

RIBA 

# Low Carbon Standards and Assessment Methods Executive Summary

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The government's advisor  
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## About this Document:

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This document reviews recommended low carbon performance standards and assessment methods for new and existing buildings. It has been developed by the RIBA as part of a suite of Climate Change Tools to encourage architects to engage with the issue of climate change and to deliver low-carbon new buildings and low-carbon refurbishment of existing buildings.

You can explore all the Climate Change Tools and download the full *Low Carbon Standards and Assessment Methods* at [www.architecture.com/climatechange](http://www.architecture.com/climatechange)

## Introduction

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Climate change brought about by man-made emissions of greenhouse gases has been identified as the greatest challenge facing human society at the beginning of the twenty-first century

This document provides a summary overview of recommended low carbon performance standards and associated assessment methods for new and existing buildings.

The adoption of low carbon performance standards is a key component of the architectural profession's response to the challenge of climate change.

**Cover image** Redbrook Hayes School, Staffordshire, Walters & Cohen Architects. The school's design maximises use of passive solar energy. Diffuse shaded east and west light combine to provide good daylight uniformity throughout, while high level windows and roof lights optimise natural day lighting of classroom areas and the heart of the school. The building also includes rainwater harvesting.

**Photo** Dennis Gilbert/VIEW

The RIBA recommends that such standards should be set and accepted as conditions of planning approval but enforced at a later, more appropriate stage in the development process, via the building control system.

## Local Planning Standards

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Local planning standards which address energy or carbon saving on developments at the time of application for planning permission have become known collectively as 'Merton Rule' standards. Typically they adopt one of two approaches:

- A set percentage of the energy demand of the development is met from local renewable energy sources
- The carbon dioxide emissions associated with energy use in the development are reduced by a set amount from the minimum requirements of Building Regulations Part L (and devolved nations' equivalents).

'Merton Rule' standards force developers and their design teams to consider, at an early stage, how their proposals should respond to the challenge of climate change.

## The Building Regulations

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The key documents addressing energy efficiency, renewable energy and carbon reductions are:

- Part L in England and Wales
- Part F in Northern Ireland (which is very similar to Part L)
- Part J in Scotland (which is very different to Part L).

This guide deals primarily with the regulations in England and Wales.

## Low Carbon Standards for Domestic Buildings

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### Building Regulations Part L1

#### Approved Documents

- *Part L1A – New Dwellings*
- *Part L1B – Existing Dwellings*

#### Second Tier Document

- *The Domestic Heating Compliance Guide*

Additional standards, codes of practice and good practice guides are also available, many published by the Building Research Establishment.

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## Part L1A

Part L1A presents five criteria for demonstrating compliance for new dwellings:

### 1 Calculation of a Dwelling Emissions Rate (DER) and Target Emissions Rate (TER)

The Dwelling Emissions Rate (DER), expressed in kilograms of carbon dioxide per metre squared per year ( $\text{kgCO}_2/\text{m}^2/\text{yr}$ ) must not exceed a Target Emissions Rate.

### 2 Design Limits

Design limits for the building fabric and services must not be exceeded.

### 3 Overheating

There must not be a high risk of the dwelling overheating in warm summer weather.

### 4 Thermal Bridges and Air Permeability

The dwelling as constructed must include no significant thermal bridges and the as-built DER, including tested air permeability, must not exceed the TER.

### 5 Operating and Maintenance Instructions

Owners or occupants of dwellings must be provided with operating and maintenance instructions for the heating and hot water systems and any ventilation or air conditioning systems.

## Part L1B

Part L1B provides guidance about the requirements that apply when work is carried out on existing dwellings:

### 1 Historic Buildings

Historic buildings are not exempt from Building Regulations, but improvements in energy efficiency should not prejudice the character of the building or increase the risk of deterioration.

### 2 Thermal Elements

Thermal elements are walls, roofs and floors separating the internal, conditioned spaces from the exterior or from adjacent unheated spaces.

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Energy efficiency considerations occur when thermal elements are provided (e.g. a building extension), replaced, retained in a material change of use (e.g. when a warehouse is converted into flats) or renovated (defined as treating more than 25% of the surface area of the element by adding or replacing any layer of the construction).

### 3 Controlled Fittings

Controlled fittings are windows, roof windows and external doors.

Maximum U values (area-weighted averages) or minimum window energy ratings are specified for new and replacement fittings.

### 4 Controlled Services

Controlled services are heating, hot water, ventilation and lighting.

The Domestic Heating Compliance Guide sets out minimum efficiencies for new or replacement heating appliances, minimum controls and minimum insulation standards for primary pipework, warm air ducts and hot water storage cylinders. It also sets out commissioning requirements.

