 kg PO ₄ eq.	3.0
Photochemical Ozone Creation	21.5 kg C ₂ H ₄ eq.	0.2
Acidification	71.2 kg SO ₂ eq.	0.05

** Fossil fuel depletion is reported as MJ based on the Lower Heating Value for any fossil fuel used. The Lower Heating Value (also termed LHV, net calorific value or net CV) assumes that there is no recovery of the latent heat of vaporisation of water in the fuel and the reaction products. 1 toe is around 42 GJ LHV.

What's produced?

A. Classification – each environmental impact category contains the amounts of all the resources and emissions (the results of the Inventory Table) that contribute to it.

B. Characterisation – an environmental profile of the levels of impact in each category in terms of each category's reference substance. The impacts cannot be directly compared.

Normalisation – an environmental profile showing how the impacts of the functional unit relate to the background levels of each category. The impacts are all 'per person per year' and can be compared with each other.

C. Valuation – a weighted, normalised profile or a weighted, single score.

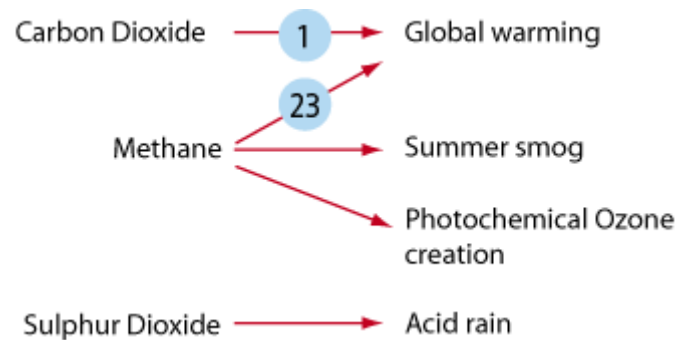
The Green Guide assesses the following thirteen environmental impact categories:

1. Climate Change
2. Water Extraction
3. Mineral Resource Extraction
4. Stratospheric Ozone Depletion
5. Human Toxicity
6. Ecotoxicity to Freshwater and Land
7. Nuclear Waste
8. Waste Disposal
9. Fossil Fuel Depletion
10. Eutrophication
11. Photochemical Ozone Creation
12. Acidification

Environmental impacts in one category can be caused by many different emission substances (inventory flows), and one substance can contribute to several impact categories. The step of characterisation assesses all the different substances contributing to an impact category relative to one another to give an overall measure of the level of environmental damage in that category.

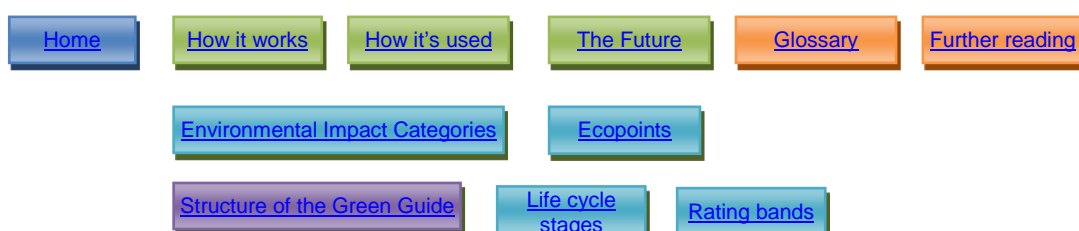
This is undertaken by using a reference substance or unit, whereby the contribution of each measured emission is calculated by converting the amount of emission into the equivalent amount of the reference substance or unit. This conversion is done by using what are called **characterisation**

factors. For example, for the impact category of climate change, the reference substance CO₂ (carbon dioxide) is used.








The use of a characterisation factor can be examined by taking methane as an example. We know that methane also contributes to climate change, but is measured to be 23 times more damaging than CO₂ over a 100-year timescale. So, through the step of characterisation, the effects of 1 kg of methane are converted into the amount of CO₂ needed to cause the same effect. This equates to applying the climate change characterisation factor of 23 to the measured methane amount of 1 kg which gives a figure of 23 kg CO₂ equivalent.








The Environmental Profiles Methodology uses **characterisation factors** to cover the full range of emissions and environmental impacts caused by the manufacture, use and disposal of construction materials.





2.2.1 Environmental Impact Categories

The thirteen environmental impact categories used within the BRE Environmental Profiles Methodology 2008 are outlined below – more details are available by clicking on the name of each category. Beside the description, icons are used to indicate the scale and compartment where the effect happens and the type of effect caused: (a) global; regional; local; (b) air; water; land; (c) environment; people; resources.

BRE Impact Categories	Description	Effect
Climate change	Climate change refers to the change in global temperature caused via the greenhouse effect by the release of "greenhouse gases" such as carbon dioxide caused by human activity. A higher global temperature is expected to cause climatic disturbance, desertification, rising sea levels and the spread of diseases.	
Water extraction	Around the world, water is becoming an increasingly scarce resource, due to increased demand, and changes in patterns of rainfall. To recognise the value of water as a resource, and the damage that over-extraction from rivers and aquifers can cause, this category includes all water extraction, except: seawater; water extracted for cooling or power generation and then returned to the same source with no change in water quality (water lost through evaporation would be included in the category); water stored in holding lakes on site for recirculation ('top-up' water from other sources would be included); rainwater collected on site.	
Mineral resource extraction	This impact category is related to the consumption of all virgin mineral material, e.g. the extraction of aggregates, metal ores and minerals. This indicator is intended to relate purely to resource use, with no coverage of other environmental impacts which might be associated with mining or quarrying, or the relative scarcity of resources.	
Stratospheric ozone depletion	Ozone-depleting gases cause damage to stratospheric ozone or the "ozone layer". There is great uncertainty about the combined effects of different gases in the stratosphere, and all chlorinated and brominated compounds that are stable enough to reach the stratosphere can have an effect. Damage to the ozone layer reduces its ability to prevent ultraviolet (UV) light entering the earth's atmosphere, increasing the amount of carcinogenic UVB light hitting the earth's surface	
Human toxicity	The emission of some substances can have impacts on human health. Assessments of toxicity are based on tolerable concentrations in air, water; air quality guidelines; tolerable daily intake and acceptable daily intake for human toxicity. Impacts to air and water have been combined. The method describes fate, exposure and effects of toxic substances for an infinite time horizon.	

