

BREEAM UK NC 2018 Ene 01 Calculation Methodology

The purpose of this guidance note is to describe the calculation methodology for energy performance under the Ene 01 issue of the BREEAM UK New Construction 2018 scheme.

Contents

Introduction	2
The triple metric approach	2
Standards for the countries of the UK	3
Relevant building regulation versions	3
Alternative methodology	3
Translating building performance into BREEAM credits	4
The BREEAM credits scale and minimum standards	5
Energy modelling input data required to translate building performance	6
Defining the BREEAM translators for the standard methodology	7
Unweighted Energy Performance Ratio standard methodology	9
Policy decisions standard methodology	9
Relationship between different country translators – standard methodology	11
Defining the BREEAM translators for the alternative methodology	13
Calculation process	13
Stage 1 - Defining the building's performance	13
Stage 2 - Benchmarking the performance improvement against the modelled building stock	14
Stage 3 - Weighting the individual ratios for each parameter	14
Stage 4 - Awarding the BREEAM credits	14
The BREEAM EPR_{NC} weightings - standard and alternative methodology	14
Example calculation – standard methodology	15
Appendix - 'n' values for alternative methodology by end uses	16

Introduction

The calculation methodology for determining the number of credits achieved for energy performance under the Ene 01 assessment issue for BREEAM UK New Construction 2014 scheme has been revised for the BREEAM UK New Construction 2018 scheme. The methodology is based on compliance modelling and uses a triple metric approach that addresses energy demand, energy consumption and CO₂ emissions. The aim of using this approach is to enhance the ability of BREEAM to recognise and promote designs that minimise energy demand and consumption in buildings and then to reduce the carbon emissions resulting from that energy use. The standard methodology is based directly on the energy modelling calculations that are used to show compliance with the Building Regulations. We have also introduced an alternative methodology which better reflects the rapid decarbonisation of the grid that has occurred since UK Building Regulations were last updated and hence encourages design choices, in particular heat pumps, that will result in lower environmental impacts from operational energy use over life of the building.

The triple metric approach

The methodology considers three parameters of the modelled performance of a new building when determining the number of credits achieved for this issue, as follows:

- Heating and cooling energy demand.
- Primary energy consumption.
- Carbon dioxide (CO₂) emissions.

‘Heating and cooling energy demand’ is a measure of the annual heating and cooling energy demand, in MJ/m² year. It is influenced by factors including the building fabric performance and air permeability, and by heat gains from people, building servicing systems and energy using equipment.

‘Primary energy consumption’ is a measure of the building’s primary energy use in kWh/m² year. Primary energy means energy from renewable and non-renewable sources that has not undergone any conversion or transformation process. Primary energy differs from delivered energy in that, delivered energy is that consumed by the building, and reflects how efficiently a building meets its energy demand. For a conventional energy supply of gas and electricity, delivered energy is the sum of the gas and electricity use, as read at the building’s meters. Delivered energy consumption is also known as operational energy consumption. Primary energy is transformed by the means of energy generation used and transmitted to the building. When it arrives at the building, it is delivered energy. Primary energy is therefore influenced by both the efficiencies of any on-site building services systems and the efficiencies of energy generation and transmission from the power generators to the building.

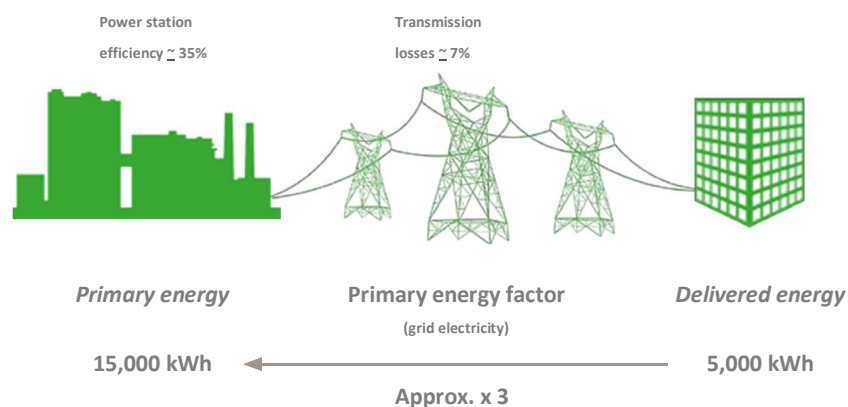


Figure 1 - Delivered energy and primary energy

The CO₂ emissions parameter is a measure of the greenhouse gas emissions the building emits in meeting its predicted energy demands for heating, cooling, ventilation and lighting, in kg CO₂ eq/m² year. It is influenced by factors including building fabric performance,

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

systems and distribution efficiency and fuel source. The specification of low or zero carbon forms of energy generation (on-site or near-site low carbon or renewable energy) are accounted for in this parameter.