### 5 Extensions

Extensions must meet the requirements for the provision of new thermal elements, controlled fittings and controlled services.

### 6 Conservatories

Conservatories with more than 30 m<sup>2</sup> of floorspace must meet the standards for new or replacement thermal elements and controlled fittings (including roof glazing), and any fixed heating must have independent on/off and temperature control, and meet the requirements for controlled services.

### 7 Material Alterations

Material alterations must include reasonable provision for energy efficiency, in accordance with the requirements for thermal elements, controlled fittings and controlled services, where these are provided, replaced, retained or renovated.

### 8 Material Changes of Use

Material changes of use (where a dwelling is created by

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The Energy Saving Trust's Energy Best Practice in Housing programme has published a set of standards for those who want to go beyond the Building Regulations. See [www.est.org.uk/housing/buildings/standards](http://www.est.org.uk/housing/buildings/standards)

conversion of another type of building) must include reasonable provision for energy efficiency, in accordance with the requirements for thermal elements, controlled fittings and controlled services.

### Energy Saving Trust: Best Practice Energy Standards

The Best Practice Energy Standards have three levels:

#### Good Practice

This represents a 10% improvement on current Building Regulations (i.e. the DER must be at least 10% lower than the TER) and provides a recipe for meeting Level 1 of the Code for Sustainable Homes.

#### Best Practice

This represents a 25% improvement on current Building Regulations and provides an approach to meeting Level 3 of the Code for Sustainable Homes.

#### Advanced Practice

This represents a 60% improvement on current Building Regulations.

### Code for Sustainable Homes

The Code for Sustainable Homes is a voluntary standard for new dwellings that is likely to underpin future updates of the Building Regulations in England and Wales, and possibly in Northern Ireland.

The Code incorporated six levels for compliance, each of which has mandatory carbon dioxide emissions standards.

Since April 2007, all new publicly-funded housing has been required to meet Level 3 of the Code. Some local planning authorities and development agencies (such as English Partnerships) are using the Code as the basis for environmental standards for new dwellings in their areas.

The Government is considering making assessment against the Code mandatory from April 2008. It is also proposed that all new dwellings should be 'zero carbon', that is, compliant with Level 6 of the Code, by 2016.

Code level	Reduction in carbon dioxide emissions compared with Building Regulations, Part L (2006)
1	10%
2	18%
3	25%
4	44%
5	100%
6	'Net Zero Carbon'

### The Zero-Carbon Standard

HM Treasury is developing a zero carbon standard for new dwellings. Dwellings that meet this standard will be exempt from Stamp Duty when they are sold.

### The PassivHaus Standard

The PassivHaus standard was developed in Germany in the early 1990s and is rapidly becoming a pan-European standard for low carbon dwellings. At its heart are requirements that annual space heating demand does not exceed 15kWh/m<sup>2</sup>/yr and that primary energy use (for all purposes) does not exceed 120kWh/m<sup>2</sup>/yr.

### The AECB Carbon Lite Standards

The Silver Standard is roughly equivalent to the EST Best Practice standard. It limits useful space heating energy to 40 kWh/m<sup>2</sup>/yr, primary energy use to 120 kWh/m<sup>2</sup>/yr and carbon dioxide emissions to 22 kg/m<sup>2</sup>/yr.

The **Gold Standard** attains the performance levels required by the PassivHaus standard, with the addition of renewable energy to reduce fossil fuel use for water heating, lighting, appliances and ventilation. The standard limits useful space heating energy to 15 kWh/m<sup>2</sup>/yr, primary energy use to 58 kWh/m<sup>2</sup>/yr and carbon dioxide emissions to 4 kg/m<sup>2</sup>/yr.

## Assessment Methods for Domestic Buildings

### BREDEM

The assessment methods used for most of the UK's energy standards for domestic buildings are based on BREDEM, the Building Research Establishment Domestic Energy Model.

This predicts annual fuel use, fuel costs and carbon dioxide emissions under a standard occupancy pattern (a typical, floorspace-dependent pattern incorporating a standard heating regime). Standard occupancy is used for most assessments because the rating refers to the dwelling, not the way it is used by a particular household.

## Assessment against Local Planning Standards

For domestic developments, assessment against local planning standards is best carried out by means of BREDEM-based performance simulation.

## The National Home Energy Rating

The National Home Energy Rating (NHER) is the leading domestic energy rating scheme in the UK. The NHER of a dwelling is based on the estimated total annual fuel use (for space heating, water heating, cooking, lighting and the use of appliances), per square metre of floorspace, under standard occupancy. It is expressed on a scale of 0 (very inefficient) to 20 (very low carbon).