BRE Impact Categories	Description	Effect
Ecotoxicity to fresh water	The emission of some substances can have impacts on fresh-water aquatic ecosystems. Assessment of toxicity has been based on maximum tolerable concentrations for ecosystems. Ecotoxicity potentials are calculated using the USES-LCA, which is based on EUSES, the EU's toxicity model. The method describes fate, exposure and the effects of toxic substances on the environment.	
Nuclear waste (higher level)	Radioactivity can cause serious damage to human health. As yet, no treatment or permanently secure storage solution exists for higher level radioactive wastes, such as those generated by the nuclear power industry and from decommissioning nuclear power stations. Such wastes need to be stored for periods of 10,000 years or more before their radioactivity reaches safe levels.	
Ecotoxicity to land	The emission of some substances can have impacts on terrestrial ecosystems. Assessment of toxicity has been based on maximum tolerable concentrations for ecosystems. Ecotoxicity potentials are calculated using the USES-LCA, which is based on EUSES, the EU's toxicity model. The method describes fate, exposure and the effects of toxic substances on the environment.	
Waste disposal	<p>This category represents the environmental issues associated with the loss of resource implied by the final disposal of waste. BRE uses an absolute measure based on the mass of any waste that is disposed of in landfill or incinerated.</p> <p>it does not include any other impacts associated with landfill or incineration – emissions from decomposition, burning and associated transport and other machinery are included in the relevant categories.</p>	
Fossil fuel depletion	This category indicator is related to the use of fossil fuels. Fossil fuels provide a valuable source of energy and feedstock for materials such as plastics. Although there are alternatives, these are only able to replace a small proportion of our current use. Fossil fuels are a finite resource.	
Eutrophication	Nitrates and phosphates are essential for life, but increased concentrations in water can encourage excessive growth of algae and reduce the oxygen within the water. Eutrophication can therefore be classified as the over-enrichment of water courses. Its occurrence can lead to damage to ecosystems, increasing mortality of aquatic fauna and flora and to loss of species that are dependent on low-nutrient environments.	
Photochemical ozone creation	In atmospheres containing nitrogen oxides (NO _x) and volatile organic compounds (VOCs), ozone can be created in the presence of sunlight. Although ozone in the high atmosphere has a protective effect against ultraviolet (UV) light, low level ozone is implicated in impacts as diverse as	

BRE Impact Categories	Description	Effect
	<p>crop damage and increased incidence of asthma and other respiratory complaints.</p> <p>Also known as 'summer smog'.</p>	
Acidification	<p>Acidic gases react with water in the atmosphere to form "acid rain", a process known as acid deposition. When this rain falls, often a considerable distance from the original source of the gas, it damages the ecosystem to varying degrees, depending upon the nature of the ecosystem.</p>	

2.2.1.1 Climate Change

CLIMATE CHANGE CC100 (Carbon dioxide equivalent)	
<p>What is it?</p> <p>The earth's atmosphere absorbs some of the heat (infrared radiation) emitted from the sun, which causes the earth to heat up. This effect occurs naturally but has increased over the past few centuries; the average temperature of the earth's surface has increased by 0.3 to 0.6 °C since the late 19th century. This is why the issue is called 'Global Warming'. The increased warming was attributed to the effects of a group of gases ('greenhouse gases') that sit in the earth's atmosphere and prevent the earth losing heat gained from the sun ('radiative forcing'). It has since been realised that increases in temperature can result in other weather extremes, e.g. droughts and floods, so the issue has become 'Climate Change'.</p> <p>Each greenhouse gas lasts for a different amount of time in the atmosphere. This is why Climate Change effects are calculated over a specific timescale. Three timescales are generally used: 20 years (for rapidly occurring effects), 100 years (enough time to address most atmospheric effects) or 500 years (enough time to cover effects on the oceans). 100 years is the most frequently used time period, for example to calculate Climate Change in Environmental Product Declarations (EPDs). The Climate Change timescale is different from the lifetime of the product or function being studied.</p> <p>Initial emphasis has been placed on the emission of carbon dioxide (CO₂) due to human activity, mainly through the burning of fuels containing carbon. The UK Government is committed to a legally binding, international target of reducing greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012. It also committed the country to the goal of cutting domestic carbon dioxide (CO₂) emissions to 20% below the 1990 level by 2010. To achieve this, the government has established a Climate Change Programme containing measures to ensure that the UK moves towards a more sustainable, lower carbon economy. One of these measures is the setting up of the Climate Change Levy, which is expected to bring significant Carbon savings</p>	<p>What causes it? (cause)</p> <p>Carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), sulfur hexafluoride (SF₆), halocarbons (including CFCs and perfluorocarbons, e.g. CF₄, and hydrohalocarbons, e.g. HFCs and HCFCs).</p> <p>Water vapour and nitrogen oxides (NO_x) have an indirect effect because they increase the effects of some of the above gases.</p> <p>The combustion of fossil fuels (oil, coal and natural gas) is the biggest source of greenhouse gases.</p> <p>What does it do? (effect)</p> <p>Raised global temperatures leading to desertification; rising sea levels; climatic disturbance, and spread in disease.</p> <p>Reference substance</p> <p>Carbon dioxide (CO₂) eq. expressed over 100 years (CC100).</p> <p>Equivalence factor</p> <p>kg of CO₂ eq. (how much CO₂ needed to give same effect over 100 years)</p>

2.2.1.2 *Water Extraction*

WATER EXTRACTION WE	
<p>What is it?</p> <p>The abstraction of water from rivers, reservoirs and aquifers can cause the depletion, and disruption or pollution of these water sources.</p>	<p>What causes it? (cause)</p> <p>The abstraction of water for human consumption, manufacturing, and agriculture and horticulture.</p> <p>What does it do? (effect)</p> <p>Reduces the amount of water resource available and can disrupt or pollute local aquatic ecosystems.</p> <p>Reference substance</p> <p>m3 of water extracted</p> <p>Equivalence factor</p> <p>None</p>

2.2.1.3 Mineral Resource Extraction

MINERALS RESOURCE EXTRACTION ME	
<p>What is it?</p> <p>The extraction of metal ore and quarried materials from the earth.</p> <p>This impact category indicator is related to the extraction of virgin abiotic material, e.g. extraction of aggregates, metal ores, minerals, earth, etc. The extraction of such substances can mean that they become unavailable for use by future generations.</p> <p>The indicator is based on the Total Material Requirement (TMR) indicators developed by the Wuppertal Institute, based on earlier work for the World Resources Institute. The indicators covering fossil fuel, biomass (mainly agricultural products) and soil erosion (only covered for agriculture, not forestry) are not included.</p> <p>The indicator calculates the total resource use associated with any use of any non-energy, abiotic materials within the EU, wherever the resource use occurs. For example, for steel use, it traces back to tonnes of iron ore extraction wherever this occurs. The TMR indicator includes material that is extracted as a result of economic activities, but not used as input for production or consumption activities; for example it will include mining overburden. Excavated and dredged material is also included.</p>	<p>What causes it? (cause)</p> <p>The extraction of minerals.</p> <p>What does it do? (effect)</p> <p>It measures the amount of resources used. Other environmental impacts which might be associated with mining or quarrying, or the relative scarcity of resources are not part of this impact category.</p> <p>Reference substance</p> <p>No reference substance is used; it is measured in total mass (tonnes) extraction.</p> <p>Equivalence factor</p> <p>tonnes / kg extracted; or tonnes / tonne extracted</p>

2.2.1.4 Stratospheric ozone depletion

STRATOSPHERIC OZONE DEPLETION OD	
<p>What is it?</p> <p>The ozone layer is part of Earth’s upper atmosphere (stratosphere). Loss of ozone in this layer creates the ‘ozone hole’ and increases the intensity of the ultra violet (UV) part of sunlight.</p> <p>Ozone is lost by its reaction with certain gases. The Montreal Protocol was signed in 1987 to address the production of man-made ozone depleting gases. CFC manufacture has been banned since 2000 and HCFCs will be phased out by 2015. The time table is:</p> <ul style="list-style-type: none"> • 1 Jan 2004 banned from new plant • 2010 banned as virgin refrigerant for maintenance use • 2015 banned as recycled refrigerant for maintenance use 	<p>What causes it? (cause)</p> <p>All halogenated compounds that last long enough to reach the stratosphere, particularly those containing chlorine and bromine, plus NOx. Major zone depleters include CFCs and HCFCs.</p> <p>What does it do? (effect)</p> <p>Skin cancer, immune system damage, and damage to plants and crops.</p> <p>Reference substance</p> <p>CFC-11 eq.</p> <p>Equivalence factor</p> <p>kg CFC-11 eq. (how much CFC11 needed to give same effect)</p>