The triple metric approach ensures that standard practice against the energy efficiency or consumption scale cannot be offset by high performance on the carbon metric scale through the specification of low or zero carbon, on or offsite energy solutions. Therefore, BREEAM seeks to encourage and reward a holistic approach to reducing energy and emissions, through a balance of good building design and systems specification.

Standards for the countries of the UK

The four countries of the UK (Wales, Scotland, Northern Ireland and England) have different building regulation standards for energy. The BREEAM credits for energy performance under Ene 01 are based on the building regulations baseline and methodology, so the credits for this issue are now tailored to each UK country and use different numbers for the translation of energy performance into credits.

Using different baselines for different parts of the UK takes account of the divergence in country-specific energy regulations for new buildings across the UK and ensures that BREEAM reflects local building regulations. This means that any improvement over local regulations will now be reflected in the scoring.

A consequence of this approach is that it means there is a loss of comparability between buildings across the UK. Therefore, the number of credits awarded for a building in one country may be different to those for a building in another country with an identical design. This could lead to a building scoring an Excellent rating in Scotland and an identical building scoring a Very Good rating in England.

Relevant building regulation versions

The versions of the building regulations that are used to define the baseline in the 2018 version of the Ene 01 energy performance methodology for Northern Ireland, England, Wales and Scotland are as follows:

Northern Ireland: Technical Booklet F2 2012 Conservation of fuel and power in buildings other than dwellings

England: Approved Document Part L2A Conservation of fuel and power in new buildings other than dwellings, 2013 edition – for use in England.

Wales: Approved Document Part L2A Conservation of fuel and power: New buildings other than dwellings – for use in Wales.

Scotland: Technical Handbook 2015 Non-Domestic, Section 6 Energy.

When entering and uploading building performance information into the BREEAM scoring and reporting tools, it is essential that the correct version of the building regulations is selected in the tool, and that the building performance information is generated by the correct version of the approved software.

Alternative methodology

The alternative methodology is a similar approach to the “standard” methodology, but with all the heating systems in the notional building being defined as a gas boiler. For Building Regulations, the notional heating systems type is defined to be the same as the actual system type in most instances. The alternative method also uses more recent SAP 10 emission factors¹ accounting for decarbonisation of the UK National Grid.

In addition, for buildings where district heating has been installed as a condition for granting planning permission, this heating energy consumption is excluded from the carbon and primary energy metrics as the design team are not able to influence this decision. Where installation of district heating is a design choice additional information on the energy sources used to generate heat need to be provided. The system is currently unable to automatically calculate credits for these buildings. Please contact us for further details about how to submit a manual application.

¹The Government’s Standard Assessment Procedure for Energy Rating of Dwellings Version 10.0 available [here](#).

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

Translating building performance into BREEAM credits

The procedure for translating modelled building performance in each of the above parameters into BREEAM credits is described in detail below. This includes a description of the BREEAM energy performance Ene 01 credits, benchmark scale and how this relates to building regulation compliance and achieving net zero carbon status.

The energy modelling data required to determine building performance is generated by National Calculation Method (NCM) compliant energy modelling software, used by the design team to demonstrate building regulation compliance. The NCM compliant energy modelling software produces a BRUKL input file (.inp file) and a standard output document, called the BRUKL Output Document: Compliance with Building Regulations. The .inp file and relevant data from the BRUKL output document, described below, is then entered into the BREEAM Ene 01 calculator to determine the EPR_{NC} and number of credits achieved. If the .inp file is unavailable, you can still enter the data from the BRUKL output document, an example is shown in figure 2, however credits are only awarded following the standard methodology. Alternatively, you can upload the .inp file and answer the additional input questions. The additional questions cover the electric generation of hot water (for Scotland only) and district heating (if applicable), this is shown in more detail below. If the .inp file is uploaded, the number of credits awarded is taken as the higher of that calculated by the standard and alternative methodologies

The Target CO₂ Emission Rate (TER) is the minimum energy performance required by building regulations for a new building for all four countries of the UK. The TER is based on the performance of a notional building, which is defined in the NCM modelling guide for each country.

For Wales, Northern Ireland and England and Scotland, the TER is set to equal the CO₂ emissions from the notional building, as the notional building is concurrent with the compliant building regulations standards for these countries. The notional building is used to generate 'Indicative Targets' for demand and consumption as well as the TER for CO₂, as shown in the Energy & CO₂ Emissions Summary table in the BRUKL Output Document (see example below).

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	1.43	0
Wind turbines	0	0
CHP generators	31.46	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	85.92	114.11
Primary energy* [kWh/m ²]	265.5	322.67
Total emissions [kg/m ²]	45.1	54.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

Figure 2 - Extract from a BRUKL Output Document

The .inp file contains detailed information on the energy consumption (kWh/m²) broken down by energy source for both the actual and notional building and the system efficiencies and heat demands met by installed heating systems. This information is used to generate the alternative carbon emissions and primary consumption energy metrics. The heating and cooling demand metric for the alternative methodology is the same as for the standard methodology. Figure 3 shows the BREEAM Projects platform built into the UK New Construction Non-domestic 2018 assessment tool. This highlights where the .inp file should be uploaded and the additional questions required when applicable. The building score shows the maximum BREEAM credits achieved by both methods and the method used, along with EPR metrics and CO₂ percentage improvement over the notional building.