## The Standard Assessment Procedure (SAP)

The Standard Assessment Procedure energy rating – SAP 2005 – is the Government's preferred domestic energy rating. The SAP of a dwelling is based on the annual fuel use for space heating, water heating and fixed internal lighting only, per square metre of floorspace, under standard occupancy. It is expressed on a scale of 1 (very inefficient) to 100+ (very efficient). Dwellings with SAP energy ratings greater than 100 are net energy exporters (due to local microgeneration).

## Passive House Planning Package

The Passive House Planning Package (PHPP) is the means of assessing compliance with the PassivHaus standard and with the AECB Carbon Lite standards.

## EcoHomes XB

EcoHomes XB is an environmental assessment method for existing housing, developed by the Building Research Establishment in collaboration with the Housing Corporation.

It is designed to enable property managers and landlords to assess the environmental efficiency of their housing stocks, to identify potential for improvement and to measure improvement when works have been carried out.

EcoHomes XB takes into consideration the constraints of the existing stock, such as site issues (access to local amenities, transport, ecology) and practical issues such as the building fabric, heating systems and ventilation.

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## Low Carbon Standards for Non-Domestic Buildings

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Standards and assessment methods relating to energy use and carbon dioxide emissions from non-domestic buildings have changed dramatically in recent years.

The Government introduced updated Building Regulations in England and Wales in April 2006. The most significant change was the development and implementation of a National Calculation Methodology (NCM) that standardises the carbon dioxide emissions from energy use in non-domestic buildings.

## The Building Regulations Part L2

### Approved Documents

- *Part L2A – New Buildings Other Than Dwellings*
- *Part L2B – Existing Buildings Other Than Dwellings*

### Second Tier Documents

- *The Non-Domestic Heating, Cooling and Ventilation Compliance Guide*
- *Low and Zero Carbon Energy Sources – Strategic Guide.*

Additional standards, codes of practice and good practice guides are also available, many published by the Building Research Establishment.

## Part L2A

Part L2A presents five criteria for demonstrating compliance for new non-domestic buildings:

### 1 Calculation of a Building Emissions Rate (BER) and Target Emissions Rate (TER)

The BER must not exceed the TER, and should be calculated using the National Calculation Methodology (through the Simplified Building Energy Model (SBEM)).

### 2 Design Limits

Design limits for the building fabric and services must not be exceeded.

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### 3 Overheating

It is important to minimise the need to retrofit energy-hungry air conditioning into buildings. This means that there must not be a high risk of overheating of spaces that do not have comfort cooling.

### 4 As-Built

The building as constructed should perform as well as or better than predicted and, to assist in checking this, a report identifying the key features of the design that deliver the predicted BER must be supplied to the Building Control Body.

### 5 Building Log-Book

The building owner or occupants must be provided with a building log-book.

## Part L2B

Part L2B provides guidance about the requirements that apply when work is carried out on existing non-domestic buildings:

### 1 Historic Buildings

Historic buildings are not exempt from Building Regulations, but improvements in energy efficiency should not prejudice the character of the building or increase the risk of deterioration.

### 2 Thermal Elements

'Thermal elements' are walls, roofs and floors separating the internal, conditioned spaces from the exterior, or from adjacent unheated spaces.

Reasonable provision for energy efficiency is required when thermal elements are provided (e.g. in a building extension), replaced, retained (in a material change of use) or renovated. 'Renovation' means treating more than 25% of the surface area of the element.

### 3 Controlled Fittings

Controlled fittings are windows, roof windows and external doors (including high usage entrance doors and vehicle access doors).

Maximum U values (area-weighted averages) are specified for new fittings (in extensions) and for replacement fittings in

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existing buildings. Less demanding U values may be acceptable in buildings with high internal heat gains.

### 4 Controlled Services

Controlled services are heating, hot water, ventilation, air conditioning and lighting.

The *Non-Domestic Heating, Cooling and Ventilation Compliance Guide* sets out minimum efficiencies for new or replacement plant, minimum controls and minimum insulation for pipework, air ducts and hot water storage cylinders. It also contains commissioning requirements.

### 5 Extensions

An extension that exceeds 100 m<sup>2</sup> of floorspace and exceeds 25% of the floor area of the original building is treated as a new building.

Other extensions must meet the requirements for the provision of new thermal elements, controlled fittings and controlled services.

### 6 Conservatories

Conservatories with more than 30 m<sup>2</sup> of floorspace must meet the standards for new or replacement thermal elements and controlled fittings (including roof glazing), and any fixed heating must have independent on/off and temperature control, and meet the requirements for controlled services.