2.2.1.5 Human toxicity

HUMAN TOXICITY (THROUGH AIR, SOIL AND WATER) HT	
<p>What is it?</p> <p>The impact on human health from toxic substances. Toxicity can be either acute or chronic.</p> <p>This is an extremely complex area. The emission of some substances can have impacts on human health. Characterisation factors, expressed as Human Toxicity Potentials (HTP), are calculated using USES-LCA, as with Ecotoxicity, which describes fate, exposure and effects of toxic substances for an infinite time horizon.</p> <p>For both human and ecotoxicity measurements, the models are measured based on total emissions, and do not take into account the location or sensitivity of the ecosystem or organisms affected by the toxic release.</p> <p>Note: The impact of emissions relating to indoor air quality and their effect on human health are not covered by this category.</p>	<p>What causes it? (cause)</p> <p>Heavy metals, VOCs, HFCs, CFCs, dioxins, nitrogen dioxide (NO₂), PCBs, pesticides, herbicides amongst many other substances.</p> <p>What does it do? (effect)</p> <p>Asthma, cancer, and reduced fertility.</p> <p>Reference substance</p> <p>1,4-dichlorobenzene</p> <p>Equivalence factor</p> <p>kg 1,4-dichlorobenzene eq. (1,4-DB eq.)</p>

2.2.1.6 Ecotoxicity

ECOTOXICITY TO FRESHWATER AND LAND

What is it?

The impact on aquatic and terrestrial ecosystems from water-borne toxic substances. Toxicity can be either acute or chronic.

This is an extremely complex area. Research on this continues.

The emission of some substances can have impacts on ecosystems. Ecotoxicity potentials are calculated with a toxicity model, USES-LCA, which is based on EUSES, the EU's toxicity model. This provides a method for describing fate, exposure and the effects of toxic substances on the environment.

What causes it? (cause)

Heavy metals, volatile organic compounds (VOCs), HFCs, CFCs, dioxins, Nitrogen dioxide (NO₂), PCBs, pesticides, herbicides.

What does it do? (effect)

Acute and chronic toxicity in ecosystems, i.e. damaging and killing plant and animal species and the environment they depend on.

Reference substance

Characterisation factors are expressed using the reference unit, kg 1,4-dichlorobenzene equivalents (1,4-DB)/kg emission, and are measured separately for impacts of toxic substances on:

- Fresh-water aquatic ecosystems
- Terrestrial ecosystems

Equivalence factor

kg 1,4-dichlorobenzene eq. (1,4-DB eq.)

2.2.1.7 Higher level nuclear waste

HIGHER LEVEL NUCLEAR WASTE NW	
<p>What is it?</p> <p>Radioactivity can cause serious damage to human health, and as yet, no treatment or permanently secure storage solution exists for higher level radioactive wastes, such as that generated by the nuclear power industry and from decommissioning nuclear power stations. Such wastes need to be stored for periods of 1,000 years or more before their radioactivity reaches safe levels.</p> <p>It is measured in spent radioactive fuel of high and intermediate origin all of which:</p> <ul style="list-style-type: none"> • are highly radioactive, accounting in total for more than 99% of the radioactivity attributed to the nuclear industry; • have no agreed form of permanent disposal anywhere in the world; • require storage for at least 1,000 years before they may be safe. 	<p>What causes it? (cause)</p> <p>Energy supply from nuclear sources: e.g. grid electricity that includes nuclear reactors.</p> <p>What does it do? (effect)</p> <p>Radioactivity can cause serious damage to human health and represents a treatment and security risk.</p> <p>Reference substance</p> <p>The characterisation factor for the category is measured in mm^3 of spent fuel, high and intermediate level radioactive waste.</p> <p>Equivalence factor</p> <p>None</p>

2.2.1.8 Waste disposal

WASTE DISPOSAL	
<p>What is it?</p> <p>This category represents the environmental issues associated with the loss of resource implied by the final disposal of waste. Any waste that is disposed of in landfill or incinerated without energy recovery will be included.</p> <p>Key points for this impact category are:</p> <ul style="list-style-type: none"> • reflects the loss of resource resulting from waste disposal (in contrast to recycling or reuse); • does not include any other impacts associated with landfill or incineration – emissions from decomposition, burning and associated transport and other machinery are included in the relevant categories; • the mass of waste is used as a proxy for the loss of resource; • includes waste sent to incineration and landfill or any other form of final disposal (e.g. dumping on land or in the sea); • does not differentiate between hazardous, non-hazardous, inert or organic wastes; • different impacts from hazardous, non-hazardous, etc will be included within the waste treatment models (landfill, incineration and composting) for these wastes; • where heat recovery, energy recovery or other material recovery (e.g. recovery/recycling of ash, metal residues etc) are undertaken as part of incineration or landfill, then this value is used to calculate the loss of resource. 	<p>What causes it? (cause)</p> <p>The disposal of materials to landfill or incineration.</p> <p>What does it do? (effect)</p> <p>Limits land use opportunities; generates noise, dust and odour; causes emissions of gases (e.g. methane) and leachate, poses risk of underground fires etc.</p> <p>Reference substance</p> <p>None</p> <p>Equivalence factor</p> <p>tonnes (mass of solid waste)</p>

2.2.1.9 Fossil fuel depletion

FOSSIL FUEL DEPLETION FFD	
<p>What is it?</p> <p>This impact category indicator is related to the use of fossil fuels. Fossil fuels provide a valuable source of energy and feedstock for materials such as plastics. Although there are alternatives, these are only able to replace a small proportion of our current use. Fossil fuels are a finite resource and their continued consumption will make them unavailable for use by future generations.</p>	<p>What causes it? (cause)</p> <p>The consumption of fossil fuels (oil, coal and natural gas).</p> <p>What does it do? (effect)</p> <p>Represents the amount of fossil fuels (oil, coal and natural gas) lost from reserves.</p> <p>Reference substance</p> <p>MJ LHV / kg</p> <p>Equivalence factor</p> <p>None</p>

2.2.1.10 *Eutrophication*

EUTROPHICATION	
<p>What is it?</p> <p>Plants need nitrates and phosphates to grow. But some ecosystems are very sensitive to the amount of these nutrients (many plants need a low-nutrient environment). If the amount of nutrients becomes too high, eutrophication (over 'nutrification') occurs, and the ecosystem collapses.</p> <p>What causes it? (cause)</p>	<p>What causes it? (cause)</p> <p>The release of ammonia (NH₃), nitrogen oxides (NO_x), phosphorus, phosphates (PO₄) and nitrates (NO₃) into air or water supplies.</p> <p>Agriculture is a large source of phosphate and nitrate release but NO_x from fossil fuel combustion also contributes nitrates. Phosphorus is also produced by sewage treatment plants.</p> <p>What does it do? (effect)</p> <p>Causes algal blooms, which remove oxygen from the water and results in the death of aquatic plants and animals.</p> <p>Reference substance</p> <p>Phosphate (PO₄)</p> <p>Equivalence factor</p> <p>kg phosphate eq. (PO₄ needed to cause the same effect)</p>