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

The screenshot displays two sections of the BREEAM Project platform interface:

- Energy performance:** This section contains several input fields:
 - Country: Scotland
 - Can a .inp file be uploaded?: Yes
 - Upload building '_bruki.inp' file: A file named 'BREEAM_Test_build.inp' has been uploaded.
 - Is any hot water generation electric?: Yes
 - Please enter the % electric hot water generated by heat pumps?: 97
 - Is space heating provided by a district (network) heating?: Yes
 - Is hot water provided by a district (network) heating?: Yes
 - Was connection to district heating a condition for granting planning application?: Yes
- Energy performance - Building score:** This section shows the results of the calculation:
 - Methodology used: Alternative
 - Total BREEAM credits achieved: 4
 - Heating and cooling demand energy performance ratio (EPRdem): 0.194
 - Primary consumption energy performance ratio (EPRpc): 0.139
 - CO₂-eq energy performance ratio (EPRco2-eq): 0.161
 - Overall building energy performance ratio (EPRnc): 0.493
 - % improvement BER/TER: 33.6

Annotations in the image highlight specific features: 'File uploaded' points to the uploaded file name; 'Questions only applicable to projects in Scotland' points to the 'Is any hot water generation electric?' and 'Please enter the % electric hot water generated by heat pumps?' fields; 'Heating consumption excluded from calculation' points to the 'Is space heating provided by a district (network) heating?' and 'Is hot water provided by a district (network) heating?' fields; 'Indicator of which methodology produced the maximum score' points to the 'Methodology used' dropdown; and 'Reset and remove uploaded file' points to the 'Clear' button.

Figure 3 – BREEAM Project platform for .inp upload and output

The BREEAM credits scale and minimum standards

The number of BREEAM credits awarded is determined by whichever is the highest of the standard and alternative EPR_{NC} for the building. The credit scale is in Table – 6.1: Ene 01 EPR_{NC} benchmark scale in the BREEAM UK New Construction 2018 technical manual. There are up to 9 standard credits available.

The minimum EPR_{NC} required to achieve 1 credit is 0.1 and there is a linear scale up to an EPR_{NC} of 0.9 for 9 credits. This entry level serves to recognise buildings which achieve a moderate improvement over a Building Regulations compliant design. Table 1 describes the BREEAM New Construction scheme’s minimum standards for Ene 01.

In addition, prediction of operation energy consumption is an alternative means of achieving credits to gain an excellent rating - see GN 32 (with the exception of shell only assessments).

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

Table 1 - Ene 01 minimum standards

BREEAM credits	EPR _{NC}	Minimum standards
1	0.1	To achieve at least one Ene 01 credit
4	0.4	To achieve an Excellent rating
6	0.6	To achieve an Outstanding rating
9	0.9 AND zero net regulated CO ₂ emissions	

The maximum number of standard BREEAM credits, 9, is awarded where a building achieves an EPR_{NC} of 0.90 and a 100% improvement on the building regulations Target Emission Rate i.e. a net zero regulated carbon building. This could be achieved by this example:

Table 2 - Example of how to achieve 9 credits for a fully fitted building located in Wales

Parameter	% performance improvement	Proportion of actual/notional performance	EPR (unweighted)	Weighting	EPR (weighted)
Building energy heating and cooling demand	40%	0.6	0.983	0.333	0.328
Primary energy consumption	40%	0.6	0.819	0.333	0.273
Carbon dioxide (CO ₂) emissions	100%	0.4	1.000	0.33	0.333

$$\begin{aligned}
 EPR_{NC} &= EPR_{dem} + EPR_{pc} + EPR_{CO2} \\
 &= 0.328 + 0.273 + 0.333 \\
 &= 0.934 = 9 \text{ credits}
 \end{aligned}$$

Energy modelling input data required to translate building performance

The calculation is informed by the following performance data which is either extracted from the .inp file, or from information entered from the BRUKL output document, for the standard methodology and calculated from the energy consumption data and heating system information in the .inp file for the alternative methodology.

Where the .inp file is available, this should be uploaded to BREEAM Projects and the additional input questions answered. This will enable the required information from the file to be combined with the additional questions to provide the maximum credit score achieved by whichever is the highest of the standard and alternative methodologies for the building. Without uploading the .inp, only the standard methodology can be used to calculate the energy performance based on manual inputs.