### 7 Material Alterations

Material alterations must include reasonable provision for energy efficiency, in accordance with the requirements for thermal elements, controlled fittings and controlled services.

### 8 Material Changes of Use

Material changes of use must include reasonable provision for energy efficiency, in accordance with the requirements for thermal elements, controlled fittings and controlled services.

### 9 Consequential Improvements

Consequential improvements apply only to buildings with total useful floor areas greater than 1,000 m<sup>2</sup>. In these cases, improvement of the energy efficiency of the whole building must be made if:

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- The floorspace is increased, or;
- The capacity of any fixed building service is increased, or;
- A new fixed building service is provided where it was not provided before.

### **CIBSE Benchmarks**

The Chartered Institute of Buildings Services Engineers publishes comprehensive guidance on energy efficiency and sustainability in buildings. This guidance includes:

- *CIBSE Guide F Energy Efficiency in Buildings*<sup>1</sup>, which includes energy performance benchmarks for new and existing buildings of various types
- *CIBSE Guide L Sustainability*<sup>2</sup> recommends broader environmental performance standards.
- *The CIBSE Energy Assessment and Reporting Methodology (TM22)*<sup>3</sup> provides a comprehensive procedure for assessing the energy performance of an existing, occupied building based on metered energy use; this document is available on CD-ROM with an implementation of the method as computer software.

For further information see [www.cibse.org](http://www.cibse.org)

### **BREEAM**

The Building Research Establishment Environmental Assessment Method (BREEAM) is a voluntary scheme that aims to quantify and reduce the environmental burden of buildings by rewarding designs and operational procedures that take positive steps to minimise their environmental impact.

BREEAM assessments can be undertaken using a number of standardised methods, for different building types:

- Offices
- Schools
- Retail
- Industrial
- Prisons
- Courts.

<sup>1</sup> CIBSE (2004) *Energy Efficiency in Buildings*, Guide F, ISBN 1903287340

<sup>2</sup> CIBSE (2007) *Sustainability*, Guide L, ISBN 9781903287828

<sup>3</sup> CIBSE (2006) *Energy Assessment and Reporting Methodology*, Technical Memorandum 22, ISBN 190328760X

Projects are assessed using a system of credits. These credits are grouped into the following categories:

- Management
- Health & Wellbeing
- Energy
- Transport
- Water
- Materials & Waste
- Land & Ecology
- Pollution.

The assessment process results in a report covering the above credit categories. The full assessment is submitted to the BRE for quality assurance, checking and certification. Certificates are awarded depending on a rating scale and will result in a building being awarded a 'pass', 'good', 'very good' or 'excellent' rating.

Further information about BREEAM including a list of licensed Assessors can be found at [www.breeam.org](http://www.breeam.org)

### **LEED**

Developed in the USA, the LEED (Leadership in Energy and Environmental Design) Green Building Rating System is a voluntary standard for sustainable buildings. LEED provides a framework for assessing building performance and meeting sustainability goals. LEED standards are currently available or under development for:

- New commercial construction and major renovation projects (LEED-NC)
- Existing building operations (LEED-EB)
- Commercial interiors projects (LEED-CI)
- Core and shell projects (LEED-CS)
- Homes (LEED-H)
- Neighborhood Development (LEED-ND).

For more information see [www.leedbuilding.org](http://www.leedbuilding.org)

## Other Standards

The Carbon Trust publishes a wealth of guidance about energy efficiency in buildings and some guides include energy performance standards. Notable amongst these is *Energy Use in Offices*<sup>4</sup>, which provides performance benchmarks for four types of office buildings. See [www.carbontrust.co.uk](http://www.carbontrust.co.uk)

Environmental standards for secondary schools in England and Wales are set out in the Government's *Briefing Framework for Secondary School Projects (Building Bulletin 98)*<sup>5</sup>, which includes the requirement that new schools achieve BREEAM ratings of 'good', 'very good' or 'excellent'. The Carbon Trust also publishes guidance on energy efficiency in schools.

UK hospital buildings are rated according to the NHS Environmental Assessment Tool<sup>6</sup> (NEAT). All new hospital buildings must achieve an 'excellent' rating, and refurbishment projects must achieve 'very good'. NEAT aims to identify the environmental impact created during day-to-day operational activities.

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<sup>4</sup> *Energy Use in Offices*, ECG019  
[www.carbontrust.co.uk/publications](http://www.carbontrust.co.uk/publications)

<sup>5</sup> See [www.tinyurl.com/2cymq2](http://www.tinyurl.com/2cymq2)

<sup>6</sup> See [www.tinyurl.com/2t55f4](http://www.tinyurl.com/2t55f4)

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