2.2.1.11 Photochemical ozone creation

PHOTOCHEMICAL OZONE CREATION (SUMMER SMOG) POCP	
<p>What is it?</p> <p>When ozone is created in the Earth's lower atmosphere (troposphere), it can create smog. The creation of ozone happens when volatile organic compounds (VOCs) react to sunlight (photo-oxidation). VOCs include solvents, diesel and petrol. The speed at which low level ozone creation happens is affected by the presence of nitrogen oxides (NO_x).</p>	<p>What causes it? (cause)</p> <p>VOCs under the influence of sunlight and the presence of NO_x.</p> <p>Vehicle exhaust fumes contain VOCs, which react with NO_x (both are often present in urban environments) to produce Summer Smog. Other sources include solvents.</p> <p>What does it do? (effect)</p> <p>Crop damage, and aggravates asthma and other respiratory conditions.</p> <p>Reference substance</p> <p>Ethene (C₂H₄)</p> <p>Equivalence factor</p> <p>kg ethene eq. (how much C₂H₄ needed to cause the same impact)</p>

2.2.1.12 Acidification

ACIDIFICATION (ACID DEPOSITION) AD

What is it?

An acid is a chemical that can produce hydrogen ions (H⁺, also called a 'proton') when it meets water. Hydrogen ions are highly reactive and can cause other substances to change their composition and their physical properties.

Acid deposition occurs when acidic gases react with rain ('acid rain') or water in the soil.

What causes it? (cause)

Ammonia (NH₃); nitrous oxides (NO_x); and sulfur oxides (SO_x).

The major source is combustion of fossil fuels for electricity, heating and transport. The acidification effect is greatest when the fuels contain sulfur.

What does it do? (effect)

Damage to forests, dead lakes, breakdown of materials, including stone and metals.

Reference substance

Sulfur dioxide (SO₂) eq.

Equivalence factor

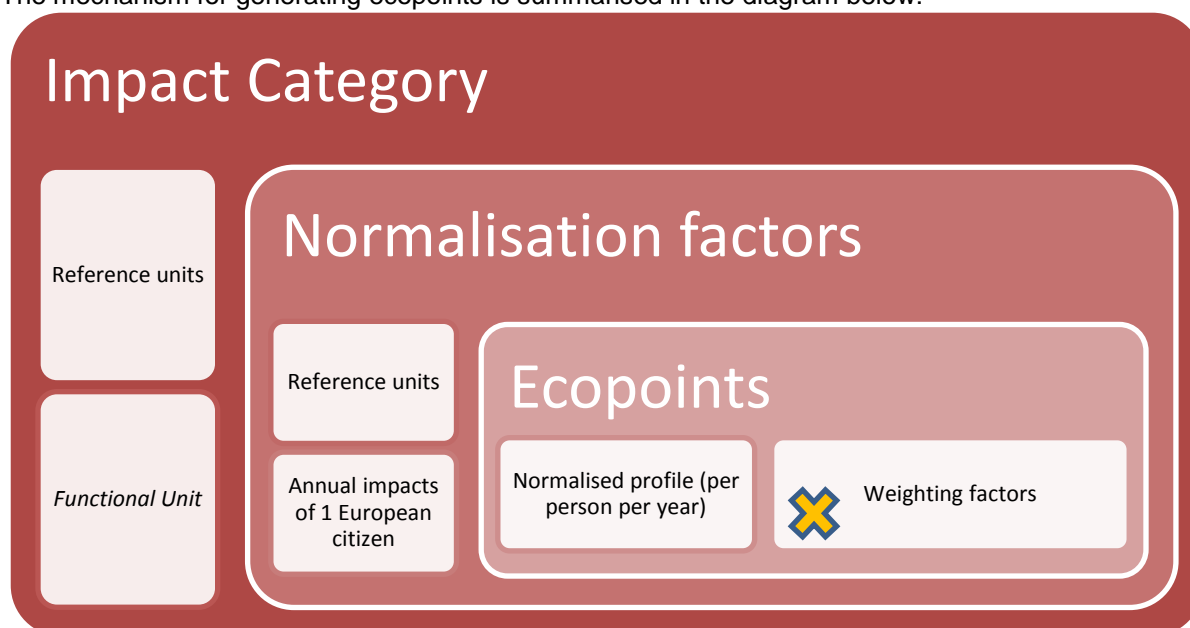
kg SO₂ eq. (how much SO₂ needed to give same effect)

2.2.2 Ecopoints

The results from an LCA study performed in accordance with BRE's Environmental Profiles Methodology produces an Environmental Profile for impacts in 13 environmental impact categories. The Environmental Profile can be presented in 3 ways:

1. as characterised data, where every impact category is listed in its own units
2. as normalised data, where all impact categories are in units of 'per person per year'. (The characterised data divided by the annual impacts of 1 EU citizen in each impact category.)
3. as weighted results, where all impact categories are still in units of 'per person per year' but reflect the importance that weighting has attached to each impact category. (The normalised profile multiplied by the weighting factor for each impact category - the total of these weighted results being the 'ecopoint' score.)

The mechanism for generating ecopoints is summarised in the diagram below:



The table below presents an example of the calculation steps for converting a characterised profile into an ecopoints score.

BRE Impact Categories	Characterised Profile	Normalised Profile	Weighted Score	Ecopoints
Climate change	277	0.0225	0.487	1.43
Water extraction	2.17	0.00575	0.0673	
Mineral resource extraction	0.363	0.0149	0.146	
Stratospheric ozone depletion	0.00017	0.000783	0.00713	
Human toxicity	567	0.0288	0.247	
Ecotoxicity to fresh water	4.66	0.00353	0.0304	
Nuclear waste (higher level)	578	0.0244	0.2	
Ecotoxicity to land	0.504	0.0041	0.0328	
Waste disposal	0.0146	0.0039	0.0301	
Fossil fuel depletion	1090	0.00398	0.0131	

BRE Impact Categories	Characterised Profile	Normalised Profile	Weighted Score	Ecopoints
Eutrophication	0.0121	0.000374	0.00112	
Photochemical ozone creation	0.127	0.00589	0.00118	
Acidification	232	3.26	0.163	

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[Life cycle stages](#)
[Rating bands](#)

[Life Cycle Assessment](#)
[Normalisation](#)
[Weighting](#)

2.2.2.1 Normalisation

Normalisation is the process by which all environmental impact categories are compared with a 'background' level of impact so that all categories are in the same units and can be directly compared. The Environmental Profiles Methodology used in the Green Guide normalises to the annual impacts caused by 1 European citizen.

The normalisation factors used are set out below.