The performance data required below is sourced from the Energy & CO₂ Emissions Summary table and the Energy Production by Technology table in the BRUKL Output Document and manually entered in the tool, shown in Figure 2:

- Building floor area (m²)
- Actual building heating and cooling energy demand (MJ/m²yr)
- Notional building heating and cooling energy demand (MJ/m²yr)
- Actual building primary energy consumption (kWh/m²yr)
- Notional building primary energy consumption (kWh/m²yr)
- Building Emission Rate (BER) (kgCO₂ /m²yr)

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

- Target Emission Rate (TER) (kgCO₂/m²yr)

Onsite renewable energy generation

- Actual Energy Production Photovoltaic systems (kWh/m²)
- Notional Energy Production Photovoltaic systems (kWh/m²)
- Actual Energy Production Wind turbines (kWh/m²)
- Notional Energy Production Wind turbines (kWh/m²)

Defining the BREEAM translators for the standard methodology

The translator of performance for each of the three parameters is derived from performance modelling of a stock of actual buildings, which represent different building types, using an NCM compliant software package.

Although minimum energy performance standards for compliance with Part L2a of the Building Regulations has remained unchanged since 2013, for the standard methodology the translators have been revised to reflect improvements in the energy efficiency of new buildings. Accordingly, the translator curves used to determine the Energy Performance Ratios (EPRs) for each of the three energy metrics, and hence the overall EPR_{NC} for compliance modelling, have been updated.

For England, a representative sample of buildings that underwent BREEAM assessment under the 2014 scheme were used to determine the 2018 translator curves for England. Using actual performance data to benchmark performance data means that the energy performance is directly comparable to other BREEAM assessed buildings. However, for Scotland, Wales and Northern Ireland sample sizes are currently insufficient to adopt this method and so the translator curves for these countries were based on the 2014 methodology using an updated energy performance specification.

England translators – Standard methodology

A representative sample of buildings that underwent BREEAM assessment under the 2014 scheme were used to determine the 2018 translator curve for each metric. For all three curves an Actual/Notional (A/N) of zero is defined as an unweighted EPR of 1.0. The mean A/N value for the sample defines an unweighted EPR 0.5, the policy decision point, which means that the unweighted EPR scores directly reflect where the performance sits within the distribution for BREEAM assessed buildings. For the primary energy and CO₂eq metrics an unweighted EPR of 0 is defined as an A/N of 1, i.e., the actual performance is no better than the notional. For the energy demand metric, it is recognised that increased energy efficiency can lead to higher heating and cooling demands compared to the notional. For this reason, an unweighted EPR of 0 is defined by a value slightly greater than 1, where this value is determined based on the observed distribution of heating and cooling demands in the sample.

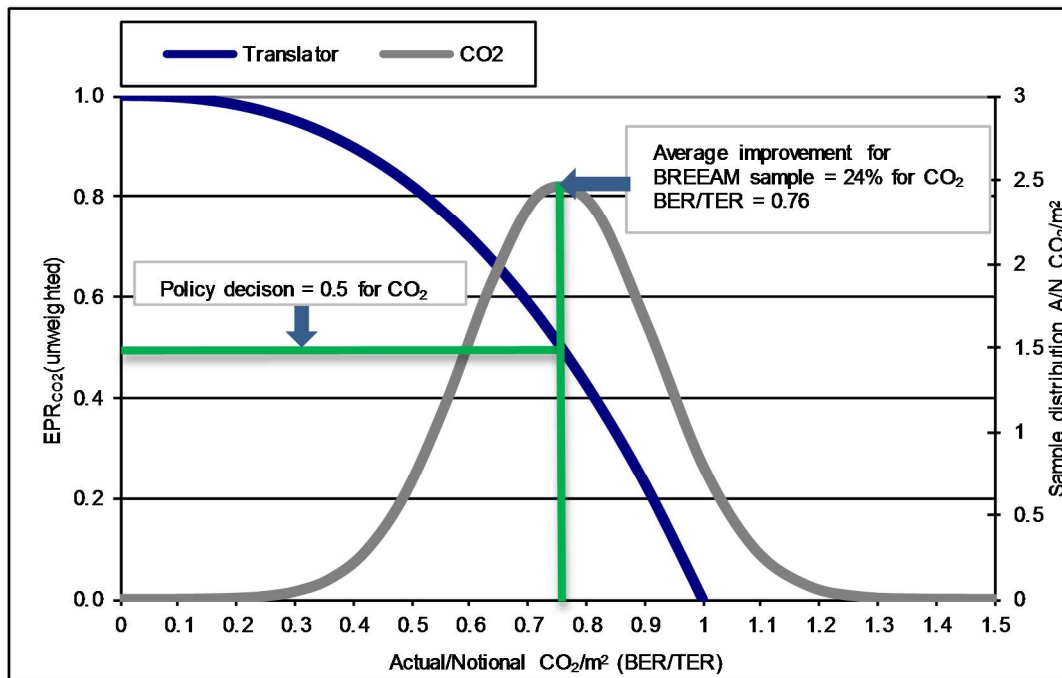


Figure 4 - Example Ene 01 building performance translator England

Scotland, Wales and Northern Ireland translators – Standard methodology

For other countries it was not possible to use data from BREEAM assessed building to determine the translator curves as the sample sizes were insufficient. Therefore, instead of using a sample of real buildings, the sample of buildings used to determine the 2014 translators was used, but with a hypothetical high performance specification¹ updated to take account of improvements in plant and equipment efficiencies. These translators were devised based on a sample of building models converted to comply with the relevant building regulations for each country and then modified to a high performance specification that comprises high thermal performance parameters, equipment and system efficiencies, etc.

Data from this modelling was used to determine the distribution of performance improvement for each of the three parameters (graphically represented by the bell curve in the example below). This average performance improvement, coupled with several ‘policy’ decisions, described below, were then used to define a means of benchmarking actual building performance (graphically represented by the curve in the following example).

¹ This was previously referred to as a best practice specification. However, as the approach used specifies high performance components rather than taking a holistic approach to optimise energy performance, hence hypothetical high performance specification is considered a more appropriate term.

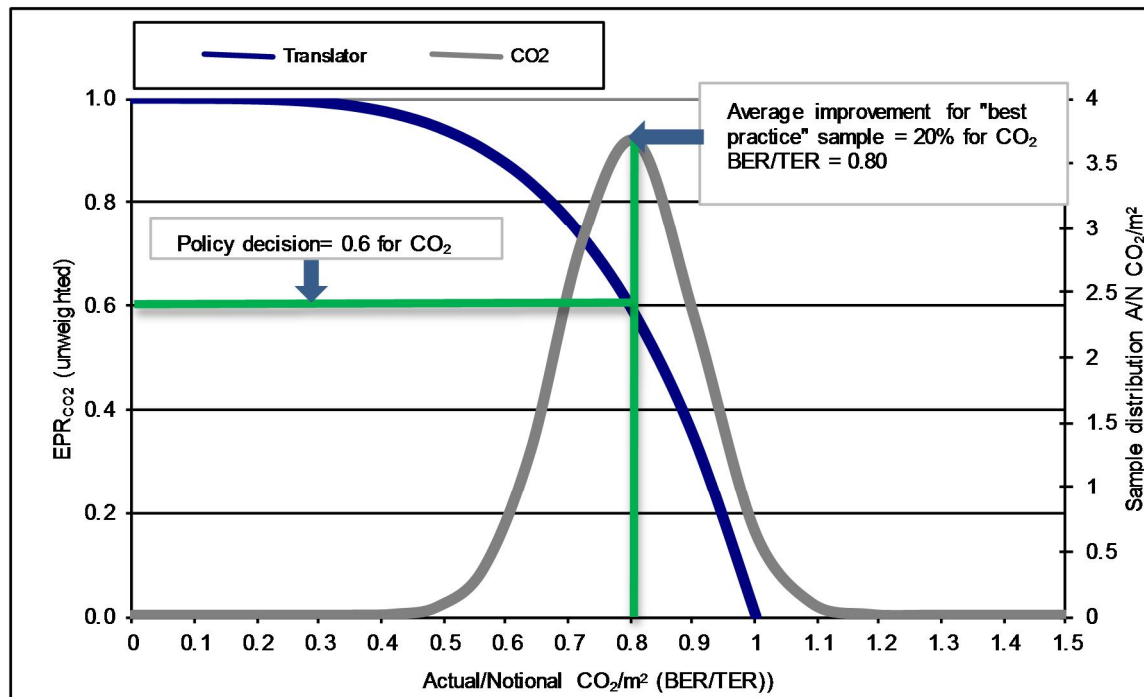


Figure 5 - Example Ene 01 building performance translator Wales

Unweighted Energy Performance Ratio standard methodology

The unweighted Energy Performance Ratio (EPR) for each parameter is derived by determining the point that the assessed building’s performance, as a proportion of actual performance compared with notional performance, intersects with the translator curve. Using the above graph as an example for the CO₂eq parameter, a building with carbon dioxide emissions 10% lower than the notional building, i.e. the proportion of its emissions is 0.9 of the notional building emissions, would achieve an Energy Performance Ratio (unweighted) for the CO₂ parameter of about 0.35 (0.325 to be precise).

Policy decisions standard methodology

Each parameter translator curve is defined from the modelled building stock, and the following ‘policy’ decisions.

A specific Energy Performance Ratio (unweighted) will be achieved where the assessed building achieves a defined percentage improvement on the notional building standard, where the defined percentage improvement is based on the average of the modelled building stock.

The policy decision points defined by the EPRs for each country are shown in the table below:

Table 3 – Policy decision points for each parameter by country

Parameter	England	Scotland, Wales and Northern Ireland
Building heating and cooling energy demand	0.5	0.8

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

Primary energy consumption	0.5	0.8
Carbon dioxide (CO ₂) emissions	0.5	0.6

Whilst the EPRs that define average high performance values for Scotland, Wales and Northern Ireland are the same, the average high performance improvements differ depending on the notional building baseline for each country.

For example, for the carbon dioxide emissions for a building in Wales, an Energy Performance Ratio of 0.8 will be achieved where the actual building achieves a defined high performance level for demand that is approximately a 20% improvement on the notional building standard, whereas for Northern Ireland it is 28% and for Scotland 2013 it is 26%.