BRE Impact Categories	Units	Normalisation factor
Climate change	kg CO ₂ eq. (100 yr)	12,300
Water extraction	m ³ water extracted (gross)	377
Mineral resource extraction	Tonnes of mineral extracted	24.4
Stratospheric ozone depletion	kg CFC-11 eq.	0.217
Human toxicity	kg 1,4 dichlorobenzene (1,4-DB) eq.	19,700
Ecotoxicity to fresh water	kg 1,4 dichlorobenzene (1,4-DB) eq.	1,320
Nuclear waste (higher level)	mm ³ high level waste	23,700
Ecotoxicity to land	kg 1,4 dichlorobenzene (1,4-DB) eq.	123
Waste disposal	Tonnes of solid waste	3.75
Fossil fuel depletion	MJ	273,000
Eutrophication	kg phosphate (PO ₄) eq.	32.5
Photochemical ozone creation	kg ethene (C ₂ H ₄) eq.	21.5
Acidification	kg sulfur dioxide (SO ₂) eq.	71.2

Normalising allows the results to be investigated in terms of the levels of each environmental impact arising from the product or specification under study.

[Ecopoints](#)

2.2.2.2 Weighting

The process of weighting allows different levels of importance to be attached to the types of environmental impact arising for a product or specification. There are different ways to obtain a set of weighting factors; BRE used an expert panel method.

The table below sets out the weighting factors used in the Environmental Profiles Methodology.

BRE Impact Categories	Weighting factor
Climate change	21.6
Water extraction	11.7
Mineral resource extraction	9.8
Stratospheric ozone depletion	9.1
Human toxicity	8.6
Ecotoxicity to fresh water	8.6
Nuclear waste (higher level)	8.2
Ecotoxicity to land	8.0
Waste disposal	7.7
Fossil fuel depletion	3.3
Eutrophication	3.0
Photochemical ozone creation	0.2
Acidification	0.05

Because weighting is subjective, some argue against its use in interpreting the results of an LCA study (ISO 14044:2006 regards weighting as an optional element of LCA). However, a suitable mechanism for reaching a robust decision when comparing many alternative approaches (such as the specifications contained within any of the Green Guide's elemental categories) is not set out in the LCA standards – the approach is left to the user of the results. This presents a considerable practical problem for anyone wanting to use the results: for the Environmental Profiles Methodology, any user wanting to compare the performance of different external walls would need to consider the results in 13 environmental impact categories for around 550 specifications, i.e. 7,150 individual figures. Given the many other factors, such as cost and aesthetics, a user would be assessing within the decision-making process, it is almost inevitable that some value judgement would be applied by the user to manage the task. Since each user will have different priorities, there is no guarantee that one user's views would be shared by another's, so two users getting the same outcome is unlikely.

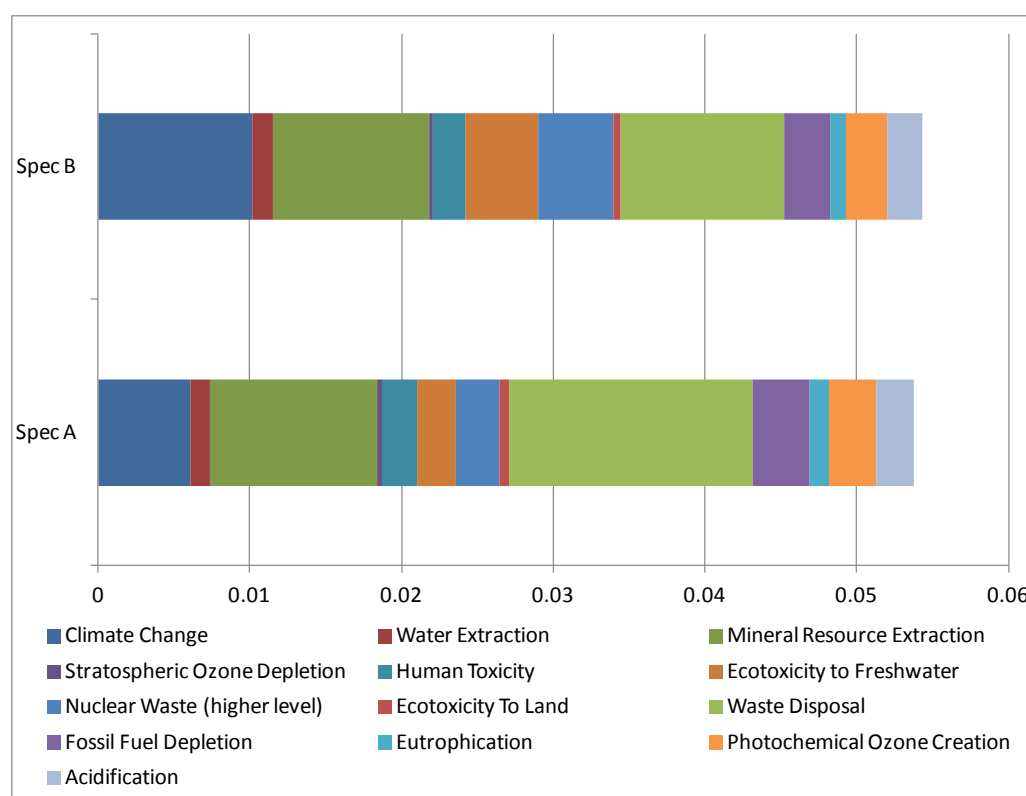
The following example uses two fictional specifications to highlight how using different forms of LCA data could affect the user's decision. The table below gives the characterised results for the two specifications.

BRE Impact Categories	Spec A	Spec B
Climate change	74.9	125
Water extraction	0.49	0.49
Mineral resource extraction	0.268	0.251
Stratospheric ozone depletion	0.0000754	0.0000679

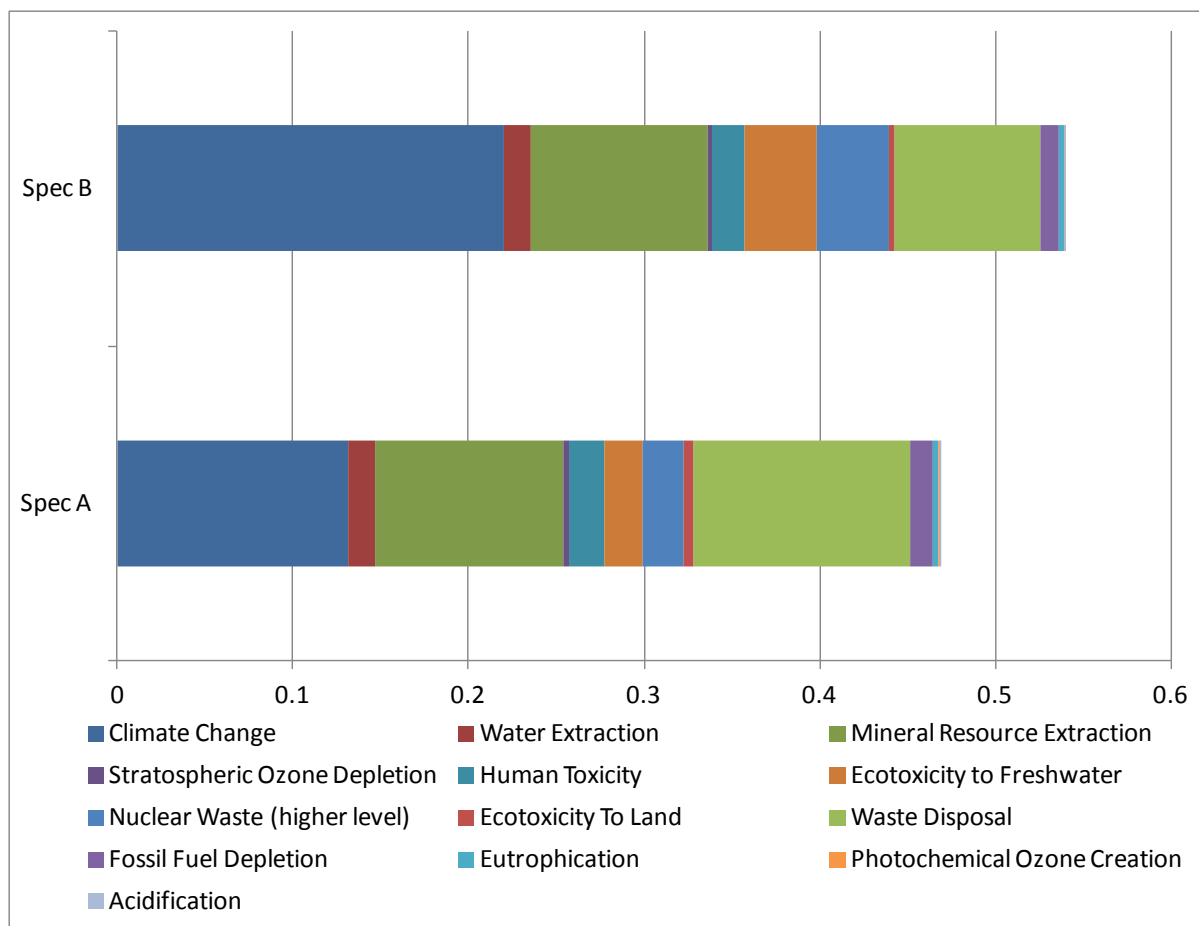
BRE Impact Categories	Spec A	Spec B
Human toxicity	46.1	41.5
Ecotoxicity to fresh water	3.28	6.3
Nuclear waste (higher level)	69	132
Ecotoxicity to land	0.0769	0.0577
Waste disposal	0.00604	0.0485
Fossil fuel depletion	317	820
Eutrophication	0.00663	0.0332
Photochemical ozone creation	0.0543	0.0592
Acidification	122	0.162

If the user is simply comparing which specification has the higher results across the environmental impact categories, then the two specifications are the same for one category, Spec A has higher results than Spec B for 9 categories and Spec B has higher results than Spec A for 3 categories.

Normalising the results allows the impacts for each category to be compared directly and the results for each specification with each other as shown in the graph below.



These results indicate that the overall levels of normalised impact are virtually the same. However, the sources of the impact are different between the two specifications and the consequence of this difference is highlighted in the weighted results shown below. The weighted results indicate that Spec A has a lower overall impact on the environment than Spec B. If the specifications were for external walls, then Spec A would get an A⁺ and Spec B would get an A.



While the use of weighting is subjective, it is also an unavoidable truth that different levels of importance are already attached to different aspects of environmental impact. The Kyoto Protocol is evidence of the importance attached to Climate Change and data continues to accrue on the growing importance of fresh water.

BRE takes the view that using a single set of robustly obtained weighting factors allows those specifying construction specifications to take into account a wide range of environmental impacts in a manageable way. The use of ecopoints to produce Green Guide ratings ensures that users of the results can have confidence that they are not inadvertently causing problem shifting by focusing on a single issue to make their decisions.



3 How it's used

The Green Guide is for use within BRE's BREEAM schemes and the Code for Sustainable Homes.

BREEAM

BRE Global's Environmental Assessment Method (BREEAM) is a voluntary scheme for the environmental labelling of buildings, developed by BRE Global with private sector partners and sponsors. The scheme awards a certificate to a building stating clearly – and in a way that can be made visible to clients and users alike – the performance of the building against a set of defined environmental criteria. BREEAM is now required for all Government office buildings⁴ – representing over 40% of construction in the UK. One of the aims of BREEAM is to encourage the use of materials that have a lower impact on the environment, taking account of the full life cycle of the materials in question. Credits are awarded for selecting high performance specifications for key building elements using the Green Guide to Specification; different BREEAM schemes take slightly different approaches to what elemental categories of the Green Guide are used.

The Code for Sustainable Homes

The Code for Sustainable Homes was launched in December 2006 by the Department for Communities and Local Government. The Code introduced a single national standard to be used in the design and construction of new homes in England, and is based on the earlier BRE EcoHomes scheme. Within the Code, credits are awarded for the use of materials with a low environmental impact. This is measured using Green Guide ratings. The following five key elements are assessed under the code:

- Roof
- External wall
- Internal walls (including separating)
- Upper and ground floors (including separating)
- Windows.

This document is only concerned with the use of the Green Guide within these schemes: for more details on the requirements of these schemes, please visit the [BREEAM website](#) or the [Code for Sustainable Homes website](#).

BRE has launched a new scheme, the "Home Quality Mark", to cover housing following Government's decision to discontinue the Code for Sustainable Homes. Please visit the [Home Quality Mark website](#) for more information.

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⁴ <http://www.breeam.org/page.jsp?id=343>

[BREEAM and EPD](#)

3.1 BREEAM and EPD

This section focuses on the Mat 01 section of BREEAM 2011 to show how elements assessed vary according to building type, the credits available and how the Green Guide and Environmental Product Declarations⁵ (EPD) can be used to obtain credits.

The table below sets out the elemental categories assessed within each building type.

Building Type	Elemental category					
	External walls	Windows	Roof	Upper floor slab	Internal walls	Floor finishes / coverings
Office	●	●	●	●	-	●
Retail	●	●	●	●	-	●
Industrial	●	-	●	-	-	
Education	●	●	●	●	●	●
Healthcare	●	●	●	●	●	●
Prisons	●	-	●	●	-	●
Courts	●	●	●	●	●	●
Multi-residential	●	●	●	●	●	●
Other buildings	●	●	●	●	●	●

The following table shows how each building type can gain BREEAM credits through the use of products that achieve Mat 01 points according to the Green Guide rating.

Building Type	Total Mat 01 points achieved						
	2	4	5	8	10	12	14
	Available BREEAM credits						
Office	1	1	2	3	4	5	-
Retail	1	1	2	3	4	5	-
Industrial	1	2	-	-	-	-	-
Education	1	1	2	3	4	5	6
Healthcare	1	1	2	3	4	5	6
Prisons	1	1	2	3	4	-	-
Courts	1	1	2	3	4	5	6
Multi-residential	1	1	2	3	4	5	6
Other buildings	1	1	2	3	4	5	6

The calculation procedure has 3 steps:

1. Use the Green Guide rating for specifications within each relevant elemental category
2. Weight the performance of the different specifications used within an elemental category according to the area (m²) of each specification

⁵An EPD is a document that: “communicates verifiable, accurate, non-misleading environmental information for products and their applications, thereby supporting scientifically based, fair choices and stimulating the potential for market-driven continuous environmental improvement.” [EN 15804:2011] - based on ISO 14025:2010 for Type III environmental labelling.

3. Weight the performance of each elemental category according to the area of each.

The points available from Green Guide ratings for each rating band are set out in the table below.

Where the total points achieved exceeds the level required for maximum credits, then there is the potential to achieve an additional innovations credit (details are in the BREEAM 2011 technical manual's exemplary level criteria).