See the table below for the average high performance improvements for Scotland, Wales and Northern Ireland, and the average BREEAM performance improvement for England, by percentage improvement and by proportion of actual to notional performance (proportion A/N).

Table 4 - Average performance improvements for each country

Country	Wales (high performance)		Scotland (high performance)		
	Parameter	% improvement	Proportion A/N	% improvement	Proportion A/N
	Building heating and cooling energy demand Fully fitted and shell and core	16%	0.84	18%	0.82
	Building heating and cooling energy demand Shell only	17%	0.83	18%	0.82
	Primary energy consumption	38%	0.62	37%	0.63
	Carbon dioxide (CO ₂) emissions	20%	0.80	26%	0.74
Country	Northern Ireland (high performance)		England (average BREEAM)		
	Parameter	% improvement	Proportion A/N	% improvement	Proportion A/N
	Building heating and cooling energy demand Fully fitted and shell and core	24%	0.76	23%	0.77
	Building heating and cooling energy demand Shell only	23%	0.77	23%	0.77
	Primary energy consumption	40%	0.60	26%	0.74
	Carbon dioxide (CO ₂) emissions	34%	0.66	24%	0.76

The translator curves for each parameter for Wales, Northern Ireland and England and for CO₂ for Scotland are derived by generating a curve that connects three points:

1. Proportion A/N = 1, EPR = 0 for primary energy and CO₂ for all project types and energy demand for shell only projects
2. Proportion A/N = 1, EPR = 0.15 for energy demand for fully fitted and shell and core projects
3. Proportion A/N = average BREEAM (for England) or “high performance” (for other countries) EPR for ‘policy decision’

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

4. Proportion A/N = 0, EPR = 1

For energy demand translators for fully fitted and shell and core projects an adjustment factor (k) of 0.15 is applied to account for the negative impact that energy efficiency typically has on the energy demand ratio. This was determined based on the observed distribution of energy demand ratios for a sample of buildings assessed under BREEAM 2014.

For the demand EPR for shell only assessments and carbon and primary energy EPRs for all assessment types k=1

This curve is formed from the following equation:

$$\text{EPR (unweighted)} = 1 - (1 - k)(A/N)^n$$

where:

- EPR = parameter Energy Performance Ratio (unweighted)
- A = actual building performance
- N = notional building performance
- n = a function of the parameter EPR at the 'policy decision' and the average proportion of actual / notional building performance.
- k = adjustment factor

k = 0 for the primary energy and for the demand EPR for shell only assessments and carbon and primary energy EPRs for all assessment types k=1

Relationship between different country translators – standard methodology

The translator approach helps to improve the comparability between different parts of the UK by reflecting the fact that the different building regulations / regulatory baselines differ.

Figure 6 illustrates the different country translators for CO₂ emissions.

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

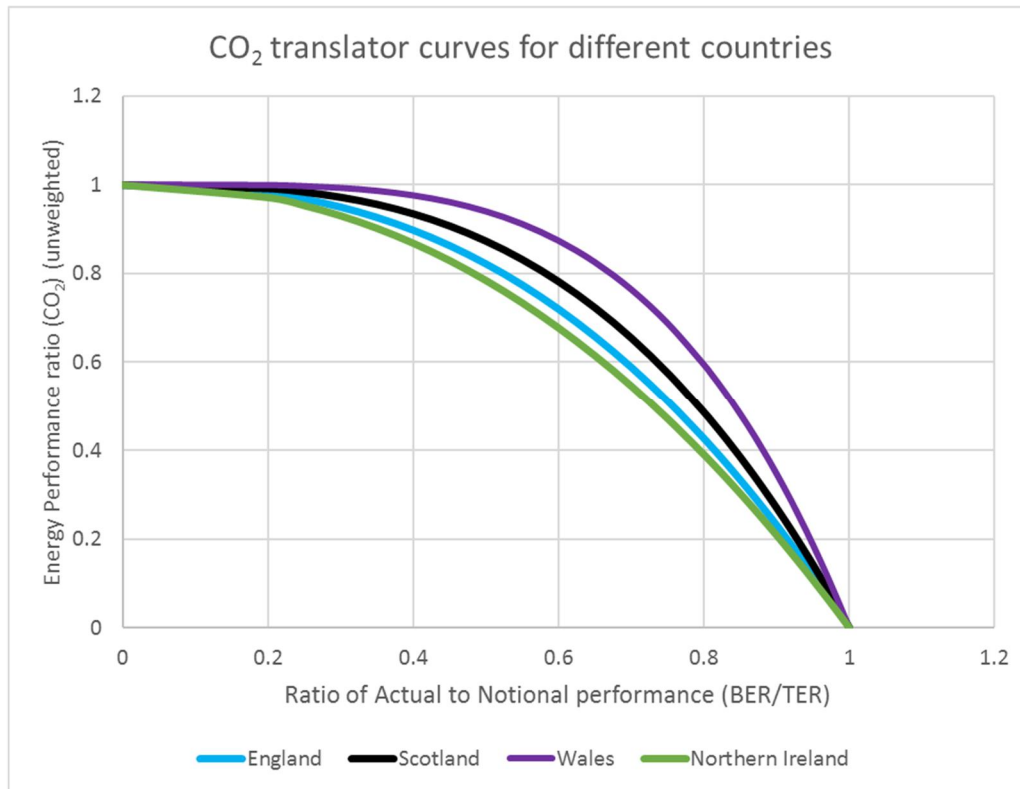


Figure 6 - Different country translators for CO₂ emissions

This shows that the translator for England is more generous than that for Northern Ireland. If for example a building were to achieve a 20% improvement over the TER (equivalent to 0.8 on the X-axis), then this would equate to an EPR of about 0.427 in England, but only about 0.390 for Northern Ireland. This reflects the fact that it is more difficult to achieve an improvement over the regulatory baseline in England.

This means that the methodology leads to a converging of the standards at higher levels, and therefore better performing buildings will tend to achieve a similar number of credits in the different countries for identical designs.

Table 5 - 'n' value for each parameter and country using standard methodology

Parameter	Wales	Scotland	Northern Ireland	England
Building heating and cooling energy demand Fully fitted and shell and core	7.667	7.230	5.431	2.061
Building heating and cooling energy demand shell only	9.078	8.230	5.882	2.674
Primary energy consumption	3.350	3.451	3.098	2.282
Carbon dioxide (CO ₂) emissions	4.044	2.984	2.217	2.493

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

Defining the BREEAM translators for the alternative methodology

Separate translator curves have been derived for use with the alternative energy metrics. Scenario modelling to simulate the energy performance improvements obtained using the alternative carbon and primary energy metrics was used to generate the policy decision points for the decision curves for the alternative methodology.

Monte Carlo analysis to simulate the distribution of A/N primary energy and carbon values that would be obtained using the alternative metrics was undertaken by varying four key input variables that affect how the actual metric will differ from the notional metric. Where the values chosen for these four input values reflect their stock distribution. The four key variables used are:

- Heating system efficiency – efficiency distribution of currently available heat pumps
- Proportion of energy used for heating – from sample of buildings assessed using BREEAM New Construction 2014
- A/N heating energy use only – from sample of buildings assessed using BREEAM New Construction 2014
- A/N other energy uses – from sample of buildings assessed using BREEAM New Construction 2014

Heat pump efficiencies were used to determine the alternative translator curves because the current carbon and energy benefits associated with this technology are not recognised by the current NCM calculations. This is because the carbon and primary energy factors they use do not adequately reflect the level of grid decarbonisation that has occurred.

The simulation results provide the distribution of A/N values for the stock using the alternative metrics. The mean value for the distribution determines the policy decision point for the translator curves. To provide translator curves for buildings where connection to district heating is a condition of planning permission (and therefore the heating system is not a design choice) simulations were also run to generate A/N metrics excluding space heating and hot water.

Table 6 – ‘n’ value for each parameter and country using alternative methodology

Parameter – all end uses	Wales	Scotland	Northern Ireland	England
Building heating and cooling energy demand	7.667	7.230	5.431	2.061
Primary energy consumption	3.138	3.243	2.894	2.144
Carbon dioxide (CO ₂) emissions	2.611	1.935	1.428	1.617

Calculation process

Stage 1 - Defining the building’s performance

The first stage of translating modelled building energy performance in to BREEAM credits is to calculate the ‘building performance improvement’. For the standard and alternative metrics this is done by comparing the actual performance of the modelled building design specification to the notional performance of the modelled building design specification as a proportion for each of the three parameters on an annual basis: heating and cooling energy demand; primary energy consumption; and CO₂ emissions.

$$\text{Building performance ratio} = \frac{\text{actual building performance (A)}}{\text{notional building performance (N)}} \quad \text{for each parameter}$$

$$\text{Building demand performance ratio} = A/N \text{ demand}$$

$$\text{Building primary consumption performance ratio} = (A\text{-onsite energy}) / (N\text{-onsite energy}) \text{ primary energy}^*$$

$$\text{Building CO}_2 \text{ performance improvement} = \text{BER/TER}$$

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

*The primary energy performance ratio is adjusted to take account of grid supply electrical energy displaced by on site electricity generation from photovoltaic systems and wind turbines as the primary energy as the BRUKL outputs only take account of electrical energy displaced by CHP generators.

Stage 2 - Benchmarking the performance improvement against the modelled building stock

Each of the percentages from stage 1 is then 'translated' into an Energy Performance Ratio (EPR) for each parameter expressed as a value. See below for a detailed description of how the translators are derived and building performance is benchmarked.

To achieve an Energy Performance Ratio of less than one for any of the three parameters, the building's performance must be better than the level achieved for the same parameter by the notional building specification.