Green Guide Rating	Points
A+	3.00
A	2.00
B	1.00
C	0.50
D	0.25
E	0.00

BREEAM 2011 also allows for the use of EPD to obtain uplift points: if a material, component or product has a 3rd party EPD then extra points may be possible. The level of EPD uplift considers the Green Guide rating obtained by the relevant specification and the contribution of the item with the EPD to the specification's rating: the better the rating of the specification and the more influence the item with the EPD has on the specification's rating, then the higher the potential uplift.

To summarise, the principles behind EPD points uplift are:

- Reward greater understanding of a product's performance
- Keep reward in context of a specification's performance
- Reward according to a product's contribution to the specification's performance
- High performing spec + EPD for main sources of impact = greatest uplift points.

The table below sets out the EPD uplift points available.

Green Guide Rating	Points	EPD Tier 1 max points uplift	EPD Tier 2 max points uplift
A+	3.00	1.00	0.75
A	2.00	1.00	0.75
B	1.00	1.00	0.50
C	0.50	0.50	0.25
D	0.25	0.25	0.125
E	0.00	0.00	0.00

Tier 1 = 3rd party verified, cradle-to-grave EPD

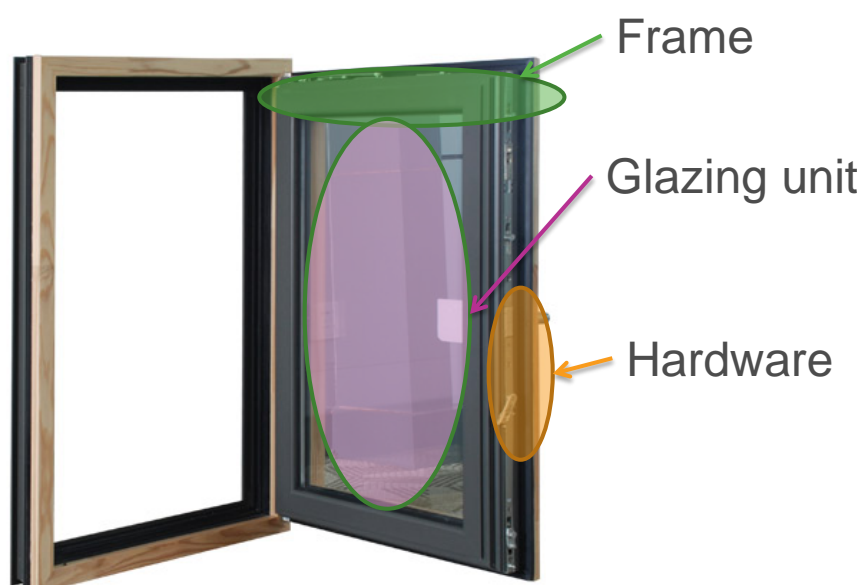
Tier 2 = 3rd party verified, cradle-to-gate or cradle-to-gate with options EPD

Eligible EPD for uplift points are those:

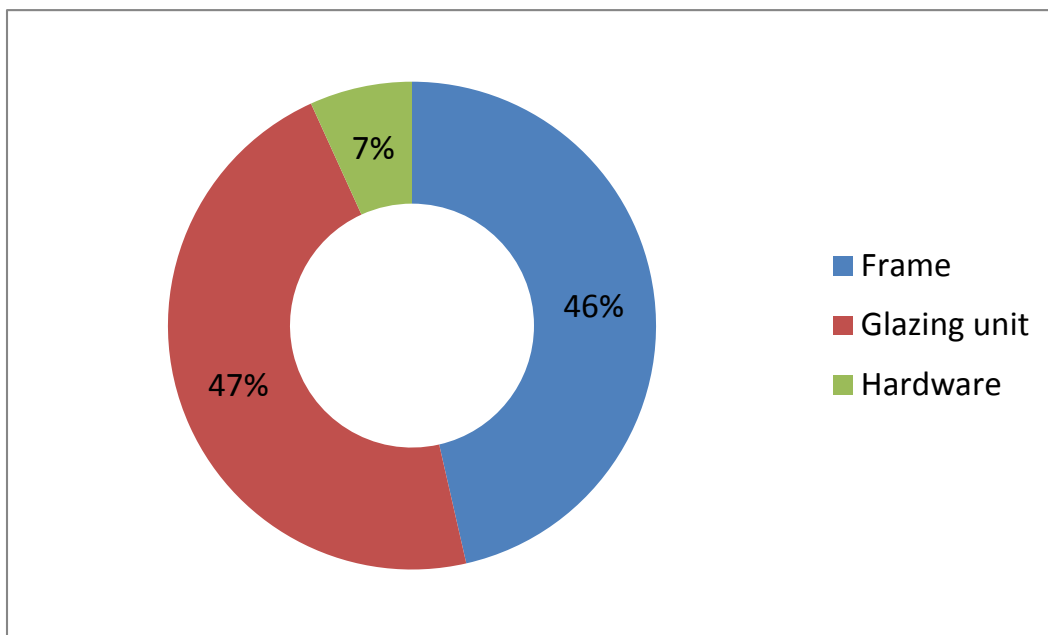
- Compliant with ISO 14025; ISO 21930 or EN 15804
- 3rd party verified, part of recognised EPD programme
- Generic (average) or specific data
- Functional unit or Declared unit
- Tier 1 (cradle-to-grave)
- Tier 2 (cradle-to-gate or cradle-to-gate with options)

The following example uses a domestic window specification to illustrate the process of calculating the EPD uplift points available.

The schematic below illustrates the opening light side of the domestic window functional unit and identifies the window's components: frame; glazing unit, and hardware.



The graph below shows how these components contribute to the window's environmental impact.



The table below compares the points available from the specification as included in the Green Guide and the specification from the Green Guide using a glazing unit that has a cradle-to-gate (Tier 2) EPD.

Specification	Contributor	Points available	Total
Powder coated aluminium window (profile > 1.08 kg/m), double glazed	Green Guide Rating = B	= 1.00	= 1.00
Powder coated aluminium window (profile > 1.08 kg/m), double glazed – using glazing unit with a cradle-to-gate EPD	Green Guide Rating = B	=1.00	=1.00+0.235 =1.235
Glazing unit with a cradle-to-gate EPD	EPD Tier 2	=1.00*0.47*0.5 0 =0.235	

This approach allows for the EPD to be from any suitable source (it does not judge the results from the EPD, but acknowledges the effort to obtain the EPD and the availability of the data); BREEAM is unique in doing this. As more EPD data becomes available it will be possible (and appropriate) to develop a means of comparison - it is important to measure environmental impact but it is crucial that suitable comparison of performance is possible.

BRE operates two schemes: a certificated Environmental Profiles scheme that uses the methodology behind the Green Guide (<http://www.greenbooklive.com/search/scheme.jsp?id=9>), and a verified EN 15804 EPD scheme (<http://www.greenbooklive.com/search/scheme.jsp?id=260>). Both schemes produce results that are eligible for EPD uplift points.

4 The Future

The Green Guide to Specification is a unique tool for enabling users to quickly determine the environmental performance of a wide range of typical UK construction specifications and to compare the relative performance of different specifications achieving the same function.

Its use of A⁺ to E ratings is an effective way of giving meaning to the detailed LCA information on environmental performance that underpins it; you can confidently use the results without having to be an LCA expert.

The separation into elemental categories recognises the different proportions of impact on the whole building of its parts and is effective in enabling a user to compare specifications performing the same function. However, it does not allow for interactions between elements influencing the overall performance of the final building.

Assessing impact at the whole building level presents many challenges for specifiers deciding on a building's design and for the evolution of the Green Guide. A key influence is the emergence of a suite of standards from CEN's TC 350, particularly EN 15978 (building level) and EN 15804 (product and service level).

EN 15978 states: "The object of the assessment is the building, including its foundations and external works within the curtilage of the building's site, over its life cycle. The curtilage used to characterise the site shall be consistent with the definition and intended use of the building."

However, the standard does allow for the restriction of the assessment to "...part of the building or to an assembled system (part of works), or to a part of the life cycle..." as long as this is justified.

If comparison is required, then EN 15978 is clear that this shall only be done on the basis of functional equivalency that includes technical and functional requirements.

EN 15978 allows EPDs produced according to EN 15804 as a potential source of data: reporting to EN 15804 for a cradle-to-grave functional unit could result in data points for 24 parameters in 17 modules of the life cycle, i.e. 408 data points from a single EPD.

Fortunately, EN 15978, whilst requiring all data to be produced, does allow for simplified communication of the results in the form of a limited selection of parameters, although it still requires separate reporting for each life cycle stage.

The two key issues facing the evolution of the assessment of the environmental impact of buildings are:

1. To meet the needs of a range of users
2. To enable appropriate comparison between functionally equivalent options to recognise and reward different levels of achievement.

The concepts applied within the Green Guide remain useful for all users - the ratings approach is useful, whether used in isolation as a decision mechanism or, if used within a whole building modelling approach, it can be a first filter for design.

The challenge for developing the Green Guide within the context of EN 15978 is to merge the requirements of the standard with the needs of various users. This will require consideration of many aspects, such as: the selection of the most relevant parameters to communicate and an appropriate set of weighting factors for these; to develop appropriate scenarios for the building types covered by BREEAM; to identify suitable functional equivalents for comparison.

Given that the TC 350 standards are so new and their application is only just beginning to be tested, BRE considers that it is appropriate for the updated Green Guide to begin by taking the 'assembled system' route and producing elemental categories for insulation and floor finishes, while undertaking

studies to investigate how best to embrace the functional equivalent requirement at the whole building level and produce suitable benchmark buildings.

A document is in production that will provide more information on the TC 350 standards.

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allocation: dividing the input or output flows of a unit process among the product system under study and other items. This may need to be done where a manufacturing process results in products and co-products, for example, steel and slag.

boundary: line between a product system and the environment of other product systems.

BREEAM: BRE's Environmental Assessment Method for assessing sustainable development. See <http://www.breeam.org/> for more information.

characterisation factor: a value that allows any substance contributing to an environmental impact category to be converted into the amount of the reference substance that would have the same effect.

characterised profile: the amount of impact in each of the environmental impact categories. Many different emissions can contribute to each impact category. The different emissions in each category are converted into the amount of reference substance needed to give the same effect. Each category has its own reference substance, e.g. CO₂ is the reference substance for Climate Change, and the amounts of any greenhouse gases in the Inventory Table are converted to the amount of CO₂ needed to cause the same effect. The impact categories are in different units and the values cannot be compared.

Code for Sustainable Homes: Department for Communities and Local Government's programme for the sustainable design and construction of new homes. The future of this programme is currently (as of March 2015) under review.

ecopoints: the normalised profile values are multiplied by weighting factors developed for each impact category and the results summed to give a single figure.

embodied energy: the energy used in the production of a material - "total primary energy that has to be sequestered from a stock within the earth to produce a specific good or service".

environmental impact category: environmental issue being examined, e.g. Climate Change, Acid Deposition and Human Toxicity to Air.

environmental profile: the level of impact in each environmental impact category for the functional unit or product being studied.

Environmental Product Declaration (EPD): is a document that: "communicates verifiable, accurate, non-misleading environmental information for products and their applications, thereby supporting scientifically based, fair choices and stimulating the potential for market-driven continuous environmental improvement." [EN 15804:201] - based on ISO 14025:2010 for Type III environmental labelling.

functional unit: the materials needed to achieve the desired purpose (function).

input: material or energy that enters a unit process (can include raw materials and intermediate products).

intermediate products: material that has already been processed before being used to produce a product.

inventory data: table of amounts of resources used, and products and emissions produced to achieve the product or function being studied.

life cycle: consecutive and interlinked stages of a product system from raw material acquisition or generation of natural resources to the final disposal.

life cycle assessment (LCA): compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.

normalised profile: The characterised profile is referenced to the environmental impact for each category at the national or global level in one year (usually for 1 citizen), giving a 'normalised' profile; the values are directly comparable.

output: material or energy that leaves a unit process (may include raw materials, intermediate products, products, emissions and waste).

primary energy: gross energy in the primary fuels extracted from resource stocks. "Stock within the earth" needs definition and is sometimes used to mean materials used for fuel that cannot be renewed, i.e. 'fossil fuels'.

raw materials: unprocessed material that is used to produce a product.

reference substance: substance that is used to calculate how much of this substance would be needed to give the same environmental impact as each of the many substance contributing to an environmental impact category. For example, carbon dioxide (CO₂) is the reference substance for Climate Change (CC100), so all the other gases contributing to Climate Change are converted into the amount of CO₂ that would be needed to give the amount of Climate Change that each different gas would cause, e.g. 1 kg of methane causes 23 times as much Climate Change as CO₂ (for the 100-year timeframe), so 1 kg methane is equivalent to 23 kg of CO₂.

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6. Further reading

CEN TC 350 standards

EN 15643-1 Sustainability of construction works – Sustainability assessment of buildings – Part 1: General framework.

EN 15643-2 Sustainability of construction works – Assessment of buildings – Part 2: Framework for the assessment of environmental performance.

EN 15978:2011 Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method.

EN 15804:2012 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

EN 15942:2011 Sustainability of construction works - Environmental product declarations - Communication format business-to-business.

CEN/TR 15941:2010 Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data.

International LCA standards

ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and Procedures.

ISO 21930: Sustainability in building construction — Environmental declaration of building products.

ISO 14040: Environmental management — Life cycle assessment — Principles and framework.

ISO 14044: Environmental management — Life cycle assessment — Requirements and guidelines.

BRE's 'Environmental impact of...' series

Dutfield, A; Mundy, J, and Anderson, J. Environmental impact of floor finishes: Incorporating the Green Guide ratings for floor finishes. Bracknell, IHS BRE Press, 2011.

Allbury, K and Anderson, J. Environmental impact of insulation. Bracknell, IHS BRE Press, 2011.

Allbury, K; Abbe, O and Anderson, J. Environmental impact of metals. BRE FB 57. Bracknell, IHS BRE Press, 2013.

Allbury, K; Franklin, E and Anderson, J. Environmental impact of brick, stone and concrete. BRE FB 58. Bracknell, IHS BRE Press, 2013.

Abbe, O. Environmental impact of windows BRE FB 66. Bracknell, IHS BRE Press, 2014.

Jones, N & Mundy, J. Environmental impact of biomaterials and biomass. BRE FB 67. Bracknell, IHS BRE Press, 2014.

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