Stage 3 - Weighting the individual ratios for each parameter

The Energy Performance Ratios for each parameter from stage 2 are then multiplied by weightings.

These weightings reflect the maximum that each parameter can contribute towards the overall Energy Performance Ratio, EPR_{NC} , and therefore BREEAM credits. BREEAM UK New Construction 2018 uses a weighting factor in the stage 3 calculation to reflect equal importance of the three energy metrics:

$$\text{Weighted } EPR_{dem} = \text{Building energy heating and cooling demand weighting} \times \text{unweighted } EPR_{dem}$$

$$\text{Weighted } EPR_{pc} = \text{Primary energy consumption weighting} \times \text{unweighted } EPR_{pc}$$

$$\text{Weighted } EPR_{CO2} = \text{CO}_2 \text{ weighting} \times \text{unweighted } EPR_{CO2}$$

Note: Different weightings are used for buildings/ building areas assessed using the domestic assessment method, e.g. Standard Assessment Procedure (SAP), i.e. residential areas. Please refer to the Methodology section of the Energy 01 issue for guidance on calculating the Ene 01 performance of buildings with residential areas modelled using the domestic assessment method.

Stage 4 - Awarding the BREEAM credits

The weighted Energy Performance Ratios for each parameter from stage 3 are totalled to give an overall Energy Performance Ratio for New Construction, EPR_{NC} . This is then compared to the table of benchmarks to determine the number of BREEAM credits awarded. See the Ene 01 issue for the BREEAM credits benchmark scale and its relation to the building regulations compliant standard for each nation and BREEAM's minimum standards.

$$EPR_{dem} + EPR_{pc} + EPR_{CO2} = EPR_{NC}$$

A completed example of this calculation procedure is provided on the following pages.

The BREEAM EPR_{NC} weightings - standard and alternative methodology

The 2018 Ene 01 methodology gives equal weighting to all three energy parameters to ensure that each parameter is given equal consideration when assessing the overall performance in terms of BREEAM credits.

Table 7 - Weightings for each parameter and country

Parameter	All countries
Building energy heating and cooling demand	1/3
Primary energy consumption	1/3
Carbon dioxide (CO ₂ eq) emissions	1/3

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

Example calculation – standard methodology

The following provides an example calculation of each of the three stages of the methodology for a building located in England where the standard methodology gives the highest score

Stage 1: Define the building's performance as a proportion of the BREEAM 2018 notional building level

Demand (MJ/m ² yr):	$65/80 = 0.813$
Consumption (kWh/m ² yr):	$250/300 = 0.833$
Carbon dioxide (kg CO ₂ /m ² yr):	$40/50 = 0.800$

Stage 2: Benchmark the performance improvement against the modelled building stock i.e. the point that a building's performance as a proportion intersects with the translator curve

Unweighted demand ratio:	$1 - (1 - 0.15)(0.813 ^ 2.061) = 0.446$
Unweighted consumption ratio:	$1 - (0.833 ^ 2.282) = 0.340$
Unweighted carbon dioxide ratio:	$1 - (0.800 ^ 2.493) = 0.427$

Stage 3: Apply the weightings

Weighted demand ratio:	$0.426/3 = 0.149$
Weighted consumption ratio:	$0.551/3 = 0.113$
Weighted carbon dioxide ratio:	$0.427/3 = 0.142$

Stage 4: Determining the number of BREEAM credits

Overall EPR _{NC} :	$0.149 + 0.113 + 0.142 = 0.404$
-----------------------------	---------------------------------

Look up the number of credits and the minimum standards achieved from the credit table in the technical manual.

No. of BREEAM credits:	4 BREEAM credits
------------------------	------------------

This meets the minimum standard for an Excellent rating.

Note that in instances where the actual building performance values are worse than that of the notional building, or more than 15% worse than the notional building for the demand metric for shell only and fully fitted buildings, will result in an EPR of zero for that metric. Furthermore, no credits will be awarded if the CO₂ emissions for the actual building (BER) is higher than the notional (TER).

This Guidance Note on the Ene 01 Methodology is available to download from the BREEAM Assessors' Extranet and the BREEAM website (see the Resources section).

BREEAM UK New Construction 2018

Guidance Note GN39

V1.0 November 2019

Appendix - ‘n’ values for alternative methodology by end uses

Table 8 – ‘n’ value for each parameter and country excluding specified end uses

Parameter	Excluded end use	Wales	Scotland	Northern Ireland	England
Primary energy consumption	Space heating	3.359	3.243	3.091	2.144
Carbon dioxide (CO ₂) emissions	Space heating	2.506	2.561	1.372	2.140
Primary energy consumption	Space heating and hot water	2.529	2.189	2.338	1.448
Carbon dioxide (CO ₂) emissions	Space heating and hot water	2.426	2.078	1.329	1.736
Primary energy consumption	Hot water	3.136	3.243	2.882	2.144
Carbon dioxide (CO ₂) emissions	Hot water	2.584	1.983	1.403	1